Ecology and Management of Cowbirds and Their Hosts

Studies in the Conservation of North American Passerine Birds

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Abstract

The Kirtland’s Warbler is an endangered species suffering from nest parasitism by the Brown-headed Cowbird and a shortage of its highly specialized habitat. The young Jack pine habitat needed by the warbler is normally a result of fires but is now being provided by forest management. The Kirtland’s Warbler nests only in northern lower Michigan, where cowbirds were controlled annually by the U.S. Fish and Wildlife Service from 1972 to 1995. The third decennial census of singing male Kirtland’s Warblers in 1971 fell 60% below the 1961 count of 502. From 1966 to 1971, 70% of Kirtland’s Warbler nests were parasitized by cowbirds, warbler clutch sizes averaged 2.35 eggs, and nesting pairs produced 0.8 fledged young per year. During cowbird removals from 1972 to 1977, parasitism decreased to 6.3% of nests, mean clutch size increased to 4.46, and production of young increased to 3.11 young fledged per pair. Annual censuses of singing male warblers remained relatively stable from 1972 to 1989, averaging about 200, but began increasing in 1990 and reached a record high of 766 in 1995. In 1995, mated pairs were found outside the traditional breeding area for the first time. Cowbirds were captured with 1 to 6/7 decoy traps, and 98,427 cowbirds were removed in 24 years. More males than females were trapped in most years. The mean proportion of males was 0.549, and the average sex ratio was 1.22:1. On average, 63% of all cowbirds were caught by the third week of trapping in early to mid-May. Cowbird control effectively protected Kirtland’s Warblers from nest parasitism each year, but had no effect on the cowbird population from one year to the next.

Introduction and Background

The Kirtland’s Warbler (Dendroica kirtlandii) was first described scientifically in 1852 after a male specimen was collected in May 1851 near Cleveland, Ohio. During the 1880s and 1890s, at least 71 specimens were collected in the Bahamas (Mayfield 1960). The nesting area was not discovered until 1903, when a nest was located near the Au Sable River in western Oscoda County, Michigan (Holden 1964). All nests of this species ever found have been located within an area of 120 x 160 km (19,200 km²) in northern lower Michigan (Figure 37.1), but strong evidence of breeding outside this area was observed in 1995 (Weinrich 1996). Mayfield (1960) and Middleton (1961) have described the northern lower Michigan area where Kirtland’s breeding habitat is located in detail.

Shortly after the discovery of the first nest, the species became the subject of ornithological study, which continues to this day. Studies from the 1920s through the 1950s led to an understanding of its life history and rarity on the nesting ground (Mayfield 1960). Mayfield (1960) and Walkinshaw (1983) provide extensive details of the bird’s life history during the nesting and brood rearing period. Many other authors have also written about the species (Huber 1980). The Kirtland’s arrives in Michigan from the Bahamas in early to mid-May. Males establish territories near each other in suitable habitat, where their density averages 1.9 per 40 ha and reaches a maximum of 2.8 per 40 ha (Probst and Weinrich 1993). Kirtland’s Warblers begin their southward migration in August, with the last birds departing in early October (Sykes et al. 1989). Aside from numerous sightings during migration, little is known about the bird during its migration and wintering in the Bahama Islands. After limited fieldwork in the Bahamas in 1985 and 1986, Sykes (pers. comm.) concluded that adequate wintering habitat existed and that no serious threats were apparent there.

