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# DIFFERENTIAL SPRING MIGRATION OF DARK-EYED JUNCOS

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Abstract.—A migrant population of 1246 Dark-eyed Juncos (*Junco hyemalis*), captured at a non-breeding location in eastern New York state between 21 Mar. and 15 May over 23 yr, showed significant earlier arrival of males than females. Migrants were 97.6% male in Mar. and 18.8% male in May and averaged 53.4% male. Passage of males peaked 11-15 Apr. and that of females 16-20 Apr. Older birds may precede young of the previous year in both sexes, but at a much lesser temporal gradient and at a relatively much lower level of significance. The male and female samples averaged 75.4% and 75.5% second-year birds, respectively.

**MIGRACIÓN DIFERENCIAL DE *JUNCO HYEMALIS* DURANTE LA PRIMAVERA**

Resumen.—Una población migratoria de 1246 individuos de *Junco hyemalis,* capturados en una localidad fuera de su ámbito de reproducción, exhibió una migración diferencial significativa en donde los machos preceden a las hembras. El estudio se llevó a cabo en la región oriental del estado de Nueva York, por un periodo de 23 años entre el 21 de marzo y el 15 de mayo. La muestra estuvo compuesta de 97.6% machos en marzo, 18.8% en mayo con un promedio de 53.4% machos. El movimiento de los machos a través de la localidad alcanzó su pico durante el 11-15 de abril mientras que el de las hembras entre el 16-20. Parece que los adultos preceden a los juveniles de ambos sexos aunque en un gradiente temporal mucho menor y a un nivel significativamente menor. Un 74.4% y 75.5% de las muestras estuvo compuesta de machos y hembras del segundo año, respectivamente.

Differential migration of passerines has been studied extensively (Gauthreaux 1982, Ketterson and Nolan 1983). Various combinations of temporal, latitudinal, and altitudinal movements of age and sex classes during autumn and spring migration have been examined. Studies in spring have demonstrated earlier migratory movement of male *Hylocichlid* thrushes (Annan 1962) and White-crowned Sparrows (*Zonotrichia leucophrys gambelii*) than females (King, Farner, and Mewaldt 1965); and differential arrival and passage by age and sex of Red-winged Blackbirds (*Agelaius phoeniceus*) at a breeding area (Allen 1914 in Pettingill 1971). *Icterids* and the European Starling (*Sturnus vulgaris*) exhibit latitudinal differences between species and age and sex classes in migration between wintering and breeding areas (Dolbeer 1982).

Among spring migrant *Empidonax* flycatchers, male *E. minimus* and *E. flaviventris* were found to precede females in Ontario (Hussell 1981, 1982). In Kansas, males migrated earlier than females, and the distribution of the total spring bandings was bimodal (Ely 1970). In the western United States, the spring migration of *E. hammondii* and *E. d. dificilis* was geographically and temporally differentiated with adults of both species favoring earlier timing and a coastal route, whereas immatures were later and used an inland route. However, male and female *dificilis* migrated synchronously, whereas *hammondii* males preceded females (Johnson 1965, 1973).

The Dark-eyed Junco (*Junco hyemalis*) has been studied by age and sex classes to establish latitudinal winter distribution; and subspecific as well as sexually differentiated altitudinal winter distribution. Among birds wintering in eastern and central North America, males predominated in the north and females in the south (Ketterson and Nolan 1976, 1979). In North Carolina, wintering Carolina Juncos (*J. h. carolinensis*) occurred at higher elevations than migrant Northern Juncos (*J. h. hyemalis*); and at higher elevations *carolinensis* males outnumbered females (Rabenold and Rabenold 1985). This altitudinal distribution of *hyemalis* was likened to the latitudinal distribution described by Ketterson and Nolan (1976, 1979). Based on 23 yr of banding data, I have assessed the differential spring migration of the sex and age classes of Dark-eyed Juncos at Schenectady, New York at a location where the species appears as a wintering bird and non-breeding migrant.

