WINTERING POPULATIONS OF JUNCOS AT THE UWM FIELD STATION

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ABSTRACT

Since 1966 the winter populations of Dark-eyed Juncos, Junco hyemalis at the UWM Field Station have been monitored by mark-recapture methods. Schnabel estimates with 95% confidence intervals are presented for each winter. The population has varied irregularly between 60 and 196. Comparisons of these estimates with Wisconsin Christmas Bird Counts of juncos reveals a positive correlation with the average number of juncos per Wisconsin Christmas Bird Count, indicating that the year-to-year fluctuations at the Field Station correspond to the general state-wide fluctuations. However, the Christmas counts show a rising trend over the past 19 years while the Field Station population does not.

INTRODUCTION

The Dark-eyed Junco, Junco hyemalis, (formerly called Slate-colored Junco) is a common winter resident bird in southern Wisconsin. The breeding range of the midwestern population lies in the Coniferous Forest Biome of Canada and the northern United States, and the wintering range extends from central Wisconsin south to the Gulf Coast. It is a member of the emberizine finch or bunting group, related to the Field Sparrow, Song Sparrow and other native American sparrows, although its solid slaty-black plumage is un-sparrowlike. In winter it is primarily a seed-eater, easily attracted to feeding stations or seed-baited traps.

When the UWM Field Station was acquired in 1965 I began to monitor the local wintering population of juncos, using trapping and banding techniques. The first two years the trapping operations were sporadic, but beginning in 1966-67, an intense 4-year study of daily and annual physiological rhythms (fat deposits, body weight, molting) was begun which involved trapping juncos weekly or twice-weekly during the entire winter period, defined here as November 15 - March 15 (Weise 1970). After 1971, the trapping effort was reduced to once every 3 or 4 weeks with a goal of 5-8 equal-effort trapping episodes each winter. In this paper I describe the population fluctuations and trends at the Field Station between 1966 and 1984.

METHODS

At each trapping episode a variety of baited wire traps are set (a constant number within each year) from shortly after dawn until dusk. Prior to 1971 the traps were scattered in 6 locations; since 1971 they have been concentrated in two areas, each used by a different group of birds. On each trapping date, previously untrapped birds are banded with individually-numbered U.S. Fish and Wildlife Service bands and re-trapped birds are examined and their band numbers recorded. At the beginning of winter most birds are new, but there are some that were banded in previous winters and have returned to the area. With each successive trapping episode the absolute number, as well as the proportion, of new birds declines so that by late winter most of the birds that are trapped are already banded. Not all birds in the wintering populations are trapped on any one day, nor are all birds in the population caught and banded during the course of the winter; there are always some birds (the number unknown) still remaining unbanded at the end of the winter. Thus, it is not possible simply to regard the total number banded as the population size. It is necessary to estimate the population size by one of the mark-recapture techniques that have been devised for use in ecology and wildlife management.

For the kind of data described above the most appropriate versions of mark-recapture are the Schnabel method, the modified removal method, or the Jolly-Seber method. The last would provide not only population estimates but also mortality rates and immigration rates for the intervals between trapping dates; unfortunately this method is very sensitive to differences in trapping effort or efficiency. Although our trapping efforts are reasonably uniform on each date (i.e. the same number of traps and number of hours of trapping), the trapping efficiency is drastically influenced by weather and by the seasonal cycle of the junco. The best time to trap juncos is on a day with some snow on the ground, light or moderate snow falling, and the temperature dropping from the previous day. The worst time is on a sunny, warm day in late winter, with no snow cover. Not only is the weather not conducive to feeding, but the birds' appetites are very low at that season (they are losing fat and weight) and they simply aren't hungry enough to go easily into a baited trap. For this reason, I have been unable to apply the Jolly-Seber method to these junco trapping data.

The modified removal method, in which a bird once trapped and banded is considered as if it had been removed from the population, also assumes equal effort but seems to be less sensitive than the Jolly-Seber to departures in efficiency. The Schnabel method is most robust with respect to these factors and is the method I rely on, although the removal method gives comparable results in most years (see below). In the Schnabel method, the data for each trapping episode include the total catch, the number of new (previously unbanded) birds, the number of recaptures (previously trapped or banded earlier in the winter), and the cumulative number of previously banded birds that are available for recapture on that date. As in any mark-recapture method, the basic idea is that if you know the number of marked animals in the population that are available to be recaptured (M) and then take a sample (a trapping episode), the proportion of marked animals (m) of the total (n) in the sample will be equal to the proportion of M in the total population (N). The relationship is

$$\frac{M}{N} = \frac{m}{n} \quad \text{which can be rearranged to} \quad N = \frac{Mn}{m}$$

By accumulating data over a number of trapping episodes the Schnabel method provides a more reliable estimate than would a single marking and a single recapture effort.

The statistical precision or reliability of the Schnabel estimate can be assessed and expressed as a confidence interval above and below the estimate. In this study I chose the 95% confidence interval as appropriate; this is conventional in biological field work. The biological inference from such a confidence interval is that the chances are high (20:1) that the interval includes the "true" population size.

