

WINTER ACTIVITIES OF THE SLATE-COLORED JUNCO  
ON THE ROSS NATURAL HISTORY RESERVATION

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Master of Science

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by  
Charles William Comer

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WINTER ACTIVITIES OF THE SLATE-COLORED JUNCO  
ON THE ROSS NATURAL HISTORY RESERVATION

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To My Parents

George and Frances Comer

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Emporia, Kansas

C. W. C.

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## INTRODUCTION

Few studies have been made on the wintering activities of the Slate-colored Junco (Junco hyemalis Linnaeus). Whittle (1926) touched upon the subject when he observed that juncos congregated at dusk in junipers at a common junco roost in Massachusetts. Sabine (1949, 1956) presented little information concerning wintering activities other than social feeding behavior and flock formation in New York. Waters (1967) was vague as to whether early arrivals which appeared in late winter or early spring were members of a wintering flock in Massachusetts. Eaton (1968), in summarizing the fall and winter habits of the species throughout North America, discussed only movement dates and abundance during migration. The purpose of the present study was to extend the knowledge of the wintering behavior of these birds, especially with reference to their winter range, forage area and migration patterns.

During 1967-68 and 1968-69, the writer observed and banded 273 Slate-colored Juncos, color-marking 144 of them during the second season, in a 250-acre area on or close to the F. B. and Rena G. Ross Natural History Reservation in Lyon County, Kansas (Fig. 1).

Approximately equal numbers of two subspecies, Junco hyemalis hyemalis (Linnaeus) and J. h. cismontanus Dwight were seen and

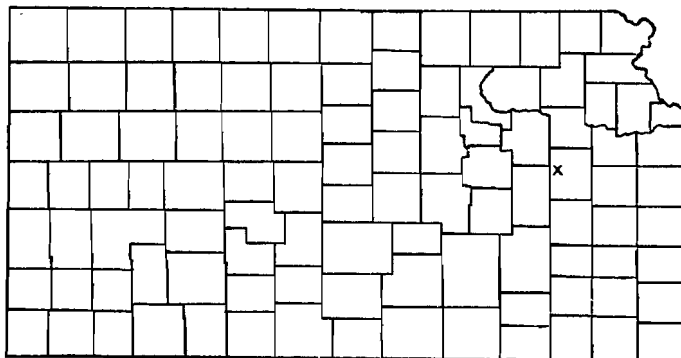


Figure 1. Map of Kansas, showing location of Ross Reservation.

caught on Ross Reservation. One flock observed was composed primarily of J. h. cismontanus, whereas another flock was made up of equal numbers of the two subspecies. An attempt was made to correlate subspecies with flock formation and feeding habits but no definite conclusions could be drawn. Further research is needed in this area.

## DESCRIPTION OF THE STUDY AREA

### History

The F. B. and Rena G. Ross Natural History Reservation was established in November, 1958, when Mr. and Mrs. F. B. Ross made available a 1040-acre tract in west-central Lyon County and northeast Chase County for use by the Kansas State Teachers College of Emporia. In January, 1959, the Rosses gave a 200-acre tract, located in Lyon County, to Kansas State Teachers College. The primary study area was within this 200 acres; in addition, observations were made in a 20-acre tract south of the reservation.

Grazing leases were held on all of the Ross Reservation acreage except the state-owned 200 acres, consequently little research could be done in this area from April through October without interference by livestock. The state-owned 200 acres was under the management of the Ross Natural History Reservation Committee of the Department of Biology, which established policies and designated areas for research by students and faculty. A headquarters classroom-laboratory building and some storage buildings were located in the south-central portion of the state-owned 200 acres, and classes were conducted during the summers and, at times, during the fall and spring semesters. Activities of classes limited the amount of

ecological research that could be pursued on the Ross Reservation. Portions of the state-owned 200 acres had been used in research on prairie grasses and much of the western portion had been subjected to disturbance by mowing, burning and plowing of native grasses and by planting of test grasses. The eastern portion of the state-owned 200 acres had been invaded extensively by trees and shrubs.

### Physical Features

Ross Reservation, located on the east face of the Flint Hills Upland, was characterized by gently rolling hills with numerous limestone outcroppings (Hartman, 1960). There were five stock ponds located on Ross Reservation, with the largest of the five, Gladfelter Pond, just north of the primary study area. The drainage of Gladfelter flowed northeastward. There was a small stock pond immediately south of Ross Reservation at the upper end of a stream which flowed southeastward for a short distance, then northeastward.

Hartman (1960) stated that there was "an annual rainfall of 30 to 38 inches with 72 percent of the precipitation occurring during the normal growing season of 186 days . . . and winters are usually mild to moderate with occasional severe cold spells." The average growing season was from mid-April through early October.

Ross Reservation was divided into 10-acre grid sections, which

were lettered and numbered according to the standard numbering system of townships (Hartman, 1960) (Fig. 2). In the discussion of this study, these grids were used in plotting movements and locations of the birds outside the primary study area on Ross Reservation.

### Vegetative Features

#### Hedgerows

Hedgerows of Osage Orange (Maclura pomifera) bounded most of the fields in the primary study area (Figs. 3-5). Hackberry (Celtis occidentalis) and American Elm (Ulmus americana) were occasionally interspersed in the hedgerows. Buckbrush (Symphoricarpos orbiculatus) occurred under and along the hedgerows. Along the edges were ragweeds (Ambrosia trifida and A. artemisiifolia), sunflowers (Helianthus spp.), Ironweed (Veronia baldwini) and Wild Gooseberry (Ribes missouriense). Osage Orange leaves began to fall in early November and hedgerows were devoid of leaves by the end of November. Hedgerows began to bud out in late April and were in full leaf by the end of the first week in May. Graul (1965, personal notes) estimated the hedgerows along the western edge of grid A57 to be 3 to 4 m in height; the author measured them in April, 1969, and found them to be 4 to 6 m tall. The hedgerows in the primary study area ranged from 4 to 12 m in height and were 12 m wide except the western half