## METHODS

Dark-eyed Juncos were captured by mist netting (mostly) and trapping at my backyard feeding station at Schenectady, New York. Sex was determined at the time of banding using a combination of body plumage color, wing covert color, and wing chord length (Balph 1975; Blake 1962, 1964, 1967; Dow 1966; Grant and Quay 1970; Ketterson and Nolan 1976; Wood 1969). There were sufficient capture data for the years 1964–1986 to allow compilation by five-day intervals (referred to as Time Intervals or TI) with only one interval sample of less than 20. The percentage of males for each sample was plotted against time and this relationship was subjected to regression analysis. Also analyzed were the results for 1981 and 1986, years for which there were sufficiently large annual samples.

Although juncos spent the winters in small and varying numbers at my feeding station, I used 21 Mar. as the beginning of the migration based on the appearance of "new," unbanded birds at about that time. I counted only birds newly banded as of that date, in order to differentiate migrants from wintering individuals; and to assure that no recapture data of previously winter-banded birds were used in the analysis. For comments on commencement of spring migration, see Bartlett (1937) and Ketterson and Nolan (1983, 1976 and references therein).

During the years 1979–1986, the age of juncos was determined using the contrast or lack thereof on the edgings of the tertials, greater coverts and flight feathers (Yunick 1981). Birds were classed as second-year (SY) or after-second-year (ASY). Birds of doubtful age were classed as after-hatching-year (AHY), and were excluded from the analysis. These data were subjected to regression analysis by time interval. For all regression analyses, the five-day intervals were assigned numerical values, beginning with 1 for the 21–25 Mar. interval through 10 for the 6–10 May interval.

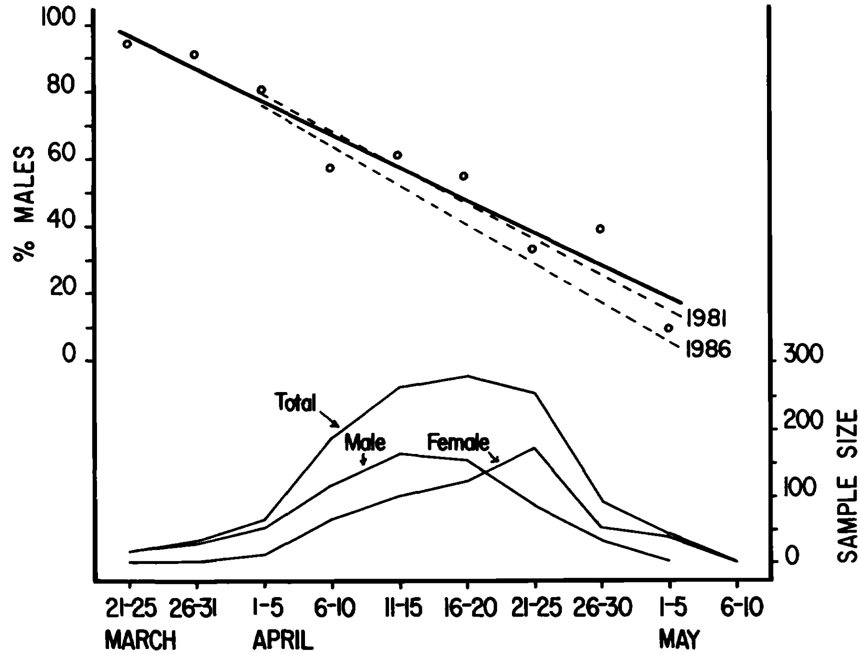


FIGURE 1. Percentage distribution of male Dark-eyed Juncos during spring migration, 1964–1986. The open circles and solid regression line refer to the left ordinate, %M = 107.40 − 9.840(TI). The dashed regression lines are the same analysis showing individual results for 1981 and 1986, for which %M = 109.53 − 10.236(TI) and 111.31 − 11.746(TI), respectively. The lower connected lines represent the size of samples on the right ordinate, and refer to the number of captured birds of all ages identified as male and female.

## RESULTS

The data for male distribution for 1964–1986 are given in Figure 1. This sample of 1246 juncos of all ages was 53.4% male and 46.6% female. The regression line for the distribution of males through the spring migration was: %Male = 107.40 − 9.840(TI), ($r$ = 0.9651, $F$ = 95.082, $P$ = 0.00003). This relationship is highly significant. The observed male percentage at the beginning of migration was 44.2 percentage points above the migrational average, and 34.6 percentage points below it near completion of migration when the last male was captured.

