



**Fig. 1.** Northern Lower Michigan. Circles mark "colonies" of Kirtland's Warblers in 1973. Shaded area covers all recorded nest sites.

Ever since its discovery in 1851 the Kirtland's Warbler (*Dendroica kirtlandii*) has been a rare species. It was probably somewhat more numerous in the half century between the finding of the first one, a migrant near Cleveland, Ohio, and the discovery of its nesting ground in northern Lower Michigan in 1903 than at any other time in recent centuries, but even then it was often called "America's rarest songbird."

How many Kirtland's Warblers existed was a matter of speculation until 1951, when we conducted our first count of singing males. The total was 432 males (Mayfield, 1953).

My long-term study of the nesting bird, heavily weighted with figures from the 1950s, led me to doubt that the bird was maintaining its numbers, but the census of 1961, ten years after the first, brought a reassuring count of 502 males. Since we believe the number of females approximately equals the number of males, we concluded the population was essentially stable at about 1,000 birds in that decade (Mayfield, 1962).

The third decennial census of 1971 confirmed my earlier pessimistic predictions. The population showed an alarming decline to 201 males, a 60 per cent reduction. This decline to about 400 birds was marked by a withdrawal from most

peripheral areas, but with the warblers still as densely distributed as ever in the core of their range (Mayfield, 1972).

As a result of our intensified concern for the fate of the warbler, we repeated the census in 1972 and found little comfort in a count of 200 singing males. Continued studies of the nesting bird did not allay our fears but rather encouraged the gloomy view that this was merely a pause in the downward slide of the population (Mayfield, 1973).

Finally, our most recent count of June, 1973, brought our first ray of hope that the decline had been arrested. The total was up slightly to 216 males. The present population nests in eight "colonies" located mainly in Crawford, Ogemaw, and Oscoda counties. The only exception is a small, isolated group located in Wexford County at the extreme western edge of the historical range of the warbler, 50 miles (80 km) from its nearest neighbor. More than half of all the nests of the species now are on lands managed for its benefit by the U.S. Forest Service or the Michigan Department of Natural Resources.

All of these censuses were taken, not by estimating or sampling, but by actual count of in-

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dividual singing males. The method is feasible because of the restricted range, recognizable habitat, and loud distinctive song of the warbler. It is still the only songbird ever to be completely censused.

The trend of the population since 1951 is shown by the following table:

**Table 1. Population trend, Kirtland's Warbler 1951-73**

Year	Males	Counties	Sections (sq. mi.)
1951	432	8	91
1961	502	9	86
1971	201	6	27
1972	200	4	27
1973	216	4	25

With a species so rare, it is important to know the reasons for any decline. Ultimately, it would seem, the size of the population is limited by conditions on the wintering ground, conditions of migration, and conditions on the nesting ground.

The wintering range in the Bahama Islands seems to have changed remarkably little in the last century or so, unlike so many other tropical locations. Some beaches have been turned into resorts, and parts of two of the northern islands have been lumbered or cleared for agriculture, but only a small percentage of the total land area has been affected. The stony soil in most places is not attractive for agriculture, and the interiors of most of the islands are almost devoid of people, probably more so than in recent previous times because the attractions of Freeport and Nassau have steadily drawn people from out-island localities.

Spring and fall migration of Kirtland's Warblers occurs during the hurricane season, and some people have felt this circumstance might have exposed the warbler to disaster occasionally. However, since the migration is spread over several weeks, not all of the birds are in flight at one time; and, in any case, hurricanes are no new problem to the species.

The nesting habitat is a narrow, specialized, and transitory niche recognizable by vast expanses of Christmas-tree sized Jack Pines (*Pinus banksiana*), low ground cover, and sterile sandy soil. These "Jack Pine plains" are limited in extent, but at no time since the discovery of the nesting ground has the bird seemed to occupy all the suitable habitat available to it (as judged by the human eye). Hence, the botanical features do not appear limiting at present, although they are always a matter of

concern because these conditions occur naturally only after large forest fires, and the control of fires improves with each passing decade. Predatory mammals and snakes are scarce on the nesting ground. The pressure of avian competitors is not obvious; in fact, all the other birds of the "Michigan barrens" seem marginal here—that is, they are more abundant somewhere else. So we have believed the Kirtland's Warbler found a measure of sanctuary in this land where no other species was entirely comfortable.