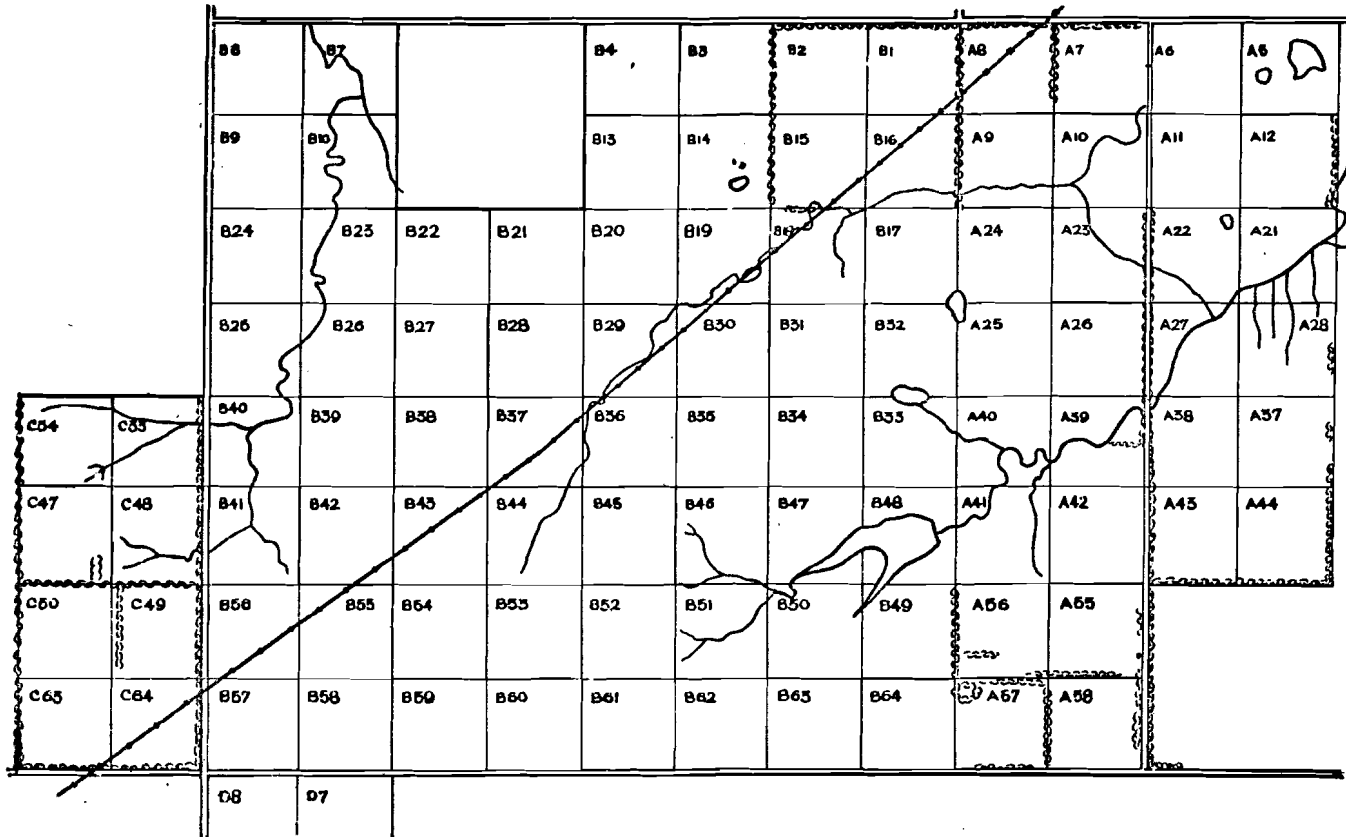


Figure 2. Map of Ross Reservation showing the grid numbering system.

Figure 3. Hedgerow, 5 m in height, along western edge of Area A, looking southward. Pole (marked in meters) at righthand side of photo was used to measure height of hedgerow.



Figure 4. Hedgerow, 5 m in height, along northern edge of Area D, looking westward.

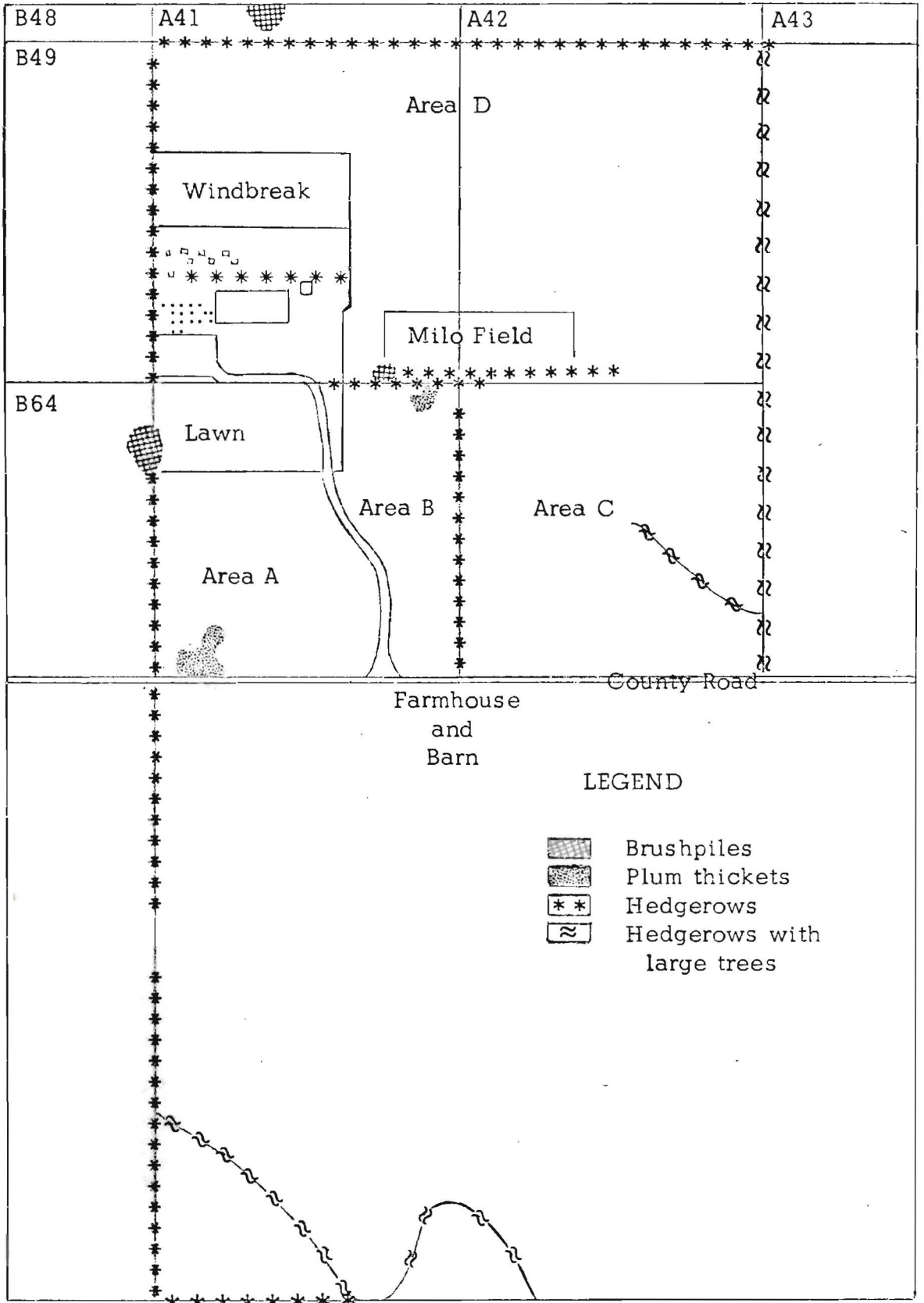


Figure 5. Vegetative map of the primary study area.



of the one immediately south of the milo field which was 24 m wide.

