SOCIAL DOMINANCE IN WINTER FLOCKS OF CASSIN'S FINCH

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Reports of social dominance by females in avian winter flocks are few but have been described in the Bullfinch (*Pyrrhula pyrrhula*; Hinde 1955, 1956; Nicolai 1956) and the House Finch (*Carpodacus mexicanus*; Thompson 1960). I have noted this dominance in the Purple Finch (*Carpodacus p. purpureus*), and it is evident in this study of Cassin's Finch (*Carpodacus cassinii*). The significance of female dominance in winter flocks is not known nor is the importance clearly evident for any pattern of avian social dominance during the winter (Watson and Moss 1970). The purpose of this study of winter flocks in Cassin's Finch was to (1) assess patterns of social dominance, (2) suggest their possible ecological significance, and (3) describe displays involving agonistic or anti-predator behavior.

Cassin's Finch is an irregular winter resident of the Cache Valley in northern Utah (K. L. Dixon, pers. comm.) where I studied flocks during the winters of 1972–73 and 1973–74. I found no flocks in the area in 1971–72 or 1974–75. Aside from fragmentary observations by those engaged in faunistic or winter surveys (Orr 1968 and references cited therein), little is known of the winter behavior or biology of Cassin's Finch.

METHODS

I observed the activity and social dominance of finches almost daily from January to April 1973 and an average of 2 days per week from November 1973 to February 1974.

Five banding stations were established during the winter of 1972–73 at different sites within Cache Valley. All were at least 1 km apart with stations 1 to 4 in residential areas and station 5 at the mouth of Green Canyon. Cassin's Finch visited only stations 2 and 3 during the second winter. I caught few finches in mist nets, but captured most in drop or walk-in traps baited with sunflower seeds and millet. Color of plumage was noted and wing lengths measured for all but 6 of 353 birds captured. Each bird was banded and I marked 131 with distinctive combinations of plastic color leg bands to permit later recognition without recapture.

Cassin's Finch females and yearling males have a similar streaked gray-brown plumage, but all females during the breeding season exhibit an incubation patch and also can be distinguished by wing length (Samson 1976). Wing length measurements in 3 summer populations I studied in northern Utah and those obtained in this study are not significantly different either for older males or gray-brown birds (Samson 1974). A criterion based on wing length similar to that employed for summer populations is used in this study to separate females (wing lengths of 85.0 to 89.9 mm) and yearling males (wing lengths of 90.0 to 96.9 mm). As discussed under head-forward display, feather arrangement also may be used to identify females during agonistic encounters.

I studied patterns of social dominance at or near banding stations. Finches concen-

TABLE 1

LOCATION AND NUMBER OF CASSIN'S FINCHES BANDED AND RECAPTURED

Banding Station	Number Banded	Mean Per Day	Number Recaptured at Banding Stations[1]				
			1	2	3	4	5
		1972–1973					
1	131	9.4	26	26	33	17	2
2	42	14.0	12	11	11	9	
3	64	5.3	8	20	19	10	
4	51	17.0	14	18	23	11	
		1973–1974					
2	38	4.8		29	26		
3	21	2.6		18	19		

[1]An individual bird may have been recaptured at more than 1 location.

trated their activity near the bait and were not observed foraging elsewhere including adjacent mountain and valley terrain which was regularly censused. Criteria of subordination in agonistic encounters included the turning away or lateral body presentation, avoidance, or fleeing of a finch relative to the approach of another individual. I also studied displays and social hierarchies in 2 captive flocks ($n = 6$, $n = 12$) maintained in the summer of 1971. Linear social hierarchies constructed from observed encounters among color-marked birds were noted in the 2 captive flocks but not in winter flocks and therefore are not presented in this report. The analysis of social dominance in early 1973 is subdivided by month to consider the influence of possible changes in sex and age ratios on patterns in aggression. Chi-square analyses of data were used to determine statistical significance.

