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SURVIVAL RATES OF RETURNED WHITE-WINGED JUNCOS

BY L. M. BAYLOR AND NATHANIEL R. WHITNEY, JR.

The White-winged Junco (*Junco hyemalis aikeni*) is a common permanent resident of the Black Hills region of South Dakota. Since the White-winged Junco readily utilizes artificial feeding facilities, we have been conducting special banding projects with this subspecies. Whitney gathers data about weights and measurements, and Baylor collects information on plumage characteristics. From these projects, we also have acquired records for juncos recaptured one or more calendar years after banding, and this report presents the survival rates for these returned White-winged Juncos.

In analyzing the data, we have followed Chandler S. Robbins' guidelines in an unpublished manuscript (1969), "Suggestions on Gathering and Summarizing Return Data." His eight steps for summarizing data on recaptured birds lead to determination of (1) survival rates by comparing one year to the next, (2) a weighted-mean survival rate for all returned individuals, (3) an adjusted overall survival rate to compensate for terminating the project while recently banded birds remain alive for potential recapture if the project were continued, and (4) a comparison between predicted and observed survival age.

RESULTS AND DISCUSSION

From February 1956 through December 1973, Whitney banded 1,602 White-winged Juncos at his residence (Station A) in Rapid City, South Dakota, and from February 1964 through December 1973, Baylor banded 644 White-winged Juncos at his residence (Station B) in Rapid City. These banding stations are about 1.7 km apart at the edge of the mountainous foothills at about 1,067 m above sea level. At Station A, 42 banded individuals were recaptured one or more calendar years after banding, and at Station B, 24 individuals were similarly recaptured.

Table 1 presents the raw survival rates by comparing the returned birds for one year with the returned birds in the subsequent year. In addition, the table indicates the weighted-mean survival rates for all years. Thus, the raw weighted-mean survival rates are 56% at Station A, 69% at Station B, and 60% for both stations. But since some juncos in this sample remained alive for potential recapture after the last banding year, the rates in Table 1 tend to have a limitation for which Robbins suggests an adjustment by subtracting from each total the number of returns in the last year being compared. Table 2 presents these results with remark-

ably high adjusted survival rates for the White-winged Junco: 63% at Station A, 93% at Station B, and 73% for the combined stations.

TABLE 1

Raw survival rates for returned White-winged Juncos

	Station A	Station B	Combined stations
Yr 1 to Yr 2	13 ÷ 21 = 62%	8 ÷ 12 = 67%	21 ÷ 33 = 64%
Yr 2 to Yr 3	9 ÷ 13 = 69%	8 ÷ 8 = 100%	17 ÷ 21 = 81%
Yr 3 to Yr 4	2 ÷ 9 = 22%	6 ÷ 8 = 75%	8 ÷ 17 = 47%
Yr 4 to Yr 5		2 ÷ 6 = 33%	2 ÷ 8 = 25%
Yr 5 to Yr 6		0 ÷ 2 = 0%	0 ÷ 2 = 0%
Yr 6 to Yr 7		1 ÷ 0 = NA	1 ÷ 0 = NA
Weighted mean	24 ÷ 43 = 56%	25 ÷ 36 = 69%	49 ÷ 81 = 60%

With such high adjusted survival rates, one bird out of 100 at Station A would have a predicted survival age of 9 years after banding, but only two birds were observed to live into the fourth year after banding. At Station B, one bird out of 100 would have a predicted survival age approaching 50 years, but only one bird lived into the seventh calendar year after banding. For the combined stations the predicted survival age is 14 years, but, again, the observed age is only 7 years. At Station A, the percentage of individuals that returned one or more years after banding is 2.62%, at Station B 3.72%, and for the combined stations 2.93%.

TABLE 2

Adjusted survival rates for returned White-winged Juncos

	Station A	Station B	Combined stations
Yr 1 to Yr 2	13 ÷ 21 = 62%	8 ÷ 9 = 89%	21 ÷ 30 = 70%
Yr 2 to Yr 3	9 ÷ 9 = 100%	8 ÷ 7 = 114%	17 ÷ 16 = 106%
Yr 3 to Yr 4	2 ÷ 8 = 25%	6 ÷ 7 = 86%	8 ÷ 15 = 53%
Yr 4 to Yr 5		2 ÷ 3 = 67%	2 ÷ 5 = 40%
Yr 5 to Yr 6		0 ÷ 1 = 0%	0 ÷ 1 = 0%
Yr 6 to Yr 7		1 ÷ 0 = NA	1 ÷ 0 = NA
Weighted mean	24 ÷ 38 = 63%	25 ÷ 27 = 93%	49 ÷ 67 = 73%

In summarizing our data, we have followed Farner's suggestion (1949, 1955) that the calendar year from 1 January through 31 December is more desirable in analyzing returns and calculating survival rates for passerine species. This annual unit assures that banded birds have lived at least one-half year before banding and thus somewhat minimizes the known effect of high mortality rate

among birds in their first year of life. This guideline seems particularly appropriate for our banding operation. The juncos tend to appear in late October or early November and remain into March, with a few remaining into April. We think it is advisable to regard as repeats all juncos recaptured during a winter banding season. To include, for example, juncos banded in December and recaptured in January would seem to influence the results disproportionately. The calendar-year orientation, however, yields a relatively small sample of returned birds and thus a lower percentage of returned individuals.