### Plum Thickets

Two thickets of Wild Plum (Prunus americana) occurred within the primary study area (Fig. 6). The largest was located in the southwestern corner of Area A and consisted of a dense stand of 3 to 4 m tall plum trees and, in addition, two large Red Mulberry (Morus rubra), three large Hackberry, one White Ash (Fraxinus americana) and three Osage Orange trees. Wild Gooseberry was a common understory plant. The second thicket, adjacent to a hedgerow at the northern edge of Area B, did not cover as extensive an area as the one in Area A and the trees averaged 2 to 3 m in height. Leaves began to



Figure 6. Plum thicket in Area A, 3 m in height.

fall in mid-October and the thickets were bare by the first week in November. Leaves began to emerge by mid-April and the trees were in complete foliage within a week after emergence.

### Windbreak

A planted windbreak north of the headquarters building had, from south to north, a row of Red Cedar (Juniperus virginiana), a row of Russian Olive (Elaeagnus angustifolia), a row of Red Mulberry alternating with American Elm, two rows of Red Cedar, a row of Russian Olive and a border row of Multiflora Rose (Rosa multiflora). In April, 1969, the cedars measured 3 m high (Figs. 7-8), the Red Mulberry, American Elm and Russian Olive trees approximately 4 m tall and the Multiflora Rose 1.5 m in height. The windbreak covered about one acre and the dominant grass between the rows, which were 61.5 m long, was Three-awned Grass (Aristida oligantha). The windbreak was mowed during the growing season.

### Overgrown Fields

Area A was a disturbed field with numerous weeds, little grass and some small shrubs (Fig. 9). Aster (Aster spp.), Curly Dock (Rumex crispus), Love Grass (Eragrostis spp.), Ironweed, Germander (Teucrium occidentale), Goldenrod (Solidago spp.) and Evening Primrose (Oenothera biennis) were common plants of this



Figure 7. Westward view of planted windbreak as seen from south side.

Figure 8. Center of windbreak, looking westward, Red Mulberry trees and Red Cedars. Osage Orange hedgerow in background. Red Cedars are 3 m tall.



area. Three small patches of Smooth Sumac (Rhus glabra), several small Osage Orange trees and several small Red Cedars had invaded the field. The Department of Biology sampled the area at regular intervals to measure the change in vegetation, and a small plot in the northeastern corner was plowed in the spring of 1969 for further study of disturbed prairie habitat. One-half meter wide trails were cut along the western and southern edge of the field in the fall of 1968 as a part of a study on Eastern Cottontails (Sylvilagus floridanus) and a fire break, approximately 2 m wide, was maintained along the southern edge.



Figure 9. Area A, weedy field, with the headquarters area in the background.

Area C was an overgrown field that was heavily invaded with trees such as Honey Locust (Gleditsia triacanthos) and Osage Orange. There were several dense stands of Buckbrush and a large invasion of Smooth Sumac. Prickly Pear (Opuntia macrorhiza) occurred in abundance on the drier sites. At the head of the gully in the east-central part of the area was a stand of Aromatic Sumac (Rhus aromatica).

#### Experimental Prairie Grass Plots

The experimental plots in Area B incorporated close to four acres, three of which were planted in Indian Grass (Sorghastrum nutans), Big Bluestem (Andropogon gerardi), Little Bluestem (A. scoparius) and Switch-grass (Panicum virgatum). The northernmost acre was Smooth Brome (Bromus inermis) with some weeds, such as Kuhnian (Kuhnia eupatorioides) and Aster. A very small portion of the lawn was located along the edge of the northwestern corner.

#### Milo Field

A one-acre plot was first planted to milo in 1959 to serve as a winter feed patch. Since then, it had been planted each year to milo, but the crops of 1967 and 1968 were poor. A second area adjacent to the eastern edge of the field was plowed in the spring of 1969 but neither plot was planted by the end of the study. The

plot was bordered by Multiflora Rose on three sides and a hedgerow on the fourth. Along the north side a 2 m wide strip of Bicolor Lespedeza (Lespedeza bicolor) was between the milo field and the Multiflora Rose.

### Prairie

Area D comprised most of the northern portion of the study area. Smooth Brome was the dominant species in this area with scattered clumps of tall grasses. Red Cedars had spread into the field north of the windbreak and 3 to 4 m Osage Orange trees were in the north-eastern and northwestern sections.

### Lawn

Bluegrass (Poa pratensis), Smooth Brome, Buffalo Grass (Buchloe dactyloides), Crab Grass (Digitaria spp.) and Foxtails (Setaria spp.) formed the major components of the three-acre lawn encompassing the headquarters area. On the lawn were Red Cedars, White Ash and Osage Orange trees, all of which were 10 to 12 m in height. West of the headquarters building was a small planting of Red Cedars, approximately 2 m tall, and a Red Mulberry of the same height. The lawn was mowed regularly during the growing season in order to maintain a fire break around the headquarters area. A series of open-topped metal lizard pens was located north of the building. These had sand

over the bottoms and some vegetation grew in them. During the summer months, the vegetation was clipped regularly to facilitate observations. In the winter months the lizards were kept indoors.

#### Area South of Ross Reservation

The 20-acre portion of the study area south of Ross Reservation contained hedgerows along the western and southern borders. A 15 m gap was located half way along the western hedgerow and a 25 m gap terminated the southern hedgerow on the eastern end. There were only open grazed fields south of this area.

A small stream cut diagonally across the southwestern corner. Along this stream were large Cottonwood (Populus deltoides) trees and a dense understory of bushes. At the southwestern corner of the area, the stream made a loop with the open end to the south. Inside the loop was a moderately dense growth of Rough-leaf Dogwood (Cornus drummondii), Smooth Sumac, Black Willow (Salix nigra) and some weedy plants.

To the north of the stream was a small cultivated field of approximately seven acres. Between the stream and the southwestern corner was an open weedy, triangular-shaped area.

The northern 10 acres of this area was a grazed weedy field, similar to Area A, but with several large trees scattered throughout.

