HABITAT USE AND FLOCK ACTIVITY OF DARK-EYED JUNCOS IN WINTER

BRADLEY M. GOTTFRIED AND EDWIN C. FRANKS

Due to the relative severity of winters in the temperate regions of the United States, research pertaining to avian winter populations has been mainly limited to studies of home range size of passerines (Price 1931, Condee 1970), and dominance relationships among flocks at feeding stations (Sabine 1949). In addition, vegetational preference studies have been reported using brief observational methods (Quay 1947, Graber and Graber 1963, Johns 1971, Pulliam and Enders 1971). Few attempts (e.g., Robins and Raim 1970) have been made to follow the movements and activities of flocks for long periods of time, and thus gather data not possible using the above techniques.

We observed winter flocks of Dark-eyed Juncos (*Junco hyemalis*) that did not visit feeding stations to determine spatial and temporal changes in movements, habitat preference, and daily flock activity during winter.

METHODS AND MATERIALS

Junco flocks were observed frequently from 13 October 1971 to 25 March 1972 on 2 study areas in McDonough Co. west-central Illinois. Juncos were captured in mist nets and in baited walk-in traps from October to January. The nets were used on approximately 20 days and the traps were used on 5 days. All captured juncos were banded and backtagged for individual recognition. Four of the 11 juncos comprising flock I, and 4 of the 13 juncos of flock II were color banded and backtagged.

Flocks were generally observed for entire days (from the time of leaving the roosts in the morning until returning to the roosts in the evening) when temperatures were above 5°C, but at lower temperatures, observations were restricted to 3-hour intervals alternated with 2-hours of no observations. The cold-weather observation schedule varied from day to day so that each part of the day was sampled. Juncos were observed for 440 hours during the winter.

The percentage of time the juncos spent in each vegetation type was calculated as the amount of time spent there divided by the total observation time that the birds were not roosting.

Home ranges were plotted on aerial photographs obtained from the U.S. Soil Conservation Service. A compensating polar planimeter was used to determine the area of each home range.

Vegetation in the study area was classified into 7 types. *Short grass pastures* were those areas where grazing had reduced most herbaceous vegetation to less than 10 cm in height, although shrubs and taller forbs were also present. *Tall grass pastures* were lightly grazed areas where most vegetation was taller than 10 cm. *Mowed hay fields* were similar to short grass pastures except they did not include shrubs and forbs. *Forb areas* were abandoned fields in an early successional stage, with foxtail grass