The warbler's greatest problem appears to be a new intruder. The only factor that has been identified positively as a depressant to the population of Kirtland's Warblers is the Brown-headed Cowbird (*Molothrus ater*). The cowbird, originating in the grasslands of the mid-continent, did not reach the pinelands of northern Michigan until farmers to the south and west had cleared the forests up from the prairies. Its entry into the nesting ground of the Kirtland's Warbler probably began in the 1870s and 1880s. It has found the warbler a perfect host, one with no defenses.

This brood parasite removes warbler eggs and places its own larger eggs in the nests of the host. Since the cowbird eggs have a shorter incubation period, they usually hatch ahead of the warblers and the young cowbirds are very much larger than the young warblers when they hatch. Thus, the cowbird takes a toll of warblers at every stage of the nesting sequence. With 55 per cent of warbler nests entered, I found the loss to the warblers totaling nearly 40 per cent of their potential production of young, more precisely, the number of fledglings would be 60 per cent larger if there were no cowbird interference; and more dramatically, the number of young produced in nests without cowbirds was four times as great as in parasitized nests (Mayfield, 1960:177).

When a larger proportion of nests are entered by cowbirds, the number receiving more than one cowbird egg increases, and the damage to the host is progressively much larger. This ominous trend has been noted in studies of recent years. Walkinshaw (1972) and Nicholas L. Cuthbert and Bruce E. Radabaugh (unpublished) have found rates of parasitism of 70 per cent and higher recently. In one year's sample by Cuthbert 83 per cent of the nests were parasitized and 29 nests produced a total of only two warblers, a rate of loss leading down the road to extinction. All of these findings demonstrate an unprecedented and perhaps intolerable pressure of one species on another year

after year Interestingly, no other bird species in the same habitat is molested nearly as often as the Kirtland's Warbler.

It was the work of Cuthbert and Radabaugh that gave us the confidence to take the radical step of removing cowbirds in an attempt to save the Kirtland's Warbler species. Their work showed conclusively that areas on which cowbirds were restrained were much more productive of young warblers than other similar areas in the same years. So the control of cowbirds on the major nesting areas began in 1972 and was expanded in 1973. Material for traps was supplied by the Michigan Audubon Society, construction by the Michigan Department of Natural Resources, and servicing by the U.S. Forest Service and the Bureau of Sports Fisheries and Wildlife.

Nesting studies show spectacular results from the program of cowbird control. Walkinshaw has been monitoring the effects in three "colonies." In 1972 he had only two instances of parasitism among 32 warbler nests, a figure lower by far than for any comparable sample in history. Also he noted an unexpected number of 5-egg clutches (instead of 3-egg and 4-egg clutches noted frequently in other years) and an unusual number of pairs producing two broods in a summer—suggesting the warblers were benefited in more ways than expected by the removal of cowbirds. Extrapolating from his sample to the entire population, we judged the Kirtland's Warbler achieved in 1972 the highest reproductive rate ever recorded for it. Equally good results were also achieved in the nesting season of 1973 but the full effects cannot be evaluated for at least another year.

The 1973 count, although an improvement—believed significant not only for its reversal of trend but also because of the associated field studies—did not fully live up the predictions of 1972. One possible hypothesis to explain the smallness of the increase is that a substantial number of one-year-old Kirtland's Warblers do not breed. If such males do not set up and proclaim territories by song, they are never counted by our method. We have long known that *some*

first-year males and females nest, but we have not been sure how many of them do so. It has seemed to us that the number of males considered first-year birds from the appearance of their plumage in the field was not as large a proportion of the total population as it ought to be, but this can be explained also by the possibility that some first-year birds cannot be distinguished from older birds by ordinary inspection through binoculars. The number of males banded as nestlings and recaptured in later years has not been large enough to throw light on this question.

If some first-year birds are not counted, the true effect of the 1972 cowbird-control campaign cannot be appraised until the census of 1974.

As in former years this count was carried out by teams, each headed by a captain responsible for the same area year after year. These captains in 1973 were as follows: John Byelich, G William Irvine, Eugene E. Kenaga, Bruce E Radabaugh, and Lawrence H. Walkinshaw They were assisted by Steve Anderson, George Burgoyne, Doris Chopard, Marvin Cooley, Elsworth Harger, Louis Hawn, Harold Mayfield, Virginia Mayfield, Douglas S. Middleton, Theodore Miley, Ray Perez, Laurie Robertson, Lawrence A. Ryel, Eric Schneider, Jean Skellenger, Jerry Weinrich, and Harold F Wing.

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