## METHODS AND MATERIALS

Data on the Slate-colored Junco were collected during the winters of 1967-68 and 1968-69 by catching birds with mist nets and traps, banding, color-marking and making field observations. Nets and traps were set from 21 October 1967 through 19 May 1968 and from 13 September 1968 through 18 May 1969.

NEBBA type A (36 mm), F (24 mm) and H (30 mm), untethered nets were tried in October and November 1967, with a fourth type, Davis No. 4 (63.5 mm), tried in December 1967. The 36 mm net proved to be the most effective in catching the greatest variety of birds. Larger birds had a tendency to bounce off the smaller-sized nets. The smaller birds became entangled and were difficult to remove from the largest size net. During the 1968-69 season, NEBBA type ATX (36 mm, tethered, full-bag) nets were used as well as some of the used 36 mm nets. New nets were used as much as possible during the second season, however.

Nets were set between two poles in lanes, 1.5 m wide, across hedgerows, in weeds and thickets and in a windbreak north of the headquarters building (Figs. 10-11). The lanes were cleared of anything that might become entangled in the net and periodic mowing and trimming were done when necessary. The net lines were attached



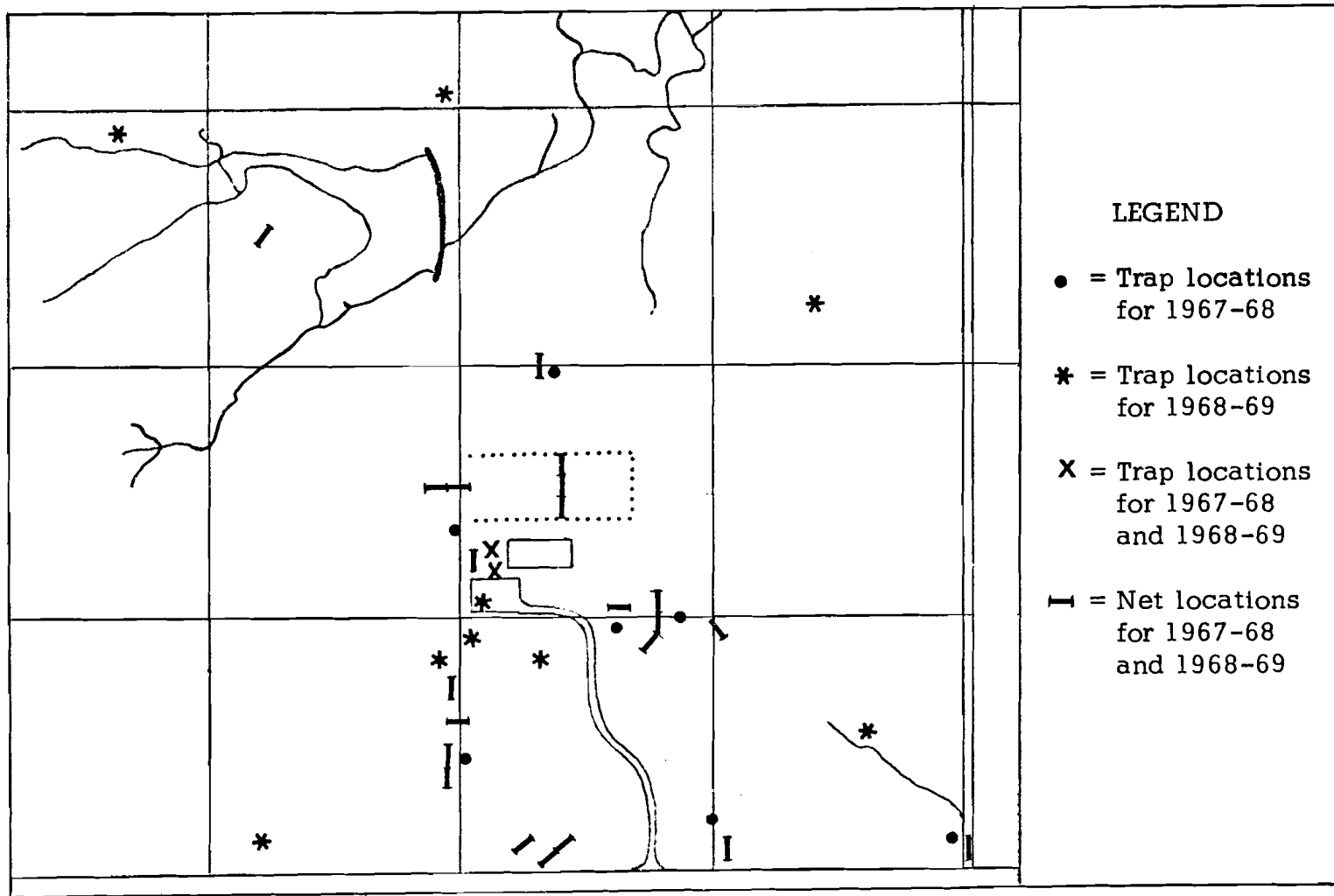


Figure 10. Trap and net locations for entire study.



Figure 11. Net lane in plum thicket in Area A.

to the poles with rubber bands in order to maintain the desired tension. All NEBBA nets were 12 m in length; types A and H were 2.4 m in height; type F, 2.2 m and type ATX, 2.6 m. The Davis No. 4 net was 12.5 m long and 2 m high. The net poles were in two pieces, the top half fitting into the bottom half, allowing for the setting and removal of nets without moving the pole itself.

Nets were usually placed upon the net poles on Friday evenings, set on both Saturday and Sunday and removed from the poles on Sunday. They were also set during the week from Monday to Friday whenever possible. Netting positions were changed during the season in order to keep resident birds from becoming accustomed to their location. Nets were checked at frequent intervals, generally hourly.

Havahart repeating sparrow traps were set at irregular times so that the birds would not become accustomed to them as at feeding stations. Traps were checked at least once a day. During the first season, traps were set within the netting area and, during the second season, they were placed around the perimeter of the primary study area as well (Fig. 10). All traps were baited with crushed corn and whole milo. Traps were placed on the ground and 1.3 m above the ground on poles in both seasons. Traps on the ground yielded the best results in numbers of juncos caught, but the captured birds were preyed upon by cats and rodents.

A total of 187 days were utilized during the entire study for observation purposes--81 days (330.25 hrs) during the 1967-68 season and 96 days (494.75 hrs) during the 1968-69 season.

Certain weather conditions were unfavorable for netting birds, consequently, nets were not run during these periods. Heavy rainstorms caused nets to sag and increased the likelihood of mortality from drowning. Winds above 10 mph made untethered nets ineffective, but in the second season tethered nets were run effectively in winds up to 20 mph. Snow filled the nets, and caused them to sag, thus making them ineffective. Heavy frost accumulated on nets and cut down their efficiency, especially during early morning. Rain and

snow weighed the treadle basket down and rendered traps inoperable.