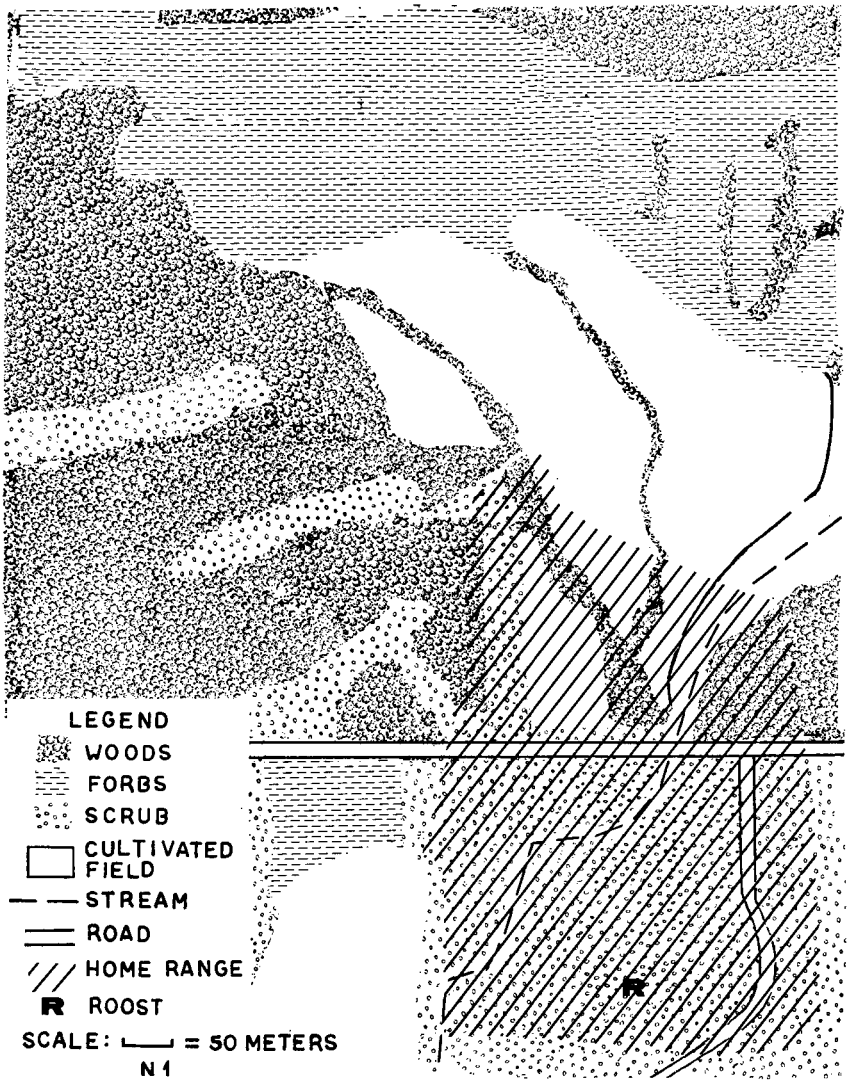

FIG. 1. Home range of flock I.

(*Setaria* sp.), asters (*Aster* sp.), and goldenrod (*Solidago* sp.). *Scrub areas* were fields in an advanced successional stage, with forbs, shrubs, and trees. *Woods* included irregular strips of mature trees along streams and larger areas with secondary growth of osage orange (*Maclura pomifera*), hawthorn (*Crataegus* sp.) and elm saplings (*Ulmus* sp.). *Cultivated fields* were the harvested stubble of soybeans (*Glycine max*) or corn (*Zea mays*).

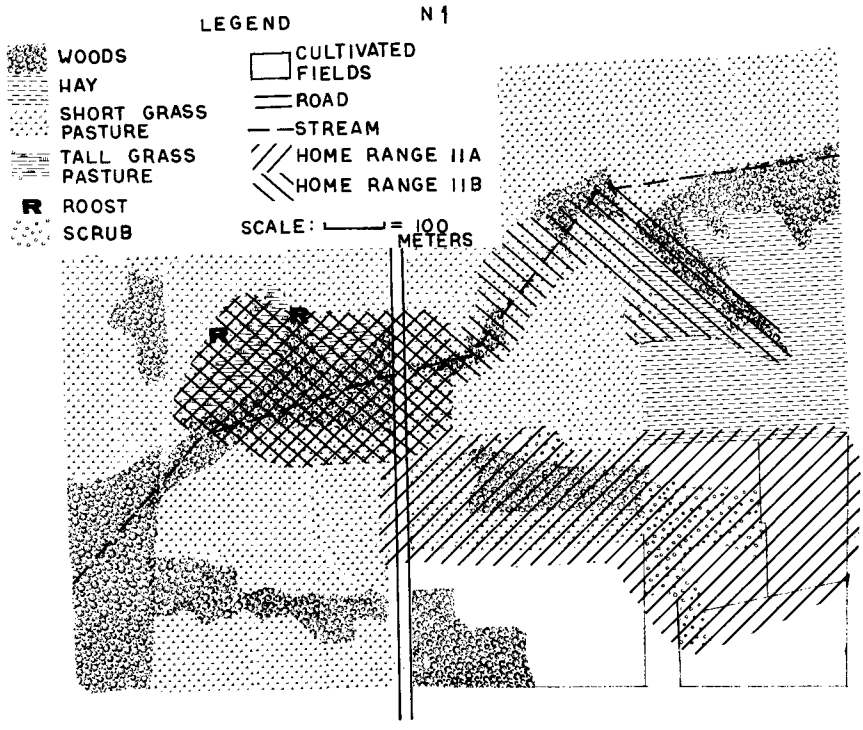

FIG. 2. Home range of flock II.