The birds nest only on the ground in young (6 to 24 years old) forests of jack pine (Pinus banksiana). The jack pine and the warbler nests are closely associated with a poor sandy soil of glacial origin. Areas suitable for warblers are not continuous but are scattered among other soil and forest types in several counties. The young stands develop naturally after older jack pine forests burn. Most jack pine cones open and release seeds only after being scorched by fire. Once a stand of Kirtland’s Warblers is in place, fires, introduced through controlled burning, are used to maintain the habitat.
of jack pine reaches about 5 m in height, the Kirtland’s will no longer nest there. The species must therefore follow its dynamic nesting habitat across the landscape through time as older jack pine stands age and new ones regenerate after forest fires. Such fires once were common, the tree itself is very flammable, and the ecological community it dominates is dependent on fire for its existence. Jack pine in lower Michigan is at the southern edge of its extensive North American range. The jack pine forests, which were lesser components of more extensive mixed pine and hardwood forests of northern Michigan to begin with, began to diminish in the early 20th century as humans suppressed forest fires and planted more valuable tree species.

Brown-headed Cowbirds were not native to heavily forested northern Michigan prior to the late 19th century. Friedmann (1929) believed the cowbird was originally a grassland species not present in the forests of eastern North America. The northern Michigan forests were completely logged or burned off between the 1860s and 1910s. Grasslands, brush, and agricultural lands predominated until the second-growth forest that now dominates this area became established. Cowbirds moved into the area about 1895 and...
have been parasitizing Kirtland's Warbler nests at least since 1908 (Mayfield 1960). Mayfield (1977) discussed the appearance of cowbirds in northern Michigan and their impact on the Kirtland's Warbler. This warbler may be particularly vulnerable to the cowbird because it had no opportunity to evolve defensive behavior prior to 1895. By 1971, 69% of warbler nests were parasitized, and pairs of warblers were fledging less than 1 young per year (Walkinshaw 1983).

The survival of the Kirtland's Warbler was being jeopardized by a decrease in its very specific nesting habitat and by parasitism of its nests by the cowbird. Beginning in 1957, the state of Michigan and the U.S. Forest Service began setting aside forest management units specifically for the warbler (Mayfield 1963). The Kirtland's Warbler was listed as a federally endangered species in 1967 (USDI 1967) and has had similar status since 1974. Management for the warbler intensified with the passage of the Endangered Species Act of 1973. There are currently 21 state and federal warbler management units, covering more than 56,000 hectares.

State and federal public forest contains nearly all occupied and protected Kirtland's nesting habitat. Each year the Michigan Department of Natural Resources and the U.S. Forest Service together manage about 700 to 1,100 ha. Management actions consist of commercial harvest of mature jack pine, followed by planting of 2-year-old jack pine seedlings. The goal is to maintain 12,000 to 14,000 ha of suitable warbler habitat (sufficient for 570 to 665 warbler territories, assuming that all habitat is occupied at mean densities). Although fire is important in the ecology of the jack pine forest and the Kirtland's Warbler, forest fires are vigorously suppressed and prescribed fire has been used only occasionally as a management tool, because it is dangerous in an area occupied by humans. Warbler nesting areas are protected and closed to public entry during the nesting season. Free guided tours are provided for persons who wish to see this rare bird.

The first census of singing Kirtland's Warblers in 1951 found 432 males (Figure 37.2). A second census in 1961.

![Graph showing census data](image-url)

Methods

Cowbirds have been controlled since 1972 on nearly every Kirtland's Warbler nesting area in Alcona, Clare, Crawford, Iosco, Kalkaska, Montmorency, Otsego, Oscoda, and Roscommon counties (total area 19,200 km2). Except for minor changes, methods are as described by Shake and Mattsson (1975). Cowbirds were captured in large (4.88 m square and 1.83 m high) cage-like decoy traps kept stocked with 6 to 24 live decoy cowbirds. Trapping began between 15 April and 1 May each spring and continued for about 11 weeks through to late June. Trapping began about nine days earlier on average in 1983–1995 compared to 1973–1982. Since 1986, increasing numbers of bait traps (4.88 m × 2.41 m × 1.83 m high) have been used in addition to the regular 4.88-m-square traps. The number of traps used increased from 15 in 1972 to 67 in 1995 (Table 37.1). Traps made of prefabricated panels were erected in warbler nesting areas. The traps remained in place and were used as long as warblers nested in the area but were deactivated each year at the conclusion of trapping. The top of the trap was removed and a large door was used as bait beginning in 1984. Cowbirds were banded and released at a small number of banding traps operated outside warbler nesting areas from 1973 to 1997 to gain knowledge about their local movements.

