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SOCIAL HIERARCHY AND ACTIVITY IN CAGED FLOCKS OF DARK-EYED JUNCOS, *JUNCO HYEMALIS*[1]

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Abstract. Activities of 3 flocks were monitored by the number of visits to the feeder and the amount of time spent feeding, drinking, perching, preening, and hopping around. There was considerable individuality among the birds with respect to the time spent in different activities. Ranking the birds by the percentage of time spent in a given activity did not consistently match the ranking of birds in the peck order. This finding indicates that a subordinate bird was under no particular disadvantage with respect to access to food and that the advantages of membership in a flock were not greatly diminished by social position. This outcome may possibly be affected by food abundance and by the role aggression plays in the dominance interactions of the particular species involved.

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Studies of the hierarchy and flocking behavior of juncos in the field have been done by Sabine (1949, 1955, 1959), who worked with both the Slate-colored Junco (*Junco hyemalis hyemalis*) and the Oregon Junco (*J. h. oreganus*). She established that juncos form peck-right dominance hierarchies. Crook (1961) studied the activities of flocks of various ploceids and analyzed the general activity cycles of the flocks but did not analyze individual activity and its relationship to the individual's position in the hierarchy. Dominance may have differing effects in different situations (Dewsbury 1978) and in times of deprivation may favor those individuals high in the hierarchy; its effects or lack of effects on individual activity during times of no deprivation have not been studied. The present paper investigates the influence that a bird's position in the hierarchy has on its daily activities when food and water are in ample supply.

METHODS

The birds used in these experiments were captured near Columbus, Ohio, during the winters of 1964–65 and 1966–67. After their capture, they were immediately taken to the laboratory and placed in individual cages in a light controlled chamber, with a cycle of 8 hr of light and 16 hr of darkness. Each bird was visually but not auditorily isolated for at least 1 month before being used in an experiment.

The observation cage was a large, hardware-cloth cage, 1.2 m square at the base and 1.5 m high (Rambo 1967). In the back right corner of the cage was a feeder area that permitted only one bird at a time to feed or to drink. Six perches, each 76 cm long, were placed in the cage.

This cage was placed in an enclosed, light-proof chamber, and the birds were observed from behind a cheese-cloth screen, which divided the area into halves. The light was provided by 3 bulbs (60-watt) which were turned on and off by a General Electric timer. A bulb (20 watt) operated by another timer came on 15 min before the main lights and was turned off 15 min after the main lights, providing an artificial twilight.

To estimate the percentage of time spent by each bird in different activities, a scan sampling technique (Altmann 1974) was used. Records of the activity of each bird were made at 5 min intervals and totaled, and the birds were compared in pairs using the test of the equality of 2 proportions outlined in Freund *et al* (1960). All visits by the birds to the feeder were recorded and analyzed for possible differences among the birds of the flock using the analysis of variance as outlined in Freund *et al* (1960).

I grouped the activities of the birds into 6 classifications, modified from systems used by Marler (1955) and by Crook (1961):

1. Perching. Not moving from one place and not engaged in any specific activity at that spot.

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[2]This work was done while the author was at the Dept. of Zoology, Ohio State University, Columbus.

2. Active perching. Staying on one spot, but engaged in some activity, excluding preening.
3. Preening. Actively preening.
4. Feeding. Feeding at the food hopper, on the feeder platform, or on the floor of the cage.
5. Drinking. Actually drinking.
6. Hopping about. Moving about the cage, not engaged in any of the above activities. Includes fighting and chasing.

To determine the rank order of dominance, the winner and loser of each fight were determined whenever possible, and the birds placed in a linear order.

Because juncos have so little sexual dimorphism, I made no effort to determine sex ratios for the flocks. If more birds were on hand than were needed for an experiment, the birds for a flock were chosen by random-number tables. Each bird was marked for identification with colored leg-bands. At the end of the experiment all the birds were sacrificed, and the gonads examined to determine the sex of each bird.

Three replications were performed, each using a different flock of juncos. Flock I consisted of 3 males and 3 females. Records of the general activities of the birds were made for a total of 21 hr and of the visits to the feeder for a total of 14 hr. This experiment was concluded prematurely when the timer failed to turn off the light and the birds were exposed to 32 hours of continuous light. Within a week the birds were singing and in an obviously changed physiological state.