RESULTS

Winter Home Range.—The 11 juncos of flock I occupied study area I from 17 November 1971 until 14 January 1972, and restricted their activities to an area of 27 ha (Fig. 1). Flock II, composed of 11–13 individuals, used 2 home range areas (Fig. 2) in study area II during the winter. Winter home range IIA (33 ha) was used from the time of flock formation (mid-December) until 30 January when the flock broke up, apparently due to 10–15 cm of snow accumulation. When the snow melted a month later, the flock reunited (containing all 4 color-marked birds). For the remainder of the winter the flock used the same roosting areas (west of the road), but used a completely different feeding area (home range IIB, 17 ha). Vegetational composition of the home ranges is listed in Table 1.

For the first week after flock II broke up on 30 January, the members stayed in 5 groups of 2 to 4 birds, each group occupying a non-overlapping feeding area within the original home range. After the first week,

TABLE 1

PERCENTAGE OF EACH STUDY AREA AND HOME RANGE OCCUPIED BY VARIOUS HABITATS

Vegetation Type	Study Area I (90 ha)	Home Range I (27 ha)	Study Area II (110 ha)	Home Range II A (33 ha)	Home Range II B (27 ha)
Short grass pasture	0	0	40	20	40
High grass pasture	0	0	4	12	20
Cultivated fields	25	31	16	32	0
Scrub	20	40	4	15	3
Forbs	26	13	0	0	0
Woods	29	16	25	21	28
Hay fields	0	0	11	0	9

4 of the 5 groups abandoned their feeding areas, and congregated with other fringillids at nearby cattle pens, where stock feed was available on the ground. The 5th group remained in an area where a large tree prevented the accumulation of deep snow. During this period all of the banded birds continued to roost in the usual area.

All 3 winter home ranges had specific areas used day after day for certain activities. Each home range included a single area where intensive feeding occurred in the morning and late afternoon, as well as an area where most non-feeding activities occurred at midday. Scrub areas were used for intensive feeding by flock I, whereas short grass pasture was used by flock II. The midday non-feeding activities usually occurred in trees and shrubs adjacent to cultivated fields.

Diurnal habitat.—Dark-eyed Juncos generally fed in areas having trees, shrubs, or tall forbs, including short grass pastures, and soybean fields having boundaries of trees or shrubs. The birds flew to this taller vegetation when disturbed and perched there between feeding bouts. The occurrence of such vegetation probably determined to some extent the feeding areas used within the home range. Areas lacking taller vegetation (hay fields, and the centers of large cultivated fields) were rarely used; tall grass pastures were never used.

The junco flocks spent most of the day in scrub and short grass pastures where preening and perching activities predominated (Fig. 3). No other habitats were frequented by the juncos for even a quarter of their non-roosting hours.

