

# THE SINGING BEHAVIOR OF FEMALE NORTHERN CARDINALS<sup>1</sup>

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**Abstract.** Observations were made and playback experiments were performed in central Kentucky in an attempt to determine the function(s) of singing by female Northern Cardinals (*Cardinalis cardinalis*). Singing by female cardinals was uncommon and was noted primarily during the period after males had established territories and before nesting had begun (early March to mid-May). When singing, females were generally joined by singing mates. Experiments revealed that females rarely sang in response to playback of male or female songs. Such evidence suggests that singing by female Northern Cardinals is important in pair bonding and, perhaps, in reproductive synchronization.

**Key words:** *Northern Cardinals; Cardinalis cardinalis; singing; pair-bond maintenance.*

## INTRODUCTION

Although females sing less than males, or not at all, in most oscine species, singing does appear to be a regular feature of female behavior in several species (Ritchison 1983a). Among the species in which singing by females has been reported is the Northern Cardinal (*Cardinalis cardinalis*). For example, Bent (1968:11) indicated that in the Northern Cardinal "both sexes sing, and the song of the female is but little inferior to that of the male." Lemon (1965) noted that both male and female Northern Cardinals possessed a repertoire of several distinctive songs.

Only a few possible functions have been suggested for singing by females. Beletsky (1982) suggested that singing by female Northern Orioles (*Icterus galbula*) plays some role in pair-bond maintenance. Ritchison (1983a) proposed that singing by female Black-headed Grosbeaks (*Pheucticus melanocephalus*) was of importance in family-group maintenance. Beletsky (1983) reported that female Red-winged Blackbirds (*Agelaius phoeniceus*) possessed two song types, one of which probably functions in pair-bond maintenance and the other in territorial defense. In a review of avian vocal behavior, Nottebohm (1975) suggested that singing by females may play some role in pair formation or may aid in territorial defense. The objective of the present study was to ascertain the possible function(s) of female song in the Northern Cardinal.

I used both field observations and playback experiments in an effort to determine the function of female song in the Northern Cardinal. Observations were undertaken to determine when and in what situations female cardinals sang. Such information could provide some insight into function. For example, if singing were limited to the period just before and after

fledging of the young, it would suggest that singing might play some role in family-group maintenance and might not be important in the formation of pair-bonds or in territorial defense. Playback experiments were used in an attempt to further clarify function. For example, an increased rate of singing in response to playback of conspecific song within the territory might indicate that female song serves a territorial function (Beletsky 1983). Further, if males, whose singing is known to serve in territorial defense, sing in response to playback and females do not, this would suggest that singing might serve different functions in males and in females.

## METHODS AND MATERIALS

Field work was undertaken from January through September in 1983 and 1984 and from mid-February through early September in 1985 at the Central Kentucky Wildlife Management Area, located 17 km southeast of Richmond, Madison County, Kentucky. Observations were made at least three times weekly. Observation periods were at least two hr in duration and began shortly after sunrise. I attempted to record on tape all observed bouts of female song. Whether recorded or not, for each bout I noted the identity and location of the female, the number of songs uttered during the bout, and the location (if known) and behavior (singing or not singing) of the nearest male. I define a "bout" as a series of songs separated in time from each other by intervals that were significantly longer than the intervals between songs within a bout (Farabaugh 1982). During the three years of the study I monitored fifteen pairs of cardinals. All cardinals under observation were captured in mist nets and marked with colored leg bands and colored plastic tape attached to the rectrices (Ritchison 1984). Recordings were made with a Uher Report Monitor tape recorder with a Dan Gibson parabolic

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reflector and microphone. Playback tapes were subsequently made from these recordings.

Playback experiments with six females were conducted from 11 April to 20 May 1983 and with six more females from 23 April to 1 May 1985. Each playback experiment consisted of three 5-min segments (pre-test, test, post-test). In 1983 each bird was tested twice with the songs of a neighboring male and twice with the songs of a neighboring female. In 1985 each female was tested twice with the songs of a non-neighboring female; in addition, a study skin of a female Northern Cardinal was placed within 1 m of the loudspeaker. Birds with common territorial boundaries were designated neighbors. For each test a loudspeaker was placed 2 to 3 m above the ground in a bush or tree near the center of the territory. Different tests with individual females were at least two days apart. All experiments were conducted between 0700 and 1200.