Flock II involved a total of 5 birds, but only 4 birds were in the cage at any one time. The birds were introduced to the cage one at a time at week intervals. One week after the fourth bird had been added to the flock, the second bird died and the flock was reduced to 3 birds, so another bird was added to bring the group size up to 4, 2 males and 2 females. Once the hierarchy had been established, I spent 2 full days of observation recording all visits to the feeder and the other activities of the birds.

Flock III had 4 birds, 3 of which were males. The 4 birds were introduced into the cage together and were observed until the hierarchy was established. Then they were observed for 2 full days to obtain a record of all visits to the feeder and other types of activities and their frequencies.

RESULTS

Flock I. Each bird had its own individual stereotype of behavior that included a favorite perch on which the bird spent much of the time, a repetitive flight pattern (such as described for canaries by Sargent and Keiper, 1967), or a particular route in approaching the feeder. A one-way analysis of variance on these data showed the variation among the birds in visits to the feeder to be significant ($P < 0.05$). The order of birds when ranked by the frequency of visits to the feeder did not match the peck order exactly, but generally the birds lower in the peck order went to the feeder more often than did those higher in the order. The major exception was the fourth bird in the peck order, who visited the feeder less often than any of the others (see table 1).

The order of the birds in time spent feeding also resembled the peck order, with only the second ranking bird out of place (table 2). The dominant bird spent significantly less time feeding ($P < 0.05$), and the lowest in the order spent significantly more time feeding ($P < 0.05$). The second ranking bird defended the feeder, and when any of the 3 birds subordinate to him went to the feeder, he chased them away and then fed. This habit may explain the high percentage of time he spent at the feeder.

The bird that spent the most time perching was significantly different from all the others ($P < 0.005$). The next bird in perching time also was higher than the 2 that perched the least ($P < 0.005$). The differences in perching time among the 3 that spent the least time perching

TABLE 1

Average number of visits to feeder per hour.

Flock I	Rank	1	2	3	4	5	6*
	Visits	7.78	7.28	10.92	6.64	11.92	13.20
Flock II	Rank		1	2	3	4	
	Visits		11.93	6.93	10.62	3.62	
Flock III	Rank		1	2	3	4	
	Visits		2.75	3.25	9.31	11.56	

*This bird died after 5 hr of data had been obtained. The experiment was continued with the 5 remaining birds.

TABLE 2
Percent of time spent in different activities.

	Types of Activity					
	Feeding	Drinking	Perching	Active Perching	Preening	Hopping
FLOCK I*						
Peck order						
1	7.8	0.4	14.4	0.0	4.1	73.3
2	19.8	2.1	18.5	0.0	1.2	58.4
3	13.2	0.8	25.1	0.0	5.3	55.6
4	14.8	2.5	43.6	0.0	4.5	34.6
5	27.1	2.1	14.0	0.0	2.1	54.7
FLOCK II						
Peck order						
1	39.6	0.5	23.4	14.1	6.8	15.6
2	20.3	0.0	48.4	12.5	3.7	15.1
3	29.2	0.0	25.5	13.5	2.6	29.2
4	34.9	0.0	25.5	13.5	14.1	12.0
FLOCK III						
Peck order						
1	25.0	1.5	56.8	0.0	9.4	7.3
2	30.7	0.0	49.5	0.0	5.7	14.1
3	26.1	0.0	43.2	0.0	3.1	27.6
4	18.8	0.5	50.5	0.0	1.5	28.7

*The sixth bird in Flock I died after 5.5 hr of observation and is not included in these data.

were not significant. The least perching was done by the top bird and the bottom bird in the peck order. The most dominant bird spent most of his time hopping around (73.3%), and much of this time was spent chasing the other birds. The time he spent hopping was significantly higher than that for the other birds ($P < 0.005$). The bird that spent the least time perching did not spend much time hopping. The fourth ranked bird tended to remain in one place; this occurrence was reflected in the activity results because this bird spent less time hopping than any other bird ($P < 0.005$).