Displays of individual Cassin's Finches were recorded on 111 m of 8 mm color movie film and 25 m of 35 mm black and white film during the second winter for later analysis.

SOCIAL DOMINANCE

Populations.—Of the 288 finches banded in January to April of 1973 (Table 1) 80 were color-banded. Throughout this winter unbanded finches were regularly observed and captured. Whether these birds represented immigrants or unbanded winter residents is not known nor is the total number of winter residents. Finches banded in mid-January were recaptured or observed in early April, suggesting that birds remained for the winter. I caught 59 finches in early winter of 1973–74 (Table 1), and captured or observed few unbanded finches by mid-December 1973. Fifty-one of the 59 captured were color-banded, and these remained in the valley from late November 1973 into February 1974. Only one finch, a female banded in the first winter, was recaptured in the second.

Older males represented 21.9% (63 of 288) of finches banded in the winter

TABLE 2

SOCIAL DOMINANCE IN WINTER FLOCKS OF CASSIN'S FINCH[1]

Dominant Bird	Subordinate Bird		
	Female	Older Male	Yearling Male
January 1973			
Female	7	8	14
Older male	2	9	13
Yearling male	6	15	19
February 1973			
Female	7	21	47
Older male	9	13	39
Yearling male	9	4	22
March 1973			
Female	2	12	17
Older male		16	8
Yearling male		2	23
November 1973–February 1974			
Female	31	134	264
Older male	27	48	263
Yearling male	21	112	140

[1] Numbers refer to victories by group at left over individuals in the respective columns.

of 1972–73 and 54.2% (32 of 59) in 1973–74. Yearling males accounted for 48.6% (140 of 288) of birds banded in the first winter when finches were numerous in contrast to 18.6% (11 of 59) in the second. Females were outnumbered by all males 203:85 in 1972–73 and 43:16 in 1973–74. These sex ratios are similar to disparities favoring males reported by Samson (1976) in 3 breeding populations of Cassin's Finch in northern Utah and to the proportion of males reported in over 15,000 Cassin's Finches banded in North America from 1956 to 1973 (J. Sheppard, pers. comm.).

Patterns of social dominance.—Dominance-subordination in Cassin's Finch winter flocks includes relationships between females, yearling males, and older males as well as between members of each group. Table 2 reflects the general dominance of females over both older and yearling males. The observed dominance by females over both male age classes is significantly different than expected in both winters (Table 3). Although not as successful in winning encounters as females, older males exceeded yearling males in proportion of encounters won in both winters (Table 2) and are dominant over the yearling male age class (Table 3).

TABLE 3

COMPARISON OF SOCIAL DOMINANCE IN WINTER FLOCKS OF CASSIN'S FINCH

Rate	Dominance	
	Result	p[1]
January 1973	females > older males	< .01
	females > yearling males	< .05
	older males > yearling males	< .01
February 1973	females > older males	< .01
	females > yearling males	< .001
	older males > yearling males	< .001
March 1973	females > older males	< .001
	females > yearling males	< .001
	older males > yearling males	< .05
November 1973–February 1974	females > older males	< .001
	females > yearling males	< .001
	older males > yearling males	< .001

[1] Chi-square with df = 1.

Heterosexual encounters most often occurred when a yearling male approached a feeding female or, rarely, when an older male attempted to supplant a female. In neither case were males regularly successful. Encounters of older males and females appeared to involve mistaken sex identification by the male. Females were tolerant of other females, and I noted few interactions in either winter.

Many finches were captured at more than 1 location (Table 1). In both winters, observers at the different locations noted the temporal and spatial association of color-marked birds. Comparison of these records indicates that feeding flocks of Cassin's Finch lack continuity in membership from day to day and from feeder to feeder on any specific day. Pairs did form in these flocks during late winter but well after the establishment of patterns of social dominance. Pair status could not have influenced social dominance exhibited by unpaired females less than a year old over older and yearling males. Thus, the dominance of females as a group appears independent of site, flock composition, or mate status.

