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Wilson Bull., 102(3), 1990, pp. 550-552

Brown-headed Cowbird parasitism on Golden-winged and Blue-winged warblers.—The Golden-winged Warbler (*Vermivora chrysoptera*) has been expanding its range northward for about the last 150 years (Gill 1980). It simultaneously has declined and even disappeared in much of its southern range. This pattern has been well documented in, for example, Massachusetts and Connecticut (Gill 1980), southern Michigan (Will 1986), and central New York (Frech and Confer 1987). The decline in southern portions of its range is correlated temporally and spatially with the expansion of a closely related congener, the Blue-winged Warbler (*V. pinus*). Hypotheses that attempt to explain the decline of the Golden-winged Warbler in the south with expansion in the north include the following: (1) Suitable habitat. The Golden-winged Warbler, at least in central New York, nests in successional fields about 20 years old. Reforestation of abandoned farmland occurred about 100-150 years ago in the southern and eastern portions of the recent Golden-winged Warbler range, such as Connecticut and Massachusetts. In the more northern portions of the Golden-winged Warbler range, farmland abandonment occurred more recently and still is occurring. Therefore, large amounts of suitable habitat are still available in the northern expanding portions of the Golden-winged Warbler range. (2) Competition with the Blue-winged Warbler. Expansion of the Blue-winged Warbler into Golden-winged Warbler range is well documented (e.g., Gill 1980, Confer and Knapp 1981, Will 1986). Will (1986) observed that the Blue-winged Warbler dominated the Golden-winged Warbler in central Michigan. However, our observations in Central New York suggested that Golden-winged Warblers dominated Blue-winged Warblers. (3) Expansion of the Brown-headed Cowbird (*Molothrus ater*) into the Golden-winged Warbler range. No sample of significant size has been examined for an effect

TABLE 1
 SOURCES OF DATA UTILIZED TO DETERMINE FREQUENCY AND EFFECT OF BROWN-HEADED
 COWBIRD (*MOLOTHRUS ATER*) PARASITISM ON BLUE-WINGED (*VERMIVORA PINUS*) AND
 GOLDEN-WINGED (*V. CHRYSOPTERA*) WARBLERS

Name	Nest number	Origin	Dates
WFVZ ^a	345	Eastern U.S.	1870-1940
LONRP ^b	87	Eastern U.S.	1940-1989
T. C. Will	27	Central Michigan	1981-1983
Coker and Confer	9	Central New York	1988-1989
R. L. Scully	6	Eastern New Jersey	1986-1988

^a Western Foundation of Vertebrate Zoology.

^b Laboratory of Ornithology Nest Record Program.

of cowbird parasitism on Golden-winged Warbler nesting success. Herein, with historical records from over 400 nests, we test the hypothesis that the Golden-winged Warbler is more susceptible to parasitism by the Brown-headed Cowbird than is the Blue-winged Warbler.

Mayfield (1965) documented that the Brown-headed Cowbird was indigenous to the prairies. Even today, the cowbird remains uncommon or absent in large, unbroken forested areas of the eastern United States such as the Smokey Mountains National Park (Wilcove 1988). Mayfield proposed that birds indigenous to the prairies have had considerable time to develop cowbird defense behavior. Short (1963) provided evidence that by the end of the last glaciation, the Blue-winged Warbler occurred along the prairie-forest ecotone, while the Golden-winged Warbler occurred in the east. Therefore, the Blue-winged Warbler was exposed to cowbird influence for a longer period of time. With the extensive clearing of eastern forests, the cowbird spread east. Mayfield collected nesting data from bird species in each of three regions of the continent: the plains, the prairie-forest ecotone, and the eastern forest. These data weakly supported the contention that birds of the plains had a lower frequency of nest parasitism.

In our study, we have used Blue-winged and Golden-winged warbler nesting data from the following sources (Table 1): our own field work, the Laboratory of Ornithology nest record program (LONRP), a doctoral dissertation by Thomas Will (1986), an extensive study by Robert Scully (in press), and oological data from The Western Foundation of Vertebrate Zoology (WFVZ).

The data from WFVZ show a frequency of cowbird parasitism that is almost identical for the two warbler species (Blue-winged Warbler, 20 of 232; Golden-winged Warbler, 11 of 113; $\chi^2 = 0.20$, $df = 1$). The chi-square 2×2 contingency value is not significant ($P > 0.05$). Data from all other sources for parasitized nests found at any stage of development are likewise not different statistically (Blue-winged Warbler, 14 of 63; Golden-winged Warbler, 15 of 51; $\chi^2 = 0.77$, $df = 1$). However, the frequency of cowbird parasitism from the older oological data compared to the more recent nest data shows a significantly lower rate of parasitism ($\chi^2 = 20.41$, $P < 0.01$, $df = 1$). Egg collectors generally did not collect incomplete clutches with cowbird eggs, and this would probably account for most, if not all, of the difference in frequency of reported cowbird parasitism. This collecting preference probably was applied equally to both the Blue-winged Warbler and the Golden-winged Warbler. Excluding data from WFVZ, parasitized nests of Blue-winged and Golden-winged warblers

reached the nestling stage with equal frequency (Blue-winged Warbler, 9 of 47; Golden-winged Warbler, 6 of 39; $\chi^2 = 0.21$, $df = 1$).

Another measure of the response to cowbird parasitism is the frequency of nest abandonment. We define abandonment as nests observed for two or more visits over a several-day interval with cold eggs and no additions to the clutch. Only a very small sample of such nests was available. For both species, the proportion of parasitized nests that were abandoned was identical (Blue-winged Warbler with cowbird, 2 of 14; Golden-winged Warbler with cowbird, 2 of 14). It is difficult to determine whether abandonment is due to human activity or the presence of the cowbird egg (Rothstein 1975). Theoretically, the observed frequency of abandonment without cowbird parasitism could provide a correction factor for human disturbance, but the sample size is too small to apply this correction with confidence. Yet the limited data do not suggest any difference in abandonment between the Golden-winged Warbler and Blue-winged Warbler.

Much of the preceding data was obtained by single visits to the nests by amateurs. The older oological data is biased against reporting the true frequency of nest parasitism. However, our analyses in all cases involved a comparison between data sets collected by the same procedures, and potential errors are unlikely to have altered the conclusions. Analyses of this large data set suggest that the influence of the Brown-headed Cowbird on both species is very similar.

Acknowledgments. — We are extremely grateful to the following: L. Kiff for providing copies of the data from the WFVZ, G. Butcher for providing copies of the nest record data, and R. Scully and T. Will for allowing us to use their unpublished data. This work was supported in part by an NSF-ROA supplement to NSF Grant Number BSR-8817950 to H. R. Pulliam and J. B. Dunning, Jr.

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