RESULTS AND DISCUSSION

Figure 1 shows the year-to-year fluctuations that have occurred in the wintering junco population at the Field Station since 1966, as determined by the Schnabel method. The modified removal method estimates are also shown: it can be seen that in most years the two estimates agree closely. Tanner (1978) states that although these two estimates can be derived from the same data they are "somewhat" independent estimates.

The confidence intervals for the Schnabel estimates in most years are acceptably narrow and many of the year-to-year differences are statistically significant. In the late 1960's and early 1970's the population was around 100 birds. In the mid-1970's it rose to nearly 200 birds for a few years then fell back to very low levels in 1979 and 1980, after which an increase again occurred. The difference between the lowest and highest populations was about 3-fold (60-196).

Do these trends at the Field Station reflect real changes in the general population of juncos or are they strictly local or random phenomena? To answer this question I compared the Field Station data with those obtained in Christmas Bird Counts (CBC's) in the State of Wisconsin. The CBC's are reported each year in The Passenger Pigeon, the journal of the Wisconsin Society for Ornithology. I looked at the three CBC's closest to the Field Station, but within the Lake Michigan shore zone: Newburg (or Cedarburg or Saukville in some of the earlier years), Milwaukee and Hales Corners. I also looked at the total junco count for the entire state. For the single locality counts I used both the raw count of juncos and the raw count divided by the number of party-hours. For the overall

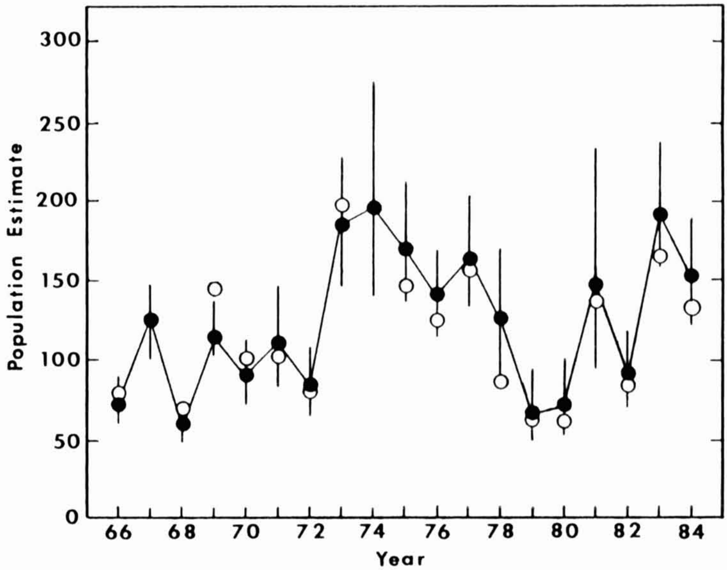

Figure 1. Population estimates for wintering Dark-eyed Junco populations at UWM Field Station. ● = Schnabel estimate. ○ = modified removal method estimate. Vertical lines show the 95% confidence intervals for the Schnabel estimates, confidence intervals for the modified removal method estimate are not given.

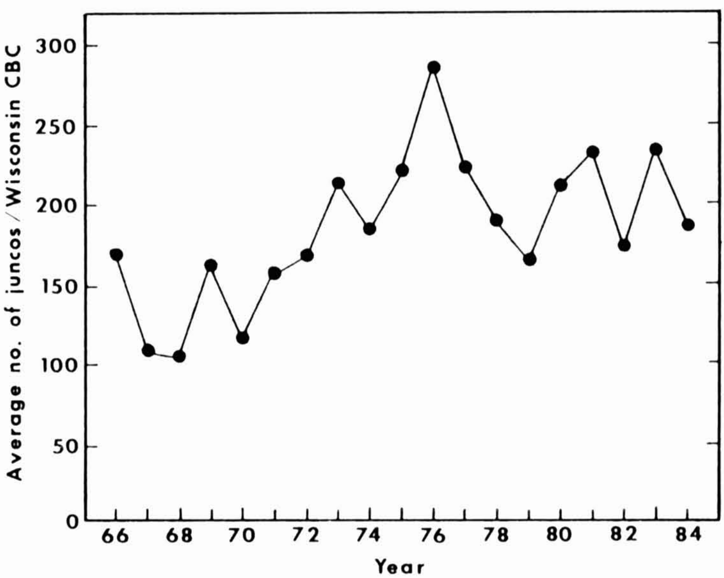

Figure 2. Average number of Dark-eyed Juncos recorded per Wisconsin Christmas Bird Count (number of counts in the state varies from year-to-year from 60-85).

Wisconsin counts I used the raw totals and the totals divided by the number of CBC's, i.e. the average number of juncos per Wisconsin CBC.

Christmas counts are notoriously unreliable censuses (Arbib 1981). Each count is supposesdly made in a 15-mile diameter circle, but the proportion of the area within the circle actually covered varies tremendously, as does the efficiency of the census. Among the variables are the number of census parties, the capabilities of the observers, and the assiduity with which each species is censused, the emphasis usually being on recording species present rather than on counting individuals. Juncos, being common and familiar birds are likely to be less conscientiously counted than rarer species. On top of this, each count is made on one day and weather variables play a crucial role. Counts made in poor observing weather are likely to be very low for most species.