Winter disappearance.—The significance of female dominance in Cassin's Finch may relate to improving their survival from breeding season to breeding season. In the winter of 1972–73, 64 of 85 females, 40 of 63 older males and 53 of 140 yearling males were recaptured at least 1 day following the initial banding. Significantly more females ($P < .001$) were recaptured than

expected. Conversely, significantly fewer yearling males ($P < .001$) were recaptured than expected. Attempts to locate or observe marked individuals within Cache Valley or adjacent mountain terrain that were not among recaptures were unsuccessful, and I presumed they were dead or had moved from Cache Valley to seek another food source.

Fewer finches were winter residents in 1973–74 (Table 1) and few ($n = 3$) disappeared. The winter of 1973–74 was mild in comparison to 1972–73. Considering that the energy needs of a homeothermic animal increase as temperature decreases, both the milder winter conditions and fewer finches present to exploit available food resources may have contributed to the disappearance of few finches during the 1973–1974 winter.

DISPLAYS

Head-forward.—This display in Cassin's Finch varied in intensity and, as in other finches (Hinde 1955, 1956; Dilger 1960; Coutlee 1967), is divided into 2 categories, the low intensity head-forward display and the high intensity head-forward display. The closed beak is directed toward the opponent, the neck partially extended, legs slightly flexed, with the body tending toward a horizontal posture in the low intensity head-forward display (Fig. 1A). If the aggressor is a female, the feathers of the forehead, breast, and back are "shuffled" (Fig. 1B) as in the House Finch (Thompson 1960). With females and yearling males nearly identical in plumage, this shuffling of feathers serves as a visual cue for sex identification in agonistic encounters. Rarely did females employ any other display to maintain their dominance or preferential access to food or roost. Vocalizations did not accompany this or any other display.

Figure 1C depicts the high intensity head-forward display. The beak is usually but not always open, the head and body feathers are sleeked, and the long axis of the body is horizontal and in line with the opponent. If the opponent was above or below the attacker, the head was directed toward the opponent and the tail slightly raised. During the most intense head-forward displays, both wings were raised through rotation at the shoulder (Fig. 1D). Although performed by females and older males, the high intensity head-forward display was especially evident in encounters between yearling males.

Combat.—I rarely noted combat (Fig. 1E) between older males, among females, or in inter-sex encounters and did not observe it in the milder winter of 1973–74. Combat when evident usually occurred between yearling males. If a high intensity head-forward display was insufficient to dislodge an opponent, the attacker would proceed directly at the opponent with wings raised. If the opponent failed to yield, combat resulted. Combat did not result in noticeable body damage, and in most cases it was of short duration.