Color-marking was utilized in the 1968-69 season to facilitate investigation of observable trends found in the previous season. Birds caught from 21 September through 30 November were marked green; from 1 December through 31 December, red; from 1 January through 28 February, blue; from 1 March through 31 May, yellow. Two types of waterproof felt tip markers (Dixon RediMark and Esterbrook All-Purpose Marker) were used to mark birds over the entire breast and belly area. From time to time the color-marking was renewed on recatches when the color had faded substantially.

In order to maintain a consistent record for each individual, the author devised a form card with spaces allotted for recording weight, assumed sex, plumage description of the bird, time of release, color-marking and location of net. A colored file card that corresponded with the color-marking of the individual was maintained for each bird that was color-marked. A separate record card was kept of all recatches, returns and recoveries for each bird banded during the entire study. These records also included net location and time of release.

Daily barometric pressure, temperature, humidity and rainfall were recorded by instruments at a weather station maintained on Ross

Reservation. The author monitored wind speed from a gauge in the headquarters building.

A botanical reference by Wilson (1963) was used for identification of plants. Some representative plants were collected by the author and compared with specimens in the Ross Reservation plant collection.

## RESULTS AND DISCUSSION

### Migration

#### Fall

Fall migration patterns at Ross Reservation appeared to be similar in 1967 and 1968. Johnston (1965) listed the fall arrival date of the Slate-colored Junco in Kansas as 23 September to 19 October with the mean date 10 October. In the fall of 1968, a single Slate-colored Junco was caught at Ross Reservation as early as 21 September. Numbers of juncos, however, did not begin to build up until the end of the third week of October.

In 1967, two Slate-colored Juncos arrived on 22 October and small numbers of the birds were caught from then until early November. The first large numbers came in early November when 10 birds were caught on the fourth and 22 birds on the tenth. Similarly, in 1968, a single, unbanded junco was seen on 19 October and on 20 October two were caught. Scattered individuals were banded until 2 November when 12 new birds, including three returns, were caught. These, in turn, were followed by 22 new individuals caught on 3 November.

Six major migratory waves of juncos occurred in November of both years. The migration season lasted longer in 1967 than in 1968, with three waves in December as opposed to only one in 1968 (Table I).

Table I. Date of fall migratory waves of Slate-colored Juncos during 1967 and 1968 on Ross Natural History Reservation.

Month	Day of Month	
	1967	1968
November	4	3
	11	9
	19	11
	23	17
	24	27
	28	29
December	3	7
	15	
	24	

Although Bennett (1952) found increases in the number of juncos seen after the passing of a cold front during autumn in the Chicago, Illinois, region, junco movements on Ross Reservation could not be definitely related to cold fronts or wind direction. New birds were more prevalent after cold fronts in several cases but, at times, there were no noticeable increases of juncos after the passing of a cold front through the primary study area.

In summary, it appeared that the largest numbers of Slate-colored Juncos passed through the Ross Reservation in waves or peak numbers during November. Whether other areas in Kansas show a similar fall migration pattern is not known.

## Winter

The winter period, here considered to be a period from 1 January through 7 February, covered a span of five weeks, during which time there were virtually no migratory movements of juncos. During the first winter, six unbanded individuals were caught, three of which were repeatedly caught thereafter, indicating that they were members of a small wintering flock probably composed of less than 30 birds. Three were not caught again and may have been wanderers from outside the banding area. Sabine (1949) noted "casual visitors" which sometimes joined the established flock of an area for only a few days. The number of casual visitors and visits varied greatly from one season to the next in her study.

During the second winter of the present study, four new birds were banded and color-marked; these, also, were never seen again and were considered casual visitors. Eight unmarked Slate-colored Juncos observed at the southern edge of grid A42 on 23 January 1969 were not seen again. Whether these birds were casual visitors or a migratory flock was uncertain. Nevertheless, it appeared that winter was a static period in the migratory movements of juncos. Again, data concerning the movements of juncos elsewhere in Kansas is lacking.

## Spring

Both 1968 and 1969 spring seasons were characterized by high



winds, snow and rain, thus banding operations and observations were hampered and the number of individuals caught or observed was lower than expected. Johnston (1965) listed the spring departure date for Kansas as 16 April to 2 May, with a mean date of 20 April. In 1968, the first spring migratory movements were observed as early as 10 February at Ross Reservation, followed by another large wave that month (Table II). In 1969, the first movements started on 9 February. Since there were ice and snowstorms, along with windy weather later in the month, data for February were scant.

Table II. Dates of spring migratory waves of Slate-colored Juncos during 1968 and 1969 on Ross Natural History Reservation.

Month	Day of Month	
	1968	1969
February	10 23-24	9
March	3 23-24	1 15 22

Migration during March followed similar patterns in both years. As apparent from Table II, there was an influx of birds in 1968 on 3 March and a second influx during 23-24 March. In 1969, the first

wave came on 1 March, followed by one on the 15th and still another on the 22nd. A few stragglers were observed that year until 7 April. One of two birds caught on 7 April had been a member of the winter flock, indicating that some birds remain in the area for several months.

Certain individuals were migrant returns. They migrated through Ross Reservation in fall and spring each year but were not taken during winter. These birds were caught only during migration waves. Thirteen banded birds at Ross Reservation fitted this category (Table III), clearly indicating that migrating juncos may follow the same route two (probably more) years in succession. During a one-year period, Fletcher (Whittle and Fletcher, 1924) experienced a 25.31 percent return of 57 migrant birds, and Whittle, who operated a station near Fletcher's, had a 14.92 percent return. Sabine (1949) had a 15 percent return of 40 individuals during a one-year study. Out of 150 banded birds, 12.67 percent returned to Ross Reservation the following season after they were banded.

### Flock Formation

During the 1967-68 season, a definite time period in which flock formation took place was difficult to determine because of the lengthy migration period and lack of color-marked birds. Of 14 birds that were caught repeatedly then, four had been caught for the first

Table III. Migrant returns of the Slate-colored Juncos through Ross Natural History Reservation during the fall and spring migration periods of 1967-68 and 1968-69. None of these birds were observed during the winter period.

Bird (In order of capture)	Fall 1967	Spring 1968	Fall 1968	Spring 1969
1	+	+	+	-
2	+	+	+	+
3	+	+	+	-
4	+	+	+	-
5	+	-	+	-
6	+	+	+	-
7	+	-	+	-
8	-	+	+	-
9	-	+	+	-
10	-	+	+	-
11	-	+	+	-
12	-	+	+	+
13	-	+	+	-

+ = capture; - = no capture

time on 10 November, one on 11 November, two on 19 November, two on 23 November and the rest during winter. Five of these returned the next season: two were caught on 9 November, one on 17 November, one on 28 November and one on 7 December. This indicated that the winter flock began to form in November.