A limitation of our data is that we do not age and sex the birds at the time of banding. The juncos, even the birds of the previous hatching season, are already in the adult winter plumage when they appear at our banding stations in autumn or early winter. These birds cannot be identified for age or sex by their plumage characteristics, and we do not age them by skull ossification. Further, because our primary reasons for banding White-winged Juncos involve considerable handling to gather information on weights, wing measurements, and plumage conditions, we believe the birds should not be exposed to the additional stress of the skull-ossification examination. The records, then, indicate only the survival rates of the returned juncos without regard to age or sex at the time of banding.

The substantial disparity between predicted age and observed survival age seems initially troublesome. Hann (1948) offers a compensating explanation in that wild birds "do not ordinarily live out their potential life span, but are subject to a fairly constant percentage of loss each year." Robbins reported (Ms, 1969) extremes between predicted and observed ages from 13 to 8 years in the Acadian Flycatcher (*Empidonax virescens*), 14 to 8 in the Ovenbird (*Seiurus aurocapillus*), and 13 to 6 in the Cardinal (*Cardinalis cardinalis*). Our records for Station A (9 to 4) and the combined stations (14 to 7) thus may not be significantly out of line. The ratio of about 50 years predicted to 7 years observed at Station B is an anomaly resulting from the small sample of returned juncos and the subsequent high survival rate.

Certain aspects of Table 2 merit clarification. For Station B and the combined stations, the comparisons between year 2 and year 3 yield survival rates in excess of 100%, an apparent impossibility. Robbins' guidelines for this comparison create this possibility in that the birds recaptured in year 3 represent a pool of potentially surviving birds that can be greater than the number of birds actually retrapped in year 2. At Station B we also have the oddity of no bird recaptured in its sixth calendar year and thus the 0% survival rate. Then with one bird recaptured in the seventh calendar year, we have a comparison not subject to an arithmetic answer (NA). But this seventh-year junco must be included in the data to compute the adjusted weighted-mean survival rates.

The adjusted mean survival rates seem high and prompt a question about their reliability. Farner's review (1955) of the literature on survival rates shows a range from 32% for the House

Wren (*Troglodytes aedon*) and 37% for the Barn Swallow (*Hirundo rustica*) and Starling (*Sturnus vulgaris*) to 60% for the Song Sparrow (*Melospiza melodia*). Robbins (Ms, 1969) attained a 67% survival rate for the Ovenbird as compared to 54% recorded by Hann (1948). Other survival rates for passerine species studied by Robbins range from 44% for the Kentucky Warbler (*Oporornis formosus*) to 65% for the Acadian Flycatcher, Red-eyed Vireo (*Vireo olivaceus*), and Cardinal. Davis (1971) has a 43% survival rate for the Barn Swallow, and Frankhauser (1971) records survival rates between 40% and 55% for the Red-winged Blackbird (*Agelaius phoeniceus*), Common Grackle (*Quiscalus quiscula*), Brown-headed Cowbird (*Molothrus ater*), and Starling. Thus, while the rate of 63% for the White-winged Junco at Station A is within the range suggested by other studies, the 93% at Station B and 73% for the combined stations are above the rates reported for other passerines.

The latter factor forces us to analyze our data by other statistical tests. The difference between adjusted survival rates at Stations A and B evokes a question whether the data from the two stations represent different local populations. The chi-square test yields a result of 1.599, a figure well below the 5% level of significance (3.84). Data from Stations A and B, therefore, may be pooled and considered as a single population, and the adjusted survival rate of 73% is statistically meaningful.

The small sample sizes and low percentages of returned juncos at each station also suggest a question about the 95% confidence limits around the percentages obtained for these returned birds. The formula to check approximate confidence limits for a normal population indicates that the 2.62% at Station A falls within the range of 1.84% to 3.40%. At Station B the 3.73% is within the range between 2.27% and 5.19%. The results, therefore, with our small sample of returned juncos are statistically acceptable at the typical level of 95% confidence interval.

We must stress that the high survival rates represented by the study are applicable to only the recaptured juncos and that the rates must not be interpreted as representative of survival patterns for the total population of White-winged Juncos in the Black Hills. Further, the distinctively different survival rates between Stations A and B represent a remarkable phenomenon. Of the 42 returned individuals at Station A, only 3 juncos were recaptured in more than one subsequent calendar year. By contrast, at Station B, 13 of the 24 returned juncos were recaptured in more than one subsequent calendar year. Since the statistical tests justify pooling the data as a single population and show the percentages of returns to be within reliable limits of variance, we seem to have the anomaly that some banded birds frequenting Station B are more prone to being retrapped in subsequent calendar years. For inexplicable reasons, these juncos at Station B apparently develop the habit of utilizing the food at the banding station. Since we are dealing with records from two stations operated by different individuals, the patterns of banding operation for each person may be somewhat different. Although this fact may influence the data from the two

stations, the previously mentioned statistical tests suggest that the nature of the two operations should not invalidate the collective results.

SUMMARY

This study reports the survival rates for 66 White-winged Juncos recaptured one or more calendar years after banding from 1956 through 1973 at two banding stations. The adjusted mean survival rate for recaptured juncos at Station A is 63%; at Station B it is 93%, and for the combined stations the rate is 73%. Although the survival rate for the total sample from the two stations is somewhat higher than rates previously reported for some other passerines, statistical tests verify that the data may be pooled and that the numbers of returns in comparison with the total banded are within the standard 95% confidence limits for the small sample. Thus, the relatively high survival rates in this study are statistically reliable.

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South Dakota School of Mines and Technology, Rapid City, S. D. 57701; 633 S. Berry Pine Road, Rapid City, S. D. 57701. Received 5 April 1976, accepted 13 July 1976.