Records kept for each trap included numbers, sex, and age (adult or juvenile) of cowbirds. Male cowbirds were aged (S-rander and Giller 1960) beginning in 1994. Capture data are compared by week of trapping rather than by actual calendar dates. Although the onset of trapping varied by up to two weeks (Table 37.1), the temporal patterns in the capture data (see below) were consistent regardless of the starting date. Thus, weekly mean data are presented here. Numbers of cowbirds captured for each week represent the total numbers for a seven-day period.

Results and Discussion

Cowbird control showed immediate results in 1972 with a sharp decrease in parasitism of Kirtland's Warbler nests and increased warbler reproductive success. Nest parasitism dropped from a mean of 70% for 1966–1971 to 6.2% in 1972 and a mean of 5.6% for 1972–1977 (Walkinshaw 1983). Warbler clutch size increased from 2.35 to 4.61 in 1972, and the fledging rate increased from an average of 0.83 in 1966–1971 to 3.35 in 1972 and a 1972–1977 average of 3.08 per pair per year (Walkinshaw 1983).

The Kirtland's Warbler population did not increase for many years (Figure 37.2) but remained stable at about 200 pairs (Ryel 1979, Weise 1987, Weinrich 1996). An increase that began in 1990, however, led to a record high of 766 singing males in 1995 (Weinrich 1996). In 1995, 2 of 8 males found by biologists in the Michigan Upper Peninsula were mated (Figure 37.1). This was the first evidence of Kirtland's breeding outside northern lower Michigan (Weinrich 1996). The increase since 1990 is directly related to the maturation of a large block of nesting habitat resulting from a 10,500-ha fire in 1980, known as the Mack Lake Burn, which the warblers began using in 1986. Figure 37.2 depicts the importance of the Mack Lake Burn to the current population. The Mack Lake Burn habitat has been decreasing in importance, but a high warbler population is being sustained by a large area of managed habitat. The highest recorded proportion of singing males (57%) found on managed habitat occurred in 1995 (Weinrich 1996). This proportion is expected to increase in the next few years, as warblers move out of the maturing Mack Lake Burn.

While habitat quality and availability are critical to the survival of the species (Probst and Weinrich 1993, Probst 1986), it is reasonable to assume that the Kirtland's Warbler would not now exist if cowbird control had not been started in 1972. Mayfield (1977) estimated that the warbler population in the late 1970s would have declined to 20 pairs without cowbird control, instead of the 200 actually observed. Research and management biologists used the VORTEX simulation model (Lacey 1993) to conduct a population viability analysis for the warbler in 1992. These simulations (Seal 1996) indicated that warblers needed to fledge at least 2.3 young per pair per year to maintain the population, well above the fledging rate recorded before the onset of cowbird control (Walkinshaw 1983).

Numbers of Cowbirds

Since 1972, 98,427 cowbirds have been removed from northern Michigan warbler nesting areas (Table 37.1). The mean annual number removed was 4,101, with a range from 2,261 to 7,595. The number of traps used increased from 15 to 7 warbler nesting areas in three counties in 1972 to 67 on 35 nesting areas in nine counties in 1995. The 24-week mean

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<th>Year</th>
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<th>Male</th>
<th>Female</th>
<th>Juvenile</th>
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<th>M/F</th>
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**Total** 53,552 44,001 8/4 98,42/ 991

**Mean** 2,231 1,833 36 4,101 1.22 37 110.1


### Catch Distribution

One of several remarkable consistencies in the cowbird catch over 24 years was the distribution of captures during the trapping period. Mean weekly catches from 1973 to 1995 are shown in Table 37.2. Data for 1972 are not included because field records were lost. Calendar dates for initiation of trapping were 1 April to 1 May from 1972 to 1982 and 15 April to 22 April from 1983 to 1995 (Table 37.1). The first and last week of trapping were not full weeks of effort since traps were opened or shut down then. Regardless of when trapping started, the catch distribution each year was very much like the composite shown in Table 37.2, with modest variations in each week’s percentage of the total catch. Shad and Mattsson (1975) presented weekly catch distributions for 1973 and 1974, with the 1974 data being most typical.