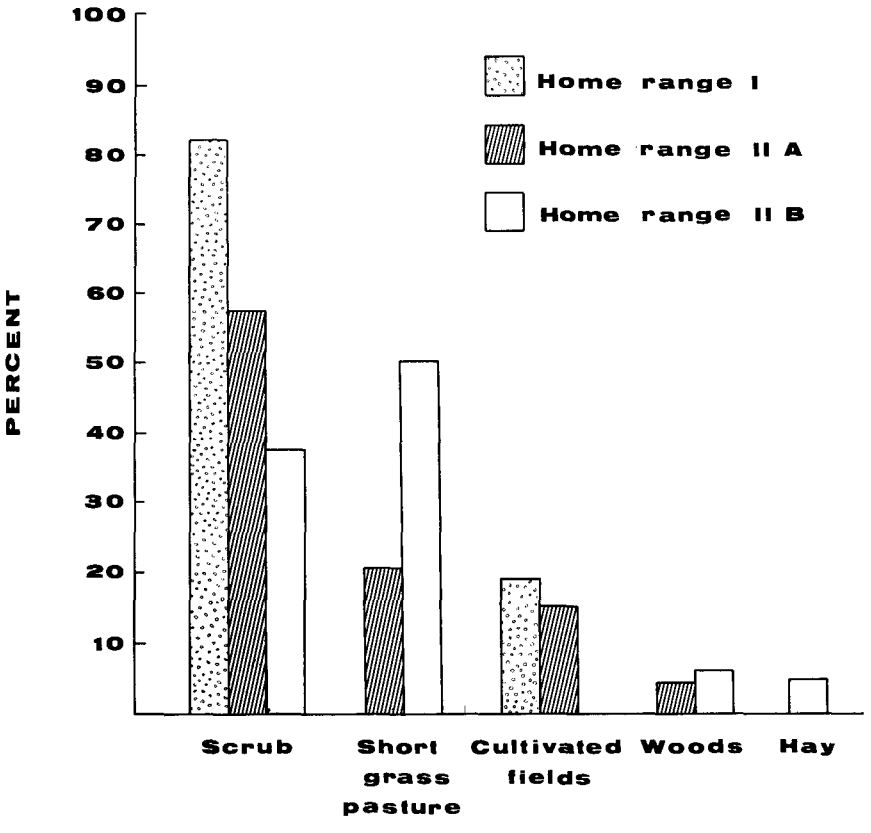

FIG. 3. Percentage of non-roosting time spent in each habitat.

Roosting habitat.—Juncos generally chose dense vegetation as roosting sites. On 10 December 3 members of flock I roosted in a red cedar tree (*Juniperus virginiana*), 3 on or near the ground in tall grass, 2 in osage orange thickets, and 2 in brush piles.

All members of flock II roosted in 2 adjacent jack pine (*Pinus banksiana*) plantations. They roosted 82–142 cm above the ground in trees 216–284 cm tall (Table 2). There was no relationship between the height of the roost tree and the height of the roost perch. The birds roosted in the part of each tree that had the densest foliage. The night temperature inside the dense foliage was generally only 1°C warmer than outside the crown, but wind velocity was substantially reduced by the foliage. A wind of 29 kph in the open was less than 1 kph at the roost site in 5 of the 7 trees.

TABLE 2

TEMPERATURE AND WIND CONDITIONS AT JUNCO ROOST SITES IN JACK PINE

Height of tree (cm)	Height of roost (cm)	Temperature (°C)		Wind (kph)	
		inside canopy	outside canopy	inside canopy	outside canopy
216	91	-3.9	-3.3	calm	29
250	135	1.0	2.2	calm	29
251	114	5.0	3.9	calm	29
265	82	3.3	1.6	calm	29
266	110	2.7	1.6	1	29
276	142	3.9	2.7	1	29
284	87	4.0	3.9	calm	29

Movements on the home range.—The daily movements on each home range followed a consistent pattern, especially on clear, cold days. The juncos in flock II emerged from the roosting trees when light intensity was between 1.1 and 4.3 luces. On overcast mornings, the birds left 12 to 18 (mean = 14) min before sunrise; on clear mornings 20 to 25 (mean = 23) min before sunrise. Temperature had no effect on the time of roost leaving (linear regression; r = .2).

Once out of the roost, the birds perched in nearby trees for variable lengths of time. The duration of this early morning perching activity was related to air temperature (Fig. 4). For example at -25°C, less than 10 min elapsed between roost leaving and first feeding, compared to 20 or more min elapsing at temperatures above 0°C.

After leaving the roost areas, the flocks followed a feeding circuit which took them .5 to 1 km away from the roosting areas, depending on the home range (58 observations). The farthest points from the roosting areas were used from mid-morning until late afternoon. Then the flocks started back toward the roosting areas, following a route similar to that used in the morning. On days with snow accumulation, high winds, or low temperatures, the movements away from and back to the roost were irregular, as many individuals left the flock for varying amounts of time.

There were 2 main types of early-morning feeding behavior. On home range I and IIB, the flocks gradually worked across a large field as they moved from the night roost, although there were some reverse movements. There were usually 11 or 12 moves per hour, but these moves were reduced to 4 to 6 per hour on windy days (winds over 32 kph), or on days with temperatures below -7°C ($t = 3.62$, $P < 0.01$, 12 df).