Migration peaked during 11–25 Apr., and the male distribution regression line crossed 53.4% during this peak period, about 15 Apr. Migration continued beyond the 1–5 May interval to 11–15 May, during which time migrants were entirely female, but due to the small sample size ($n$ = 4), the birds captured in these last two intervals are not included in the analysis. The regression line predicts 0% males by 11–15 May, which is within the period of last-observed migration when only females were

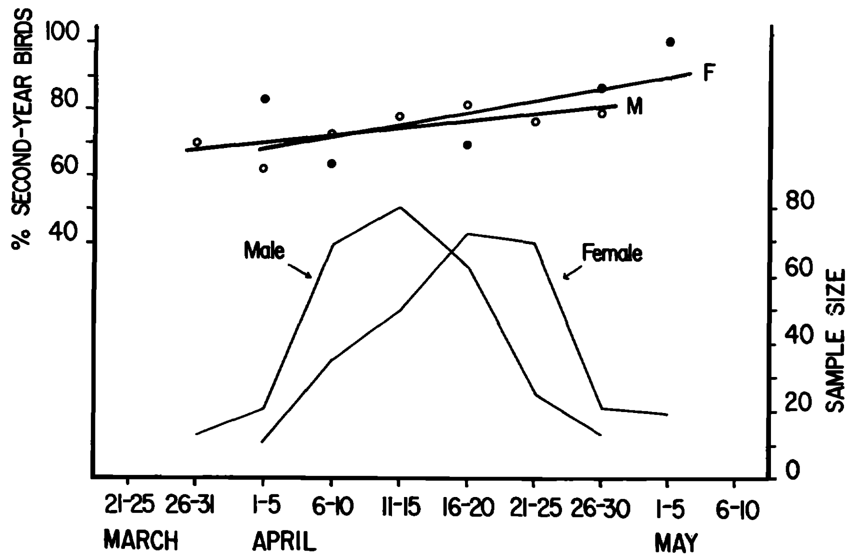


FIGURE 2. Percentage distribution of second-year male (M) and second-year female (F) Dark-eyed Juncos during spring migration, 1979–1986. Solid circles = F and open circles = M; and on the two dates when only one open circle appears, it represents a common data point for both sexes, both referring to the left ordinate: %SY M = 62.89 + 2.136(TI), and %SY F = 57.97 + 3.500(TI). The lower connected lines represent sample sizes of males and females of all ages from which data on the SY age class were extracted, and refer to the right ordinate.

caught. Extreme last banding dates were 12 May in 1964 and 1984, and last recapture dates were 10 May 1970, 11 May 1966, and 13 May 1986.

Figure 2 represents the age distribution of males and females for the years 1979–1986. The sample of males of all ages was 75.4% SY and the 278 females were 75.5% SY (M = 50.5%, F = 49.5%). The percentage of SY birds among captured males rose from 67.2% at 26–31 Mar. to 80.0% SY males at 26–30 Apr., whereas females rose from 68.5% at 1–5 Apr. to 89.5% at 1–5 May. The regression analyses on distribution of SY birds during migration gave: %SY M = 62.89 + 2.136(TI), ($r$ = 0.7234, $F$ = 5.4880, $P$ = 0.0662), and %SY F = 57.97 + 3.500(TI), ($r$ = 0.6315, $F$ = 3.3171, $P$ = 0.1282). The distribution of SY males bordered on being significant, whereas that for females was not.

The sample size distribution in Figure 1, covering 1964–1986, showed the peak number of males banded during 11–15 Apr. or about 10 d before the peak number of females during 21–25 Apr. The 50th percentile male among the 665 males was banded during the same 11–15 Apr. interval, but the 50th percentile female out of 581 females was banded about 5 d later during 16–20 Apr. A similar analysis of the 1979–1986 data in Figure 2 shows both the peak number of males and the 50th percentile male occurring during 11–15 Apr.; and both female events occurring during 16–20 Apr., or about 5 d later. The 50th percentile SY and ASY males occurred simultaneously in the 11–15 Apr. male peak interval, and similarly the 50th percentile SY and ASY females occurred during the 16–20 Apr. female peak.