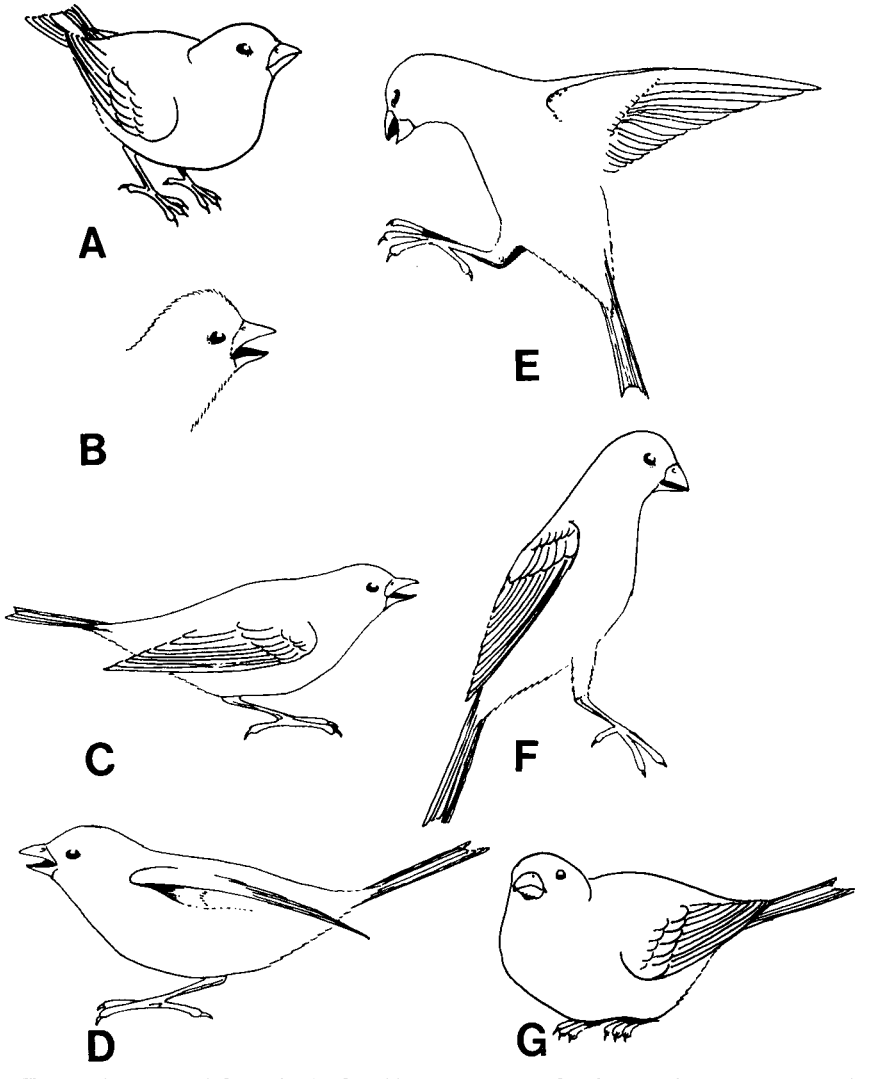

FIG. 1. Postures of Cassin's Finch: (A) low intensity head-forward; (B) female with head, neck and upper breast feathers shuffled; (C) and (D) high intensity head-forward; (E) combat; (F) submissive; and (G) anti-predator.

Often, the birds would fly up almost vertically continuing to engage in combat before one or both birds withdrew to separate perches. Beaks remained open and feet extended during the combat phase of these flights.

Submission.—When approached by an aggressor, submissive birds often

assumed an erect, stiff-legged posture leaning away from the attacker (Fig. 1F). If not directly approached but in the presence of a dominant bird, subordinate birds would flex their legs and assume a partially crouched posture similar to that described for other fringillids (Hinde 1956, 1957; Thompson 1960; Coutlee 1967). This posture is similar to that observed when an avian predator was present (Fig. 1G). Sharp-shinned Hawks (*Accipiter striatus*), Cooper's Hawks (*Accipiter cooperii*), and Northern Shrikes (*Lanius excubitor*) were active and preyed on Cassin's Finches near banding stations. Finches in this posture remained stationary moving only the upper throat until the predator departed. The legs were flexed so that the breast and abdomen nearly rested on the substrate.

Supplanting and avoidance.—As in the House Finch (Thompson 1960), I did not see special behavior by an attacking finch prior to supplanting a second bird. The direct or frontal presentation described for other Fringillidae (Hinde 1955, 1956) is apparent in Cassin's Finch. In nearly all attempted supplants, the attacked bird flew before the attacker landed. When the attacked bird did not flee, a lateral body presentation, a submissive posture, or a slight fluffing of the feathers were considered indicators of avoidance. Aggressive chases among finches associated with supplanting were not observed either winter. Displacement activities (i.e., bill wiping, head scratching, breast preening) were rarely observed in free-flying flocks but were common in the 2 captive flocks.

DISCUSSION

Social dominance is not uncommon in avian winter flocks (Brian 1949, Sabine 1959, Dixon 1963, 1965; Kikkawa 1961, Zahavi 1971). In these studies, males or males and their mates are reported dominant. In the House Finch (Thompson 1960), Purple Finch and Cassin's Finch, the members of this genus which breed in North America, females in winter flocks are either as or more dominant than males in agonistic encounters.