The following features of response were used to ascertain a bird's reaction to playback: (1) *Number of songs and notes per song*. Songs of Northern Cardinals may vary considerably in the number of notes per song and previous studies suggest a possible correlation between the number of notes per song and a bird's level of aggression (Gottfried and Gottfried 1978). Notes were uttered by test birds at a rate that allowed accurate counting. (2) *Distance of closest approach to the speaker*. (3) *Number of flights*. Flights of less than 50 cm were not counted. (4) *Number of chip calls*. Northern Cardinals utter these calls in various situations, and they may indicate excitement. Lemon (1968a) reported that territorial males uttered *chip* calls in response to trespassing males and females. The Wilcoxon signed-ranks test was used for all statistical comparisons (Sokal and Rohlf 1969).

## RESULTS

### FIELD OBSERVATIONS

The singing behavior of female Northern Cardinals differed from that of males in several respects. First, females sang less frequently than males. I spent over 45,000 min in the field and noted only 207 min of female song (less than 0.5% of the time). In addition, male and female Northern Cardinals differed in the timing of their singing. Whereas males begin singing in January or February (Laskey 1944), females did not begin singing until March (Fig. 1). Further, whereas males continued singing until late August or early September (Fig. 1; Laskey 1944, Lemon 1967), I rarely heard singing by female cardinals after mid-May (Fig. 1). Most pairs of cardinals began nesting by late April. Thus,

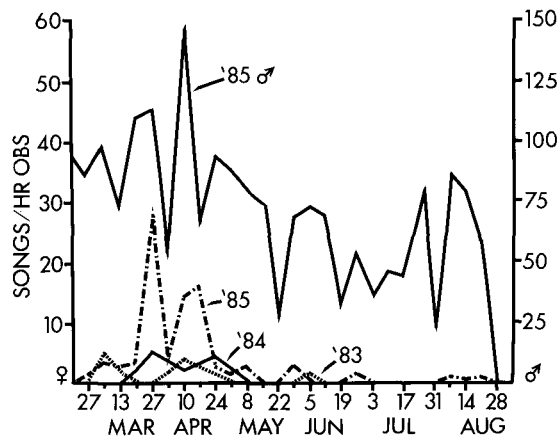


FIGURE 1. Singing rates of male and female Northern Cardinals. (Values are averages for seven-day periods beginning on the dates indicated. Six females were observed in 1983, four in 1984, and five in 1985. Five males were observed in 1985.)

almost all singing by females occurred before nesting had begun. Finally, singing females were usually accompanied by singing mates. The fifteen females under observation sang for a total of 207 min and were joined by "duetting" mates for 162 min, or 78% of the time. This value increases to 87% if one exceptional singing bout is removed from the analysis. On 20 April 1985 an unbanded female was sighted near the territorial boundary of the pair under observation. After this female began to sing, the territorial male flew to a perch near the center of the territory and also began to sing. After nearly two minutes the unbanded female flew across the boundary and was chased, first by the male and then by the female. Shortly thereafter, the two females began to sing from perches about 35 m apart and continued, unaccompanied by any males, for nearly 22 min.

### PLAYBACK EXPERIMENTS

The playback experiments performed in 1983 revealed that females responded similarly to the songs of males and females (Tables 1 and 2). Typically, females responded to playback of both male and female songs by moving a few meters closer to the speaker and uttering a significantly greater number of *chip* calls ( $P < 0.05$ ). Only two females sang in response to male songs (Table 2), and no singing was noted in response to female songs (Table 1). In similar experiments with males, all individuals tested ( $n = 6$ ) responded to playback of male and female songs with a significant increase in number of songs ( $P < 0.05$ ).

The observation of 20 April 1985 noted above appeared to indicate that female song may be important in certain female-female interactions. Tests were conducted in 1985 in an

TABLE 1. Responses of females to the songs of neighboring females.

	Closest approach (m)	No. songs	Flights	Chips
Pre-test period (PTP)	32.5 <sup>a</sup>	0	1.4	3.2
Test period (P)	18.1	0	5.9	28.9
Post-test period (PP)	26.2	0	4.2	15.0
PTP vs. P	NS <sup>b</sup>	—	NS	0.05
PTP vs. PP	NS	—	NS	NS
P vs. PP	NS	—	NS	NS

<sup>a</sup> Values for responses are averages for all twelve tests.