On home range IIA, the birds fed for approximately an hour in a short

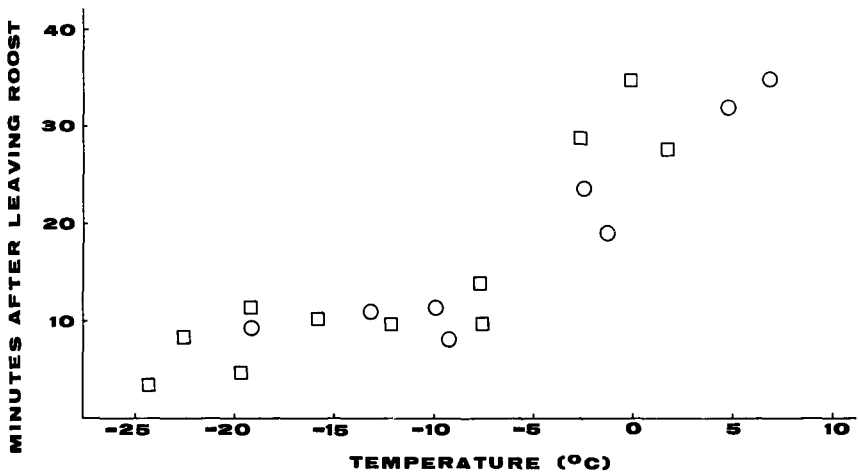

FIG. 4. Minutes elapsed between leaving roost tree and first visits to feeding areas as related to temperature. Squares indicate February observations, circles March observations ($r = 0.87, P < 0.01$).

grass pasture after leaving the roosting area each morning, then made a long flight to an area 600 m away where they remained for most of the day. Thirteen hectares of this flyway, which lacked tall vegetation were never used for feeding.

The only observable seasonal differences in feeding activities were in the portions of the cultivated fields that were used. During the fall migration, large flocks of juncos usually were widely dispersed in a harvested soybean field, often flying directly into its center. During mid-winter, the flock fed mostly near trees at the field edge, gradually moving toward the center of the field. In late winter and early spring, the birds began flying directly to the center of the field again, perhaps due to the depletion of the food supply near the edges (see West 1967).

Junco flocks merged temporarily at various times. Flock I merged with an adjacent junco flock each afternoon for about an hour (26 observations). This merging occurred in an area where the home ranges of the 2 flocks overlapped, and ended when one of the flocks flew out of the area. Flock II never merged with another flock, although one was sometimes only 100 m away.

DISCUSSION

Our findings on habitat use agree in most respects with those of other workers. However, some other published observations on junco habitat

use do not include cultivated fields (Quay 1947, Johns 1971), and only Graber and Graber (1963) and Pulliam and Enders (1971) noted as wide a range in habitat preference.

The change in home range area by flock II is somewhat perplexing. The flock could have "forgotten" the boundaries of the old home range after the long period of snow accumulation, but this seems an unlikely explanation. Whittle and Fletcher (1924) have documented that juncos may winter year after year in the same locality. If juncos can find their way back to a previous wintering area, they would surely remember home range boundaries after only one month. It is unlikely that the food supply was depleted in the first home range, as the flock used only a small percentage of the home range for feeding. The juncos may have changed home ranges because the long period of snow accumulation reduced their fat reserves sufficiently that they could no longer afford to waste energy just flying over large areas of the home range.

This last possibility may explain why home range IIB was half the size of home range IIA. In home range IIA (33 ha), only 2 ends were intensively used; much of the rest was merely flown over. In contrast, most of the 17 ha of home range IIB was used for feeding. The areas actually used for feeding in both home ranges are similar in size, thus indicating that the needs of a flock of 11 to 13 juncos could be supplied by about 16 ha.

According to West (1967) a flock of 10 to 20 Tree Sparrows (*Spizella arborea*) can find enough seeds in 1 ha to survive through the winter. Yet, both juncos and Tree Sparrows travel daily over relatively large areas (Helms and Drury 1960). Covering more area in the winter home range than is actually needed for a food supply may have 3 major functions. By being familiar with many potential feeding areas, the birds may, in times of food unavailability (after snow and ice storms), be more successful in finding food. In addition, an increase in area covered may reduce interactions among members of the flock, thus promoting flock stability. By constantly moving about, losses through predation may also be reduced. Crowcroft (1966) observed that mice (*Mus musculus*) exhibit this feeding strategy even when food is abundant.

Juncos fed on seeds that were on the ground except during periods of high snow accumulation when they were forced to feed on seeds still on plants. They either pulled the seed head to the ground, or perched on the plant while eating. West (1967) has shown that more than 90% of the annual seedfall in Illinois occurs by January. After the 30 January snow fall, the juncos of flock II were forced up onto the forbs, but if the seedfall was mostly complete, the juncos may have been feeding on the vegetative

parts of forbs or very sparse seeds. This poor diet may have been the reason why the junco groups left their feeding areas within the home range and gathered at the cattle pens in early February.