The catch peaked sharply in the second week, the first full week of trapping, then rapidly declined and stabilized at a lower level. On average, 33% of all cowbirds were caught in the second week and 19% in the third week. Sixty-three percent of the cumulative total was caught by the third week. This type of distribution is expected if cowbirds were being removed from an area without being replaced. A similar though less pronounced pattern of captures occurred in the banding traps (Table 37.3), where most cowbirds were caught in the first week and the peak was between weeks 2 and 3.
banded and released at the trap. The numbers reported in Table 37.3 are for first captures only. Dufour and Weatherhead (1991) noted a similar distribution of captures in banding traps operated from April through July in eastern Ontario. Some factor other than removal apparently diminishes cowbirds’ susceptibility to capture after the first three weeks.

Data on the movements of banded cowbirds in this project have not been fully analyzed, and it is beyond the scope of this report to do so, but 12.9% of the 3,011 cowbirds banded from 1973 to 1979 were recaptured at least once. Most recaptures were within a day or two at the same trap, although some birds were captured more than one week later.

In 1979, 73 of 273 cowbirds were recaptured, 68.5% at the first trap and 31.5% at another trap.

The large number of cowbirds captured in the first three weeks of trapping was probably due in part to migrating cowbirds moving through the area. The temporal distribution of captures may also reflect a change in cowbird behavior and susceptibility to decoy traps. When migrating, cowbirds are in flocks, still mobile, gregarious, sociable, and thus likely to encounter and enter a trap. Once migration ends, flocks break up and cowbirds disperse for breeding, perhaps with females becoming territorial (Darley 1983).
traps happened only three times in 24 years, including the only year in which females outnumbered males (1983). In the other 21 years, males outnumbered females by as much as 2.62 to 1 (1972), but more typically by 1.1 to 1.5 to 1. The overall predominance of males is further indicated by the 24-year sex ratio in removal traps of 1.22 males per female. The proportion of males observed (0.549) differed significantly from a 0.50 expectation ($Z = 30.58, P < .001$). In banding traps the proportion of males was 0.52 (1,332 males : 1,221 females), and this proportion was also significantly different from 0.5 ($Z = 2.2, P = .022$).

The temporal pattern of males and females in the catch distribution and a seasonal shift in the sex ratio were also very consistent over the years. Each year but one, females predominated for the first two or three weeks (Table 37.2), then their numbers dropped off more sharply than those of males, with male captures exceeding female captures thereafter and making up more than half of the total capture (Table 37.1). The same pattern occurred at the banding traps (Table 37.3). The cumulative data in Tables 37.2 and 37.3 illustrate another consistent characteristic of the catch distribution. On average, females outnumbered males until the eighth week for removal traps and the seventh week in banding traps. This point of crossover varied between years. For example, males did not exceed females until the tenth week in 1993, the year with the fourth lowest sex ratio (Table 37.1).

Sex ratio has long been of interest to cowbird observers. Friedmann (1929) reported a ratio of 3 males for every 2 females, and many investigators have subsequently found that sex ratios favor males, with values often close to Friedmann’s figure. Duffy (1982), Darley (1971), and Duffy and Wingfield (1986) all reported ratios of males : females of 1.51 : 1 to 1.55 : 1, similar to Friedmann’s value. McIlhenny (1940) reported 2.82 : 1, but he felt this was an error. Yokek (1989) reported a higher value of 1.9 : 1, and Rothstein et al. (1987) reported much higher values (from 3.33 : 1 to 7.6 : 1) from both trapping data and field observations. The last two studies were from the Owens Valley and Sierra Nevada of California, which may have extreme sex ratios, while the others were from eastern North America.