<sup>b</sup> The significance levels are according to Wilcoxon signed-ranks tests, two-tailed;  $P <$  number given; NS = not significant.

attempt to further examine this possibility. During these playback experiments an "intruding" female cardinal (i.e., a study skin) was placed near the speaker. During playback, females typically approached to within a few meters of the study skin or even closer. Four of the six females approached to within 1 m or less and two females made contact with the skin. Females also responded with a significant increase in number of *chip* calls ( $P < 0.05$ ). Few songs were uttered in response to playback (Table 3).

## DISCUSSION

My observations, and those of others (Shaver and Roberts 1933, Laskey 1944, Lemon 1968b), indicate that female Northern Cardinals sing primarily during the weeks just before the initiation of nesting. In contrast, male cardinals begin singing months before nesting begins. Typically, males begin to sing and defend territories in late January or early February, and most territories are well established by early March (Laskey 1944, Gould 1961, Lemon 1968a). Thus it is not until territories have already been established that females begin to sing.

The persistent singing of male passerines during the period of territorial establishment is well documented (Armstrong 1963, Welty 1982). Such persistence is apparent in male Northern Cardinals, with individuals uttering

TABLE 2. Responses of females to the songs of neighboring males.<sup>a</sup>

	Closest approach (m)	No. songs <sup>b</sup>	Notes/song	Flights	Chips
Pre-test period (PTP)	29.7	0	—	1.0	3.7
Test period (P)	21.0	0.9	6.1	3.3	12.9
Post-test period (PP)	18.1	1.4	8.5	2.0	10.9
PTP vs. P	NS	NS	NS	NS	0.05
PTP vs. PP	NS	NS	NS	NS	NS
P vs. PP	NS	NS	NS	NS	NS

<sup>a</sup> Values and significance levels as in Table 1.

<sup>b</sup> Two females responded.

TABLE 3. Responses of females to the songs of non-neighboring females and a female model.<sup>a</sup>

	Closest approach (m)	No. songs <sup>b</sup>	Notes/song	Flights	Chips
Pre-test period (PTP)	23.0	0	—	0.5	1.1
Test period (P)	7.1	2.3	6.3	5.6	32.6
Post-test period (PP)	12.2	0	—	0.6	12.8
PTP vs. P	0.05	NS	—	NS	0.05
PTP vs. PP	NS	NS	—	NS	NS
P vs. PP	NS	NS	—	NS	NS

<sup>a</sup> Values and significance levels as in Table 1.

<sup>b</sup> Four females responded.

as many as 100 songs per hour (Fig. 1). In contrast, females typically sing fewer than 10 songs per hour (Fig. 1). Such infrequent singing suggests that female song is of little importance in the establishment and maintenance of territory (Farabaugh 1982).

The responses of female Northern Cardinals to the playback of conspecific songs is also of interest. Although females uttered *chip* calls in response to playback, I noted no significant increase in singing, with or without a female model present. In similar tests, male cardinals sang significantly more songs in response to playback. If singing by females served a territorial function, an increase in singing rates might have been expected during playback. Such a response has been noted in female Red-winged Blackbirds (Beletsky 1983) and has also been noted in males in numerous other species (e.g., Weeden and Falls 1959, Goldman 1973, Brooks and Falls 1975, Wunderle 1978, Ritchison 1983b).

As noted above, female Northern Cardinals sing primarily after males have established territories and before nesting begins, i.e., during the period when pair-bonds are being formed (Shaver and Roberts 1933, Land 1952, Kinser 1973). Such timing suggests that female song may be important in the establishment of pair bonds. In addition, I found that females are generally accompanied by singing mates. Lemon (1968b) reported similar observations. He observed a total of 104 min of female song in cardinals and indicated that females were accompanied by males for 97 min. Farabaugh (1982) suggested that such overlapping bouts of songs given by members of a mated pair can be considered duets. It has been suggested that such duets may play a role in establishing pair bonds, synchronizing reproductive activities, or establishing and maintaining territories (Armstrong 1963, Wickler 1980, Farabaugh 1982).

The evidence presented indicates that singing by female cardinals plays little or no role in the establishment and maintenance of territory. The observation of 20 April 1985 de-

scribed previously indicates that, on rare occasions, female song may be used in interactions with other females. However, all other evidence, including the timing and relative rarity of female song and the duets with mates, indicates that pair bonding and, perhaps, reproductive synchronization are the most important functions of singing by female Northern Cardinals.

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