Our observations on the feeding heights of juncos are similar to those of Johns (1971) who found that 95% of the juncos' feeding activities occurred on the ground. However, Pulliam and Enders (1971) reported that juncos spent only 35% of their feeding time searching for food on the ground. The causes of these differences are not evident.

Wintering birds may metabolize up to 15% of their body weight during the night (Kendeigh 1934, Newton 1969), therefore the presence of protected winter roost sites that can minimize energy losses may be essential for birds to inhabit an area. An opaque cover reduces radiation heat loss and any wind-stopping material reduces convection heat loss (Moore 1945, Gates 1962). The wintering juncos in this study used well-protected sites. Most of them roosted in conifers. The juncos which roosted in tall grass or in brush piles were in areas without pines and in which cedars were so scattered that the flock would have been widely dispersed if each bird had roosted in an unoccupied tree. The inference is that conifers, where available, are selectively used for roosting in preference to tall grass or brush piles. During migration, when junco flocks are large and mobile, roosting in tall or fallen grass may be very common.

SUMMARY

The movements and habitat preference of 2 flocks of Dark-eyed Juncos were studied in the winter of 1971–1972. One flock established a new home range following a heavy snow fall. The 3 home ranges were found to be 27, 33, and 17 ha in area. Each flock night-roosted in dense vegetation at one end of the home range, and spent midday at the opposite end. Most feeding activities were restricted to areas containing grasses and forbs with taller vegetation in the general vicinity. Most day-light hours were spent in scrub and in short grass pasture habitats. Home range overlap of 2 junco flocks resulted in temporary intermingling among members of the flocks at certain times during the day.

ACKNOWLEDGMENTS

We are grateful to Drs. David Osborne and Charles Thompson for making critical comments on this paper. Harvey Kimble, Lee Rowland, and Calvin Spencer kindly allowed this study to be conducted on their land.

LITERATURE CITED

Condee, R. W. 1970. The winter territories of the Tufted Titmice. Wilson Bull. 82: 177–183.

Crowcroft, P. 1966. Mice all over. G. T. Foulis & Co. Ltd., London.

Gates, D. M. 1962. Energy exchange in the biosphere. Harper & Row, New York.

GRABER, R. R. AND J. W. GRABER. 1963. A comparative study of bird populations in Illinois 1906–1909 and 1956–1958. Ill. Nat. Hist. Surv. Bull. 28:378–528.

HELMS, C. W. AND W. H. DRURY. 1960. Winter and migratory weight and fat field studies on some North American buntings. Bird-Banding 31:1–40.

JOHNS, F. L. 1971. Habitat exploitation by four species of sparrows in ecotones in winter. Ph.D. thesis, North Carolina State Univ., Raleigh.

KENDEIGH, S. C. 1934. The role of environment in the life of birds. Ecol. Monogr. 4:300–417.

MOORE, A. D. 1945. Winter night habits of birds. Wilson Bull. 57:253–260.

NEWTON, I. 1969. Winter fattening in the Bullfinch. Physiol. Zool. 42:96–107.

PRICE, J. B. 1931. Some flocking habits of the crowned sparrows. Condor 33:238–242.

PULLIAM, H. R. AND F. ENDERS. 1971. The feeding ecology of five sympatric finch species. Ecology 52:557–566.

QUAY, T. L. 1947. Winter birds of upland plant communities. Auk 64:382–388.

ROBINS, J. D. AND A. RAIM. 1970. Late winter movements and social behavior of the Black-capped Chickadee. Jack-Pine Warbler 48:66–72.

SABINE, W. S. 1949. Dominance in winter flocks of juncos and Tree Sparrows. Physiol. Zool. 22:68–85.

WEST, G. C. 1967. Nutrition of Tree Sparrows during winter in central Illinois. Ecology 48:58–67.

WHITTLE, C. L. AND L. B. FLETCHER. 1924. Further observations on the group habit among birds. Auk 41:327–333.

DEPT. OF BIOLOGICAL SCIENCES, WESTERN ILLINOIS UNIV., MACOMB 61455. (PRESENT ADDRESS: BMG, DEPT. OF ZOOLOGY, MIAMI UNIV., OXFORD, OHIO 45056). ACCEPTED 15 JAN. 1975.