Dufour and Weatherhead (1991), who found a sex ratio of 1.35 : 1 for decoy-trapped cowbirds, also noted a sharp decline in catches of female cowbirds in decoy traps after mid-May, although males predominated throughout their entire trapping period from early to mid April through July. They suggested that females become “trap shy” with the onset of egg laying and that males are over-represented in decoy trap samples because of sex-specific dietary needs. These interpretations fit the data presented here. A preliminary analysis of data from cowbird banding traps in the Kirtland’s study area for 1973 and 1975–1978 showed that 70% of retrapped cowbirds were males, suggesting that males have a greater tendency to enter traps. No investigation has been made of new cowbirds in this study area, which would be important to the future of this species.
cowbird breeding physiology and chronology on or near Kirtland’s Warbler nesting areas. However, the decline in female captures recorded in Table 3.2 coincides with the peak egg-laying period of the Kirtland’s Warbler (Walkinshaw 1983).

The excess of adult male cowbirds apparently is a result of lower survival of females, since cowbird eggs and fledglings have an equal sex ratio (Weatherhead 1989). Fuikhauser (1971), Darley (1971), and Searcy and Yasukawa (1981) all calculated higher survival rates for males, but Arnold and Johnson (1983) found that more females survived at winter roosts. The latter authors suggested that competition for food affected males more, while Darley (1971) and Searcy and Yasukawa (1981) attributed lower female survival to the high demands of egg laying.

Dutour and Weatherhead (1991) found that mist-netted cowbirds exhibited a lower sex ratio than those caught con temporaneously in decoy traps. They cautioned that data from decoy trapping may be biased, because decoy-trapped cowbirds were in poorer condition than mist-netted cowbirds. While a consistent condition bias may exist, the large sample size and consistent sex ratios in the data presented here add to the long list of other reports of excess males. It seems clear that males predominate among adult Brown-headed Cowbirds.

**Conclusion**

Brown-headed Cowbird control with decoy traps in a large area of Michigan has allowed Kirtland’s Warblers to reproduce successfully. There is agreement that the warblers are now limited by habitat, as long as cowbird numbers continue to be controlled. Probst and Weinrich (1993) developed a habitat-based model that accurately predicted Kirtland’s populations during the late 1980s. Recent increases in the Kirtland’s singing male count due to the Mack Lake Burn and an increase in the area of managed habitat were also predicted. These increases, however, have exceeded maximum projections, perhaps because of higher than expected maximum male densities and/or better than expected habitat quality. Probst (unpubl. reports, pers. comm.) believes that both habitat and numbers of Kirtland’s Warblers may decline around the year 2000. Consideration for human safety in the warbler nesting range means that fire suppression must continue and that costly habitat management will be a permanent requirement for this species’ continued existence.

This program has shown that Brown-headed Cowbird nest parasitism can be controlled on a limited but still large spatial scale (approximately 19,000 km²). Similar cowbird control programs may be appropriate and successful in other limited situations. The methods used in Michigan are labor intensive and costly and probably would not be practical on a larger scale (see also Hayden et al., Chapter 39, this volume).

Although cowbirds have been removed annually in the same general area for 24 years, large numbers of cowbirds return each year. The overall cowbird population does not seem to have been reduced. An important interest of the participants in the population viability analysis was an examination of the consequences of varying cowbird parasitism rates. The model indicated that with known and predicted habitat and known warbler productivity, survival, and mortality rates, nest parasitism above 30% would lead to extinction of the warbler (Seal 1996). Cowbird control is thus likely to remain a permanent management requirement for the Kirtland’s Warbler. Thus, the Kirtland’s Warbler faces continued serious jeopardy, not merely of a biological nature but of a political and fiscal nature as well.

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