Flock II. Analysis of the number of visits per hour to the feeder showed that variation among the 4 birds was significant ($P < 0.01$). The ranking corresponded neither to ranking in the peck order nor to ranking in amount of time spent feeding (table 2). The bird spending the most time feeding was the dominant bird, followed in descending order by the fourth, the third, and the second bird in the hierarchy. Analysis of the percentages of time spent feeding showed that the differences between the 2 that fed the most and between the 2 in the middle were not significant. The dominant bird, however, was significantly higher in percentage of time feeding than the 2 that fed the least ($P < 0.05$), and the bird that fed the least was significantly less that any of the others ($P < 0.05$).

The behavioral idiosyncrasies of the birds were largely responsible for the discrepancies between ranking in the data on feeding behavior. The subordinate birds always approached the feeder from the floor and almost never flew directly to it, and they went to the feeder at almost every opportunity. Whenever one of the more dominant birds left, one or the other or both of the subordinate birds went to the feeder.

All the birds spent approximately the same amount of time in active perching, and 3 of them were almost uniform in the amount of time spent perching. Significantly more time ($P < 0.01$) was spent perching by the second bird in the peck order. The third ranked bird spent significantly more time hopping around than the others ($P < 0.01$). The least dominant preened more than the other 3 ($P < 0.05$), and the most dominant

preened significantly more than the 2 middle birds ($P < 0.01$).

Flock III. As in the first 2 flocks, the variation among the birds in visits to the feeder was significant ($P < 0.01$). The order of the birds in increasing numbers of visits to the feeder matched the decreasing peck order (table 1). The bird making the most visits to the feeder spent the least amount of time feeding. He was generally chased away from the feeder when he tried to feed and was never able to eat much in any one visit. The 2 lowest ranked birds went to the feeder whenever the dominant birds were not feeding. In this situation they were similar to the lower birds in the hierarchies of both the other flocks. This was also the occasion for most of the conflicts between the 2 subordinate birds. Analysis of these data showed significant differences between birds 1 and 4 in the peck order ($P < 0.10$), between birds 3 and 4 ($P < 0.05$), and between birds 2 and 4 ($P < 0.01$).

The 2 lowest birds in the peck order spent significantly more time hopping about ($P < 0.01$) than did either of the other 2 birds, which were significantly different from each other with respect to the amount of time spent hopping about ($P < 0.05$). The bird spending the least amount of time hopping about spent the most time perching, but this inverse relationship did not apply to the rest of the birds. The bird that was second lowest in the time spent hopping about was second lowest in time spent perching, and the most subordinate bird, which spent the most time hopping about, was second highest in the time spent perching. With respect to the amount of perching time, there was a significant difference between birds 1 and 3 in the peck order ($P < 0.01$), and there was some difference ($P < 0.10$) between the 2 most dominant birds and between the 2 most subordinate.

DISCUSSION

When all 3 flocks are considered together, no correlation is consistent through all the flocks. If any of the flocks were to be taken individually, some correlation might be shown between a bird's position in the hierarchy and its position with respect to some activity. These data show the need for extreme caution in interpreting the results of any experiment using a limited number of birds or flocks. The significant individual differences occurring in the activities of birds may possibly contribute to erroneous conclusions unless replications are made.

Overall, this lack in correlation would seem to indicate that a bird's position in the hierarchy does not necessarily affect its ability to feed and carry out its normal activities. While social position does not affect the activity as a whole, it may affect the manner in which these activities are carried out. Behavior patterns similar to the behavior of the subordinate birds in these flocks were noted by Sabine (1949, 1959) in the wild juncos she observed. Although the behavior pattern consistently appeared in the subordinate birds, the feeding time and the number of trips to the feeder did not follow a consistent trend.

Ordinarily a subordinate bird is under no particular disadvantage with respect to access to feed. It becomes advantageous for the bird to be a member of a flock even though it is in a subordinate position. This may explain why males do not outnumber females in the spring even though in the winter flocks, males are generally dominant over the female (Sabine 1949, 1955, 1959). This finding supports Fretwell's (1969) hypothesis that in a small flock the least dominant bird should have a survival rate not too different from the most dominant. These circumstances may change in times of severe food shortage or in larger flocks, but in the wild where food resources are widely scattered and not concentrated in a feeder, the conflicts over food are less likely to occur. In juncos, avoidance is probably as important as aggression in establishing dominance (Balph 1977, Rambo 1967). Different circumstances may occur in species in which aggression plays a greater role in the achievement and maintenance of dominance relationships.

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