During 1981 and 1986, sufficient captures were made ($n$ = 248 and 165, respectively) between late March and early May to allow separate regression analyses of the kind done for 1964–1986. In 1981, the sample was 54.8% male and %M = 109.53 − 10.236(TI), ($r$ = 0.9054, $F$ = 22.750, $P$ = 0.005). In 1986, the sample was 49.1% male and %M = 111.31 − 11.746(TI), ($r$ = 0.9495, $F$ = 45.787, $P$ = 0.0011). The regression lines (dashed lines with no data points given) for these two years appear in Figure 1 for comparison purposes.

The sex ratio of wintering juncos of all ages banded during December through February was determined also for comparison purposes. From a sample of 111 bandings, 90 birds (81.1%) were sexually identified, and of these 63.3% were male.

## DISCUSSION

The Dark-eyed Junco is a common migrant in New York state (Bull 1974, Eaton 1912). In eastern New York, Bartlett (1937) identified the migratory period as mid-March to early May with extreme dates of 11 Mar. and 19 May, whereas, in western New York Beardslee and Mitchell (1965) identified 29 Mar.–4 May as the migration season. My observations and banding data are consistent with these findings.

The results in Figure 1 show males arriving significantly earlier than females. Were there no differential migration, sex ratios during 21 Mar.–15 May would be grouped about a flat line representing the overall average of 53.4% male and 46.6% female. However, the regression value for 21–25 Mar. was 97.6% male, differing quite substantially from the overall migration average. This value differs substantially also from the sex ratio for the winter period immediately preceding migration. Based on the results of Ketterson and Nolan (1976), the Schenectady area at 42°48′N latitude should have a predicted winter population of 20–30% females, and 70–80% males. Slightly south and west at Pt. Pelee, Ontario at 41°43′N latitude, Dow (1966) found 76% males in the winter population. Much further west Balph (1975) found 80.8% males at Logan, Utah at 41°33′N latitude. My own observations showed 63.3% males at my station in winter. During the transition from winter population to migrant population, males increased substantially.

The annual variation of results for 1981 and 1986 from the 1964–1986 summary depicted in Figure 1 is small. Near the beginning of migration at 1–5 Apr., the 1981 and 1986 populations were 78.8% and 76.1% male, respectively, compared to 77.9% male for all years. As migration progressed, the rate of decline in males was slightly greater in 1981 (10.2 percentage points per interval), and greatest in 1986 (11.7 percentage points per interval) when compared to that of all years (9.8

percentage points per interval). Despite the slightly greater rate of decline in 1981, the predicted date when male % = 0 is still 11–15 May as predicted by data for all years. The 1986 rate was sufficient to move up that event to 5–10 May. This kind of annual variation may be related to the variable rate of advance of the season which can tend to hasten or retard migrational events in some years.

The finding of differential sexual migration is consistent with reported observations in Eaton (1912) and Ketterson and Nolan (1983) that imply a preponderance of females at the end of migration. In New York, Eaton defined the migrational peak as 22 Apr.–5 May, but then commented, "I have seen a few dull-colored (=female) migrants as late as the 12th and 23rd of May . . . ." In Indiana, Ketterson and Nolan found that winter residents seldom stayed beyond 5 Apr., and observed, "Migrant flocks made up of mostly females are numerous until mid-April."

This study is the first quantitative assessment of differential migration by male and female juncos in spring, and represents one of relatively few such spring studies in North America. These results are similar (males preceding females) to the findings of Allen (1914 in Pettingill 1971) on Red-winged Blackbirds; Johnston's (1970) results on Indigo Buntings (*Passerina cyanea*) at much more southerly locations in Jamaica and the Dry Tortugas; and Nice's (1937) Song Sparrow (*Melospiza melodia*) study where male arrival on the breeding ground in Ohio generally preceded that of the female. It parallels also King, Farner, and Mewaldt's (1965) results with White-crowned Sparrows in Washington where spring migration began with flocks consisting of about 95% males, and ended with about 50% males. My junco samples were 97.6% male at the start and 18.8% male near the end of migration when the last males were captured.

Less clearly defined in this study is the distribution of age classes during spring migration. The statistical significance of data in Figure 2 is marginal, and the results portray only a very slight gradient in the change of age distribution through the migration. Among SY birds, the female gradient was slightly greater than the male gradient, favoring a greater distribution of SY females toward the end of migration.

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