The following observations also indicated that flock formation occurred late. A single bird caught on 21 September 1968 was not seen again. Of five juncos caught in the latter part of October that year, four were not recorded again. One was found injured in November, held in captivity, released on 14 December and not seen again.

Both unmarked and color-marked birds were observed, singly and in groups of three to four, from 9 November through 23 November in the hedgerow near a deer feed station west of the headquarters building. A flock of 10 individuals was seen on 24 November, a flock of 10 on 26 November, and a flock of nine on 28 November.

From 23 to 29 November, there were 30 recatches of 22 green individuals: five had been color-marked on the second or third of November, three on the eighth and 11th, and the remainder on the 16th or later. Whittle and Fletcher (1924) thought wintering juncos came to the winter area as a group; however, Sabine (1956) said:

The significant point is that although the migrant individuals which are to become winter residents arrive irregularly over a period of several weeks, they somehow

manage to form themselves into distinct, stable winter flocks with mutually exclusive foraging territories.

The author agrees with Sabine and considers the eight early arrivals in this study the nucleus of the winter flock which formed in late November.

A second flock, which contained one green junco and 14 unmarked juncos, was observed in grid A<sup>2</sup>7 north of the primary study area on 11 November. A flock was observed there on 23 November at which time it contained two green members among 25 to 30 unmarked juncos that were with Tree Sparrows (Spizella arborea). On 27 November, 10 to 15 juncos, including one green individual, were in the area. Not one of 14 seen on 8 December was color-marked. No observations were made in grid A27 from 8 December to 19 January. No flock was in the area on the later date and no juncos were seen there again until 16 March when four unmarked birds were observed with Tree Sparrows. The earlier flock evidently had left the area during the winter period.

#### Winter Movements

During the 1967-68 season newly caught birds were banded and released from the headquarters building, or from the net or trap where captured. This was done to ascertain whether the point of release in the study area affected junco movements. No apparent effect was noted. During the 1968-69 season all new birds were released from

the headquarters building, while most recatches were released at the point of capture.

Sabine (1956) suggested that adults from the previous season had a "homing" instinct. She found that a few birds returned to her study area early and formed the basis of a winter flock. The first few birds that arrived were adults that had been banded during the past season. They went immediately to the feeding station that they had used the previous year.

Observations at Ross Reservation were similar. In 1967-68, junco flocks were often seen feeding on the lawn south of the headquarters building, but not in hedgerows at the southwest corner of Area D. Not until February 1968, when a deer feed station was established west of the headquarters building, did juncos appear in that area regularly. Juncos appeared there during the second season as early as 2 November. Some of these birds (marked) had been in the area both seasons.

Juncos inhabited all of the hedgerows early in the fall, excepting the one at the eastern edge of Area B (Fig. 5). During both seasons this hedgerow for some reason was not visited by the winter flock. In 64 days of observation in the 1968-69 season, only one junco was seen (18 January) there, and it is quite possible that the bird was forced into the hedgerow while the author was driving nets near by.

On 31 March, 10 juncos were observed in this hedgerow. Two of the 10 were color-marked which clearly indicated these birds were spring migrants that had recently moved into the area. Why the winter flock shunned this area remains a mystery, for the hedgerow appeared to have the same features as others and was also occupied by other fringillids, namely Tree Sparrows, Harris' Sparrows (Zonotrichia querula) and American Goldfinches (Spinus tristis). Sabine (1955) also found that repeated returns to a definite spot appeared to be characteristic of the Slate-colored Junco's winter behavior.

When Slate-colored Juncos first began to arrive at Ross Reservation in the fall, hedgerows had not started to lose their leaves but plum thickets were partially bare. At this time, juncos moved in and along most hedgerows, marginal weed areas and plum thickets. As plum thickets became devoid of leaves, juncos tended to move into the hedgerows that offered more cover. By the end of November, when the hedgerows had lost all of their leaves, the juncos were well established. The birds tended to stay with the hedgerows despite loss of leaves. It was along these hedgerows that the juncos established forage trails.

During the entire first season, few juncos were caught in nets placed near plum thickets. Those that were caught were taken in mid-December during a migration wave, and in March during spring

migration. These birds had arrived at a time when leaves of hedgerows as well as those of the plum thickets had fallen, there then being no obvious advantage in the hedgerows.

Observation of junco flocks indicated that the 1967-68 winter range covered the hedgerow along the western edge of the Ross Reservation portion of the primary study area and the westernmost part of the hedgerow along the northern edge of Area D, in addition to the windbreak to the north of the headquarters building and the lawn south of there. The author did not pursue observations south of Ross Reservation during the first season.

Two color-marked birds were trapped in a number of places in the primary study area. Since both were part of the winter flock, their movements were considered fairly typical of those of the flock (Fig. 12). One of the birds, a banded member of the 1967-68 winter flock, returned to the deer feed station west of the headquarters building and was color-marked red on 7 December 1968. It was observed six more times during the remainder of the season. On 11 January 1969, it was netted in a hedgerow at the west end of the windbreak and, on 19 January, in a hedgerow along the northern edge of the primary study area. A red-marked bird, believed to be this individual, was seen several times: on 27 January at the deer feed station west of the headquarters building; on 1 February along a stream 200 m east of



