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RETURN RATES OF BANDED GRANIVORES IN RELATION TO BAND COLOR AND NUMBER OF BANDS WORN

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Abstract.—We tested the null hypotheses of (1) no effect of band color and (2) no effect of number of bands worn on annual recapture rates of birds on their winter range. Results are reported from four species of granivores—Spotted Towhee (*Pipilo maculatus*), Golden-crowned Sparrow (*Zonotrichia atricapilla*), White-crowned Sparrow (*Z. leucophrys*), and Dark-eyed Junco (*Junco hyemalis*). We found no effect of the number of bands worn on return rates of these species, nor did we detect an effect of band color on return rates. In the latter case, however, the power of our tests was low, and some results hinted at possible effects of color, especially yellow bands on Golden-crowned Sparrows.

TASA DE RETURNO DE GRANÍVOROS ANILLADOS EN RELACIÓN AL COLOR Y AL NÚMERO DE BANDAS

Sinopsis.—Probamos los hipóteses nulos de (1) no efecto del colór y (2) no efecto del número de anillos en los porcentajes de recaptura anual de pájaros en su área invernal. Reportamos aquí las resultas por cuatro especies de comedores de granos—Rascador Ojirojo (*Pipilo maculatus*), Gorrión Coronidorado (*Zonotrichia atricapilla*), Gorrión Coroniblanco (*Z. leucophrys*), y Junco Ojioscuro (*Junco hyemalis*). No hallamos ningún efecto de número de anillos en los porcentajes de recaptura por estos especies, ni hallamos un efecto de colór de anillos en los porcentajes de recaptura. Aunque en el último caso, el poder estadístico de las pruebas fue bajo, y algunos de las resultas sugerieron efectos posibles de colór, especialmente anillos amarillos en los Gorriónes Coronidorados.

Both physical and behavioral changes have been noted in birds as a result of leg bands. Rothstein (1979), for example, reported graying in tarsal color and a 3% increase in tarsal diameter on legs of White-crowned Sparrows (*Zonotrichia leucophrys*) wearing aluminum Fish and Wildlife

seed and distributed evenly in a grid pattern throughout an area of about 40 ha (410 × 780 m). We attempted to run all traps each day but, when the crew was too small to do so, we alternated between halves of the grid on successive days.

Unbanded birds were weighed to the nearest 0.1 gm, and a sample of aluminum and colored bands used on each species was weighed to the nearest 0.001 gm. We attached an aluminum, Fish and Wildlife Service band and one, three, or five colored leg bands to each bird. Colored bands were sealed together with acetone to reduce loss of bands. The few bands missing from recaptured birds were replaced. Each bird received colored bands of only one color (red, yellow, blue, green, white, or black) and the same number of bands (one, two, or three) on each leg, counting the aluminum band. In an effort to balance the sample across possible band color/number combinations for a given species, we rotated the series of numbers and colors of bands among birds in the order they were captured. We doubt that any appreciable bias could have been introduced by this ordering of color/number combinations.

We assume that recapture rates are suitable indices of survival rates for purposes of this study, even though observed return rates cannot be assumed to give unbiased estimates of annual survival rates (e.g., see Eberhardt 1972, Nichols et al. 1982, Pollock and Raveling 1982, Lakhani and Newton 1983, and Martin et al. 1995). We believe, however, that they were adequate for the comparisons made here because we had nearly equal numbers in each combination of band color and number of bands for each species. Systematic biases in survivorship should have affected all combinations equivalently in each year. Because annual samples were too small for statistical analyses, we pooled samples across all years. To assure independence in the data sets, an individual bird was counted as a return only if it was recaptured the year following the year it was banded, even though many individuals were first recaptured after 1 or 2 intervening years.

We used logistic regression (SAS Institute Inc., 1995, Stokes et al. 1996)

recapture (includes newly banded birds and first-time recaptures from earlier years) and numbers l colors. Numbers give counts pooled over all years.

Golden-crowned Sparrow		White-crowned Sparrow		Dark-eyed Junco	
Number avail.	Number recapt.	Number avail.	Number recapt.	Number avail.	Number recapt.
53	22 (41.5%)	71	15 (21.1%)	66	10 (15.2%)
54	11 (20.2%)	71	14 (19.7%)	63	9 (14.3%)
54	19 (35.2%)	68	16 (23.5%)	61	9 (14.8%)
54	20 (37.0%)	67	15 (22.4%)	60	13 (21.7%)
53	16 (30.2%)	67	13 (19.4%)	59	9 (15.3%)
52	15 (28.9%)	66	10 (15.2%)	63	5 (7.9%)

TABLE 4. Results of logistic regression testing the effects of the number of bands and band color on return rates. Model concordance was 64.1% for the number of bands and 65.0% for band color.

	χ^2	df	*P*
Number of bands			
Species	36.3	3	0.000
Year	16.3	1	0.000
Number of bands	0.5	1	0.490
Band color			
Species	36.5	3	0.000
Year	16.2	1	0.000
Band color	9.2	1	0.103

DISCUSSION

The statistical analysis supports a conclusion that the number of bands worn by birds in this study did not have a significant effect on their return rates (assumed to mirror survival). This conclusion is further supported by the facts that no species conformed to the expected pattern of declining return rates with increasing numbers of bands carried, and no species had its lowest return rate with six bands. On the other hand, conclusions of no effect of band color on return rates clearly risk Type II errors because of the low power of those tests. Several other field studies, cited earlier in this paper, also failed to find effects of band colors on birds. We estimated power to detect a difference of 10% in the parameter tested in 22 cases reported in the eight studies that provided sufficient data. Power ranged from 0.05–0.64 for 20 of these tests and was 0.92 and 0.99 for the remaining two, suggesting a likelihood of Type II errors in most of those cases. Sixteen of the 22 cases used chi-square or likelihood tests for their categorical data, which require unusually large sample sizes for adequate power (Kraemer and Thiemann 1987).

Following Burley's (1981, 1986a) conclusions that many parameters

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