This social dominance in Cassin's Finch is considered independent of location in contrast to the importance of site attachment in other species (Brown 1963, Dixon 1963). It may be related to (1) their lack of annual fidelity to a winter area (Bailey and Niedrach 1965, Buckley 1973), (2) the lack of consistent flock organization as in certain other carduelines (Newton 1972), (3) the mobility of the species, or (4) the variable number of finches at a winter area which may range from none as in Cache Valley in 1971–72, 1974–75 to over 5000 as reported in northern Colorado (Chapin 1958).

Other studies of finch populations during the winter (Fretwell 1969, Pulliam and Enders 1971, Davis 1973) point out that food is important in determining population levels and that intraspecific competition may influence

patterns of mortality. Newton (1964) provided evidence in the Bullfinch and Murton et al. (1966) in Wood Pigeon (*Columba palumbus*) that the availability of winter food influences subsequent breeding population numbers. In Cassin's Finch (Samson 1976) as in 2 other montane finches with sex ratios favoring males, the Black Rosy Finch (*Lecousticte atrata*, French 1959) and the Gray-crowned Rosy Finch (*L. tephrocotis*, Johnson 1965), the number of females is considered the limiting resource for reproductive effort. The significance of female dominance in Cassin's Finch appears to involve the protection of this limiting resource during the non-breeding season. Survival of females is enhanced by preferential access to food and roost sites in winter, thus allowing for maximization of reproductive effort during the subsequent breeding season. Considering that Cassin's Finch, lacking a strong fidelity to a wintering area or breeding area, must colonize new wintering and breeding areas annually, a reproductive strategy to maximize reproductive effort may represent an important correlate to their nomadic lifestyle and enhance the efficient use of an unpredictable environment (i.e., food and weather). These habitat and species correlates all pertain to an *r*-strategy (Pianka 1970). Opportunism and reproductive strategy in North American birds have not, however, been intensively studied (Cody 1972).

The displays used by Cassin's Finch in agonistic encounters are generally homologous to those of the House Finch and to other fringillids (Hinde 1955, 1956; Coutlee 1967). Cassin's Finch does differ from many fringillids in that vocalizations did not accompany displays. This was particularly evident in interspecific encounters between the Cassin's Finch and the House Finch, the latter regularly using vocalizations in association with certain intense agonistic displays.

In nearly all phases of its annual cycle, Cassin's Finch tends to flock. The flocks are characterized by an absence of agonistic encounters except in winter and in those of yearling males which remain at high altitudes in late summer after other Cassin's Finches have departed. Except among yearling males, the lack of intense agonistic encounters observed in this study may contribute to the flocking tendency. Aggressive behavior did increase at a food source as in the House Finch (Thompson 1960), but this increase was not as substantial as that observed in early 1973 when weather conditions were severe and finches numerous. Nor, was it as intense as in yearling male flocks in late summer (Samson 1976).

Females and yearling male Cassin's Finches are well camouflaged in their striped gray-brown plumage when roosting on woody branches or foraging under a forest or shrub canopy. This coloration combined with the motionless anti-predator posture may enhance their survival from breeding season to breeding season. However, the explanation for the imbalance in the sex

ratios, subadult male plumage, and possible hormonal factors influencing female dominance in Cassin's Finch remains to be resolved.

SUMMARY

Female Cassin's Finches were determined socially dominant over older and yearling males in flocks during 2 winters. Few females disappeared either winter in contrast to males. With number of females limiting for breeding effort, the dominance of females in winter is interpreted as a behavioral modification to maximize reproductive effort. This species' trait and the need to semiannually colonize a new and often unpredictable environment are correlates of an *r*-strategy. Displays in agonistic encounters are considered homologous to other fringillids. Reasons for the observed disparities in sex ratio or hormonal factors influencing female dominance are not known.

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