Despite all these faults one might hope that when a larger number of CBC's are collectively considered, many of the variables will cancel out and the result will be a credible, representative index to the actual population. The total Wisconsin figures, based on 60-85 counts each year, should fit this description (Figure 2).

Trends in the curves for the Field Station Schnabel estimates and the Wisconsin CBC averages are fairly similar in most years although there are a few glaring exceptions, (e.g. 1967, 1974, 1980). One major difference is that the CBC averages show an overall upward trend. Testing this with a linear regression technique gives a statistically significant slope of +4.85. In other words, each year the count is higher by almost 5 birds, or the count doubles every 20 years. The Field Station data when tested similarly has a slope of +2.60, but it is not statistically different from a slope of 0, i.e. there is no consistent long-term trend.

To account for the upward trend in the CBC's I hypothesized that the counts have become more efficient over the years, perhaps due to more participants and better coverage of the count circles. To test this, I ran regression tests (year versus average/CB) on 5 other common Wisconsin birds of about the same size and feeding habits (in winter). The Black-capped Chickadee, <u>Parus atricapillus</u>, and the American Goldfinch, <u>Carduelis tristis</u>, showed significant increases of 6.72 and 3.33 birds per year, respectively. The Northern Cardinal, <u>Cardinalis cardinalis</u>, had a slope of +0.41, the American Tree Sparrow, <u>Spizella arborea</u>, a slope of -0.32, and the House Sparrow, <u>Passer domesticus</u>, a slope of -7.59, none of these slopes are statistically significant. These results lead to rejection of the hypothesis and the conclusion that the increase in juncos in Wisconsin is real. Another hypothesis would then be that the increase in juncos is related to the increasing numbers of winter feeders for birds in the state. I have no evidence to support this, but if it were so, then the lack of a long-term increase in the Field Station population could be explained by the constant supply of food over the 19 year study period.

To examine further the relationships between the various censuses I mentioned above, I ran correlation tests among them (Table 1). The results show that the CBC totals (for juncos) for each area give higher correlations than the CBC totals/party-hour, indicating that the party-hour is not a good way of measuring the level of counting effort or efficiency. Considering the CBC junco totals, Newburg and Hales Corners were significantly correlated with each other and with the average number of juncos/Wisconsin CBC (state average); the Milwaukee counts were not significantly correlated with the other two counts or with the state average. The highest correlation (+0.67) was between the Newburg counts and the state average, while the next highest (+0.57) was between the Field Station Schnabel estimates and the state average. Both figures were highly significant (P <.01).

Table 1. Pearson product-moment correlation coefficients (r) among selected Christmas Bird Counts and UWM Field Station Schnabel Estimates of Dark-eyed Junco populations.

	Number of Years (n)	r
Field Station Schnabel vs. Newburg CBC total	17	+0.44
Field Station Schnabel vs. Newburg CBC total/pty/hrs.	16	+0.10
Field Station Schnabel vs. Milw. CBC total	19	+0.30
Field Station Schnabel vs. Milw. CBC total/pty/hrs.	19	+0,38
Field Station Schnabel vs. Hales Corners CBC total	18	+0.42
Field Station Schnabel vs. Hales Corners CBC total/pty/hrs.	18	+0.02
Field Station Schnabel vs. Wisconsin CBC's total	19	+0.47*
Field Station Schnabel vs. average number of juncos/Wisconsin CBC	19	+0.57**
Newburg CBC vs. Milwaukee CBC, totals	17	+0.41
Newburg CBC vs. Hales Corners, totals	16	+0.56
Milwaukee CBC vs. Hales Corners CBC, totals	18	+0.19
Milwaukee totals vs. Av. No. of juncos/Wis. CBC	19	+0.26
Newburg CBC total vs. Av. No. of juncos/Wis. CBC	17	+0.67**
Hales Corners CBC total vs. Av. No. of juncos/Wis.CBC	18	+0.56*

* P<.05

** P<.01

On the basis of these analyses I conclude that while the Field Station estimates do not show the long-term upward trend apparent in the state, they do reflect the year-to-year ups and downs of the general population of juncos. The ecologically more interesting problem will be to determine the reasons for these ups and downs. One approach might be to look for correlations between weather patterns and the population fluctuations. For example, the declines in 1978-80 might be have related to three very cold winters in succession. Of course, winter populations are also influenced by events on the breeding grounds. Some clues to such events might be variations in the ratio of adults to juveniles in the winter populations, or in the percent of returning adults. Further analysis of these is underway.

ACKNOWLEDGMENTS

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LITERATURE CITED

Arbib, Robert S. 1981. The Christmas bird count: constructing an "ideal model". Studies in Avian Biology 6: 30-33.

Tanner, J. T. 1978. Guide to the Study of Animal Populations. Univ. Tenn. Press.

Weise, C. M. 1970. The fat and weight cycle in Wisconsin juncos. UWM Field Stations Bulletin 3(1): 11-17.