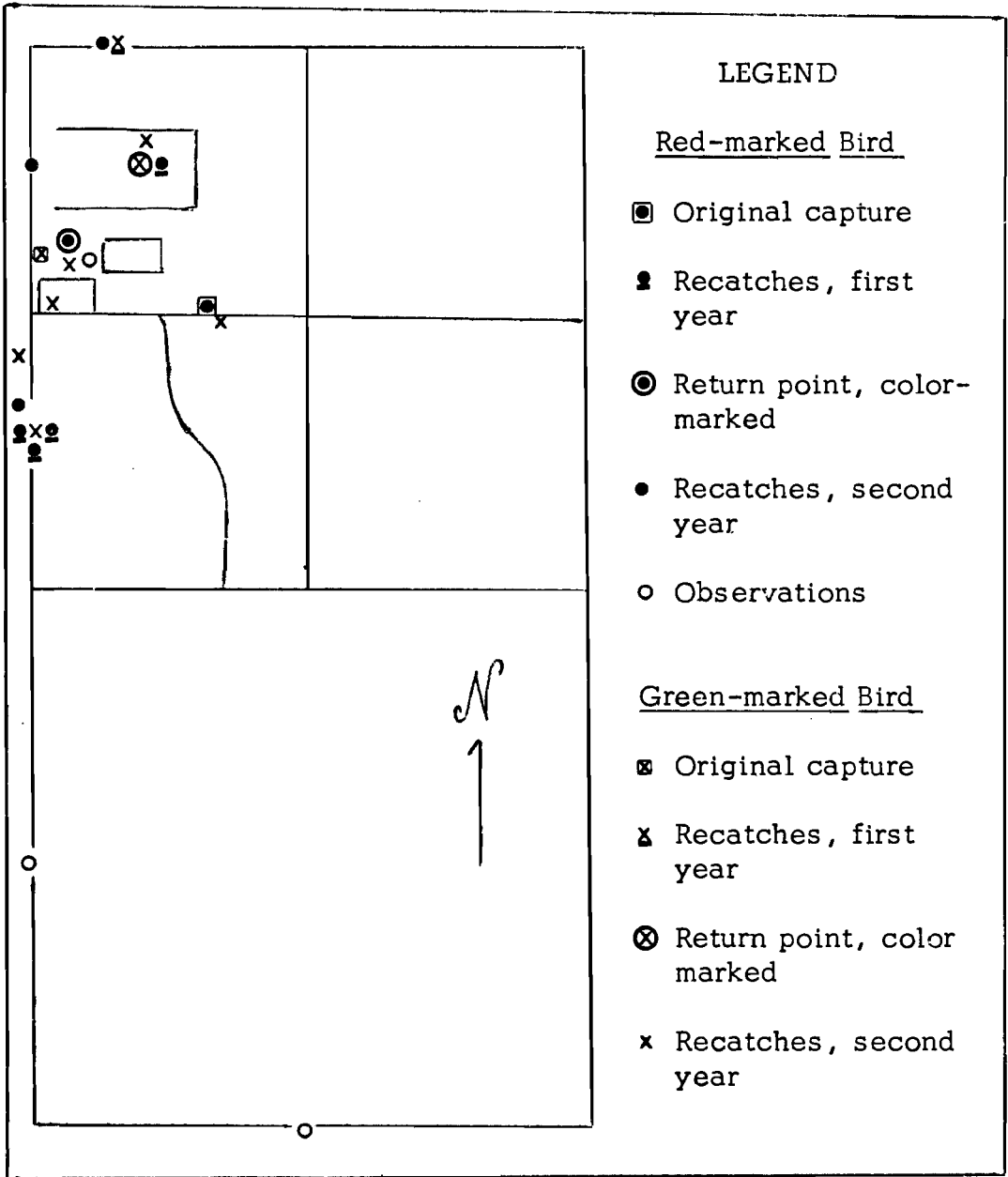


Figure 12. Observation and trapping points of two Slate-colored Juncos in the primary study area in 1967-68 and 1968-69.

the southwest corner of the primary study area; on 1 March in a hedgerow approximately 200 m north of the southwestern corner of the primary study area. On 14 March, the bird was caught in the hedgerow along the western edge of the primary study area.

The second bird was netted twice in the spring of 1968 but was not definitely known to be a member of the 1967-68 winter flock. It returned the following fall and was color-marked green on 17 November. During the following winter and spring it was netted or trapped six more times: on 27 November in the hedgerow along the western edge of the primary study area; on 28 November at the west of the headquarters building; on 8 December in the hedgerow east of the headquarters building; on 19 January 1969 in the wind-break; on 1 April southwest of the headquarters building; on 6 April near the western edge of the primary study area.

#### Winter Forage Range

The winter forage range at Ross Reservation was on the western edge of the primary study area along a 800 m hedgerow and had three extensions (Fig. 13). The first extension ran for 90 m along the northern edge of the northwest corner of the primary study area; the second encompassed the windbreak and lawn surrounding the headquarters building; the third included the stream and hedgerow eastward

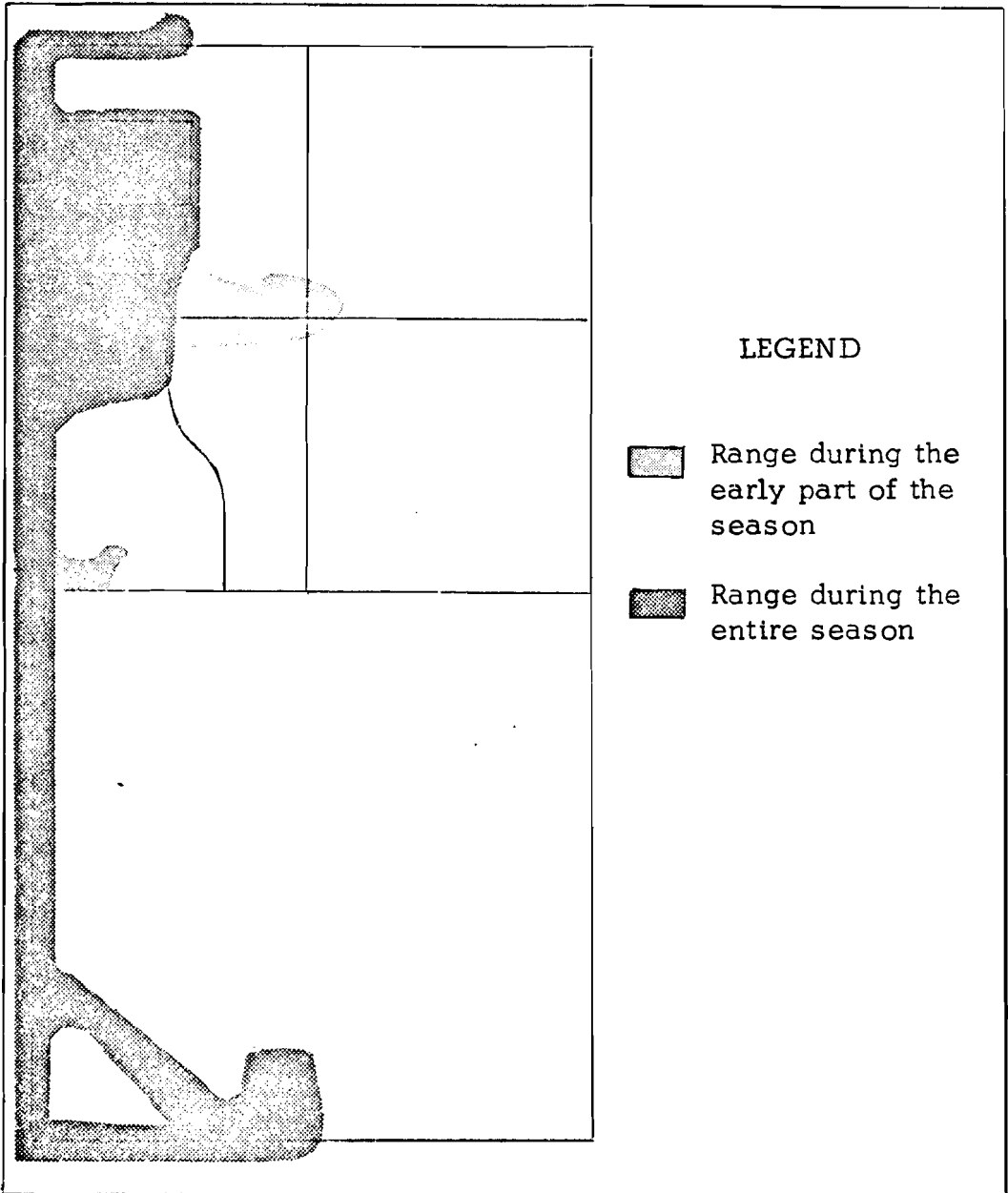


Figure 13. Winter range of the Slate-colored Junco in the primary study area during 1968-69.

for 200 m along the southern edge of the primary study area. In November and December, the second extension continued eastward along a hedgerow to the corner where vegetative Areas B, C and D intersected (see Fig. 5). It should be understood that forage ranges were within or near areas of cover.

An area of approximately 15 acres was used as the forage area by the 1968-69 wintering flock on Ross Reservation. It would appear that Slate-colored Juncos on Ross Reservation utilized nearly twice the forage range of that needed by a wintering flock of comparable size in New York. Sabine (1949) had three wintering flocks totaling 40 juncos in a nine-acre tract at Ithaca. The birds apparently do not range as far as some fringillids. Whittle and Fletcher (1924) stated that there was only one record of a Slate-colored Junco traveling from one banding station to another in Cohasset, Massachusetts, where the closest two stations were one mile apart. These authors found that American Goldfinches and Purple Finches (Carpodacus purpureus) commonly flew from one station to another.

### General Observations

#### Habitat

At Ross Reservation, Slate-colored Juncos were seen almost

invariably in hedgerows, edge situations and under large trees on the lawn of the headquarters area. Quay (1947) found the Slate-colored Junco abundant in old field situations in the Uplands of Raleigh, North Carolina, but did not state whether it was found along the field edges or in open areas. Fretwell (1969), upon reviewing Quay's 1940 unpublished thesis data, thought juncos were most abundant in open weedy fields in winter. However, Sabine (1956) stated that the characteristic habitat of juncos was "under or near trees, edge situations or open wooded areas." Ely (personal correspondence) likewise noted the usual habitat for juncos at Hays, Kansas, was edge situations.

Despite the fact that other seemingly suitable habitat was available, only one winter flock used the 15-acre portion of the 250-acre study area at Ross Reservation. Sabine (1956) suggested that some sort of spacing device functioned to distribute junco populations over suitable habitat. On the basis of this study it would appear that factors other than suitable habitat determine habitat selection by the wintering flock.

The reluctance of the species to move into open situations was noted several times. For example, when a mixed flock of Tree Sparrows and Slate-colored Juncos was approached one day, the sparrows flew approximately 400 m across an open weedy field to

cover, but the juncos remained behind in the hedgerow. The only time juncos were seen flying into an open area was when they fed on windy days inside the open topped lizard pens (see p. 14) north of the headquarters building. These pens, however, were located near trees into which the birds immediately flew at the slightest disturbance.

### Roost Areas

During 1967-68, large flocks of juncos inhabited the wind-break north of the headquarters building. These flocks, noted primarily at dusk and dawn, used this particular hedgerow as a principal roost. Red Cedars were preferred for roosting. Piles of droppings indicated repeated use of these trees. Small cedars west and southwest of the headquarters were also used by juncos for roosting.

Further observations were made on roosting sites during the 1968-69 season. Droppings were invariably found in proximity to the main tree trunks. The trunks evidently provided the maximum wind protection for the roosting birds. Most roost perches were located in a zone between 1 and 2 m above ground in trees 3 m in height. Individual roost sites were separated by at least .33 m.

### Interspecies Flock Movements

Slate-colored Juncos at Ross Reservation often formed mixed flocks with Tree Sparrows. Both were seen feeding and perching together on numerous occasions, but the two species exhibited different behavior when moving along a hedgerow. Juncos moved above the Tree Sparrows in a zone approximately 2.5 m to 4 m above ground, while the Tree Sparrows tended to stay in the lower parts (up to 2.5 m) of the hedgerows. Harris' Sparrows were often in the same hedgerows but did not mix with either Slate-colored Juncos or Tree Sparrows. They moved along the tops of the trees above the other two species.

## SUMMARY

Winter activities of Slate-colored Juncos were studied on the F. B. and Rena G. Ross Natural History Reservation, Lyon County, Kansas, from October 1967 through May 1969. The birds were banded and color-marked to facilitate observations. Two subspecies, Junco hyemalis hyemalis and J. h. cismontanus, were found in the study area.

Juncos first arrived at Ross Reservation in force about 20 October. Fall migratory waves of juncos occurred in November and December. Little, if any, migration of the birds took place during the winter period from 1 January through 7 February. Spring migratory movements began in the second week of February and continued until early April. No correlation was found between cold fronts and migratory movements.

Thirteen individuals observed were migrant returns in that they returned to Ross Reservation in fall and spring but did not remain there during winter. Of 150 juncos banded on Ross Reservation, 12.67 percent returned during the second season of the study.

The winter flock of 1968-69 began to form early in November around a nucleus of individuals that had been part of the 1967-68 winter flock. A deer feed station had been established during the



winter of the first season in an area not regularly frequented by juncos prior to its establishment. The following year the birds returned to that station as early as 2 November and frequented it regularly for the rest of the season.

The winter forage range of a flock of 10 Slate-colored Juncos encompassed an area of approximately 15 acres at Ross Reservation.

The preferred habitat of the Slate-colored Junco was edge situations along hedgerows, hedgerows and a lawn with scattered large trees. Hedgerows offered the most cover in early fall and the extensive cover was conducive to the junco's establishing forage trails along hedgerows rather than in plum thickets. Juncos were reluctant to leave the hedgerow cover and rarely flew across open areas. Certain hedgerows were not occupied by the juncos during either of the two winters, indicating that the winter range was an established area.

Red Cedars were favorite roost trees. Birds moved into them at dusk and left them at dawn. Roost perches were near the main trunk of the tree, at least .33 m apart, and in a zone between 1 to 2 m above ground.

Stratification was noted among Slate-colored Juncos, Tree Sparrows and Harris' Sparrows when they moved together along

hedgerows. Harris' Sparrows moved along the upper zone, Slate-colored Juncos along the middle zone up to 4 m above ground and Tree Sparrows generally along a lower zone up to 2.5 m above ground.

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