

**Lowells Management Area** — In one nest 4 eggs were deserted. In 4 nests, 1 egg failed to hatch; 2 eggs and 5 nestlings were taken by predators; one was apparently killed by a cowbird. The young newly hatched KW was found dead on the edge of the nest which contained a two-day old cowbird. Another nestling died on a rainy day.

**Muskrat Lake** — Three eggs disappeared from one nest (evidently taken by a predator) and the female (8 years old) deserted the other two.

#### SUMMARY

Cowbird removal has aided the success of Kirtland's Warbler nesting in Michigan but the counts of singing males continue to decline. Indications are that losses may occur during migration or on the wintering grounds.

#### LITERATURE CITED

- Layfield, H. F. 1972. Third decennial census of Kirtland's Warbler. *Auk* 89:263-268.  
 Layfield, H. F. 1973. Kirtland's Warbler census, 1973. *American Birds* 27:950-952.  
 Walkinshaw, L. H. 1972. Kirtland's Warbler — endangered. *American Birds* 26:3-9.  
 Walkinshaw, L. H., and W. R. Faust. 1974. Some aspects of Kirtland's Warbler breeding biology. *Jack-Pine Warbler* 52:64-75.

## 1974 Breeding Success of The Kirtland's Warbler

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During the summer of 1974 I studied the breeding success of the Kirtland's Warbler (*Dendroica kirtlandii*) on three main nesting grounds in northeast Michigan. These studies supplemented those of Walkinshaw and Faust and helped to ascertain the effectiveness of the Brown-headed Cowbird (*Molothrus ater*) removal program conducted by the U. S. Fish and Wildlife Service.

#### METHODS

Observations were carried out almost continuously from 20 May, 1974, to 15 August, 1974, between duties as a tour guide on the U. S. Forest Service Volunteer Program. Most nests were found by following a singing male as he took food to the young or female on the nest. Other nests were located by searching an area where an adult had been seen repeatedly and then by flushing the sitting female. Nests were checked almost daily to determine progress. Nests at Muskrat Lake were reported on by Charlie Munn. Nestlings were marked with government aluminum bands.

#### STUDY AREAS

Studies were made in three different parts of Oscoda and Crawford Counties, Michigan. Two areas, including the main study area, were located on U. S. Forest Service land in the Huron National Forest. The third was owned by the state and administered by the Department of Natural Resources.

The state land was located near Muskrat Lake in Oscoda County. Sixteen males were located there during the 1974 census by William Irvine, Jean Skellenger, Joe and Verna Beaver, Judy Alderson, Doris Chapard, Judy Eldridge, and myself. This was an area of approximately 800 acres accidentally burned 17 April 1964, which has yet to reach its prime. Jack pines (*Pinus banksiana*) were three to six feet tall.

Pere Cheney in Crawford County was a more mature area of jack pines extending over an area of 486 acres burned on 12 May, 1958. We found 21 males there during the 1974 survey.

Mack Lake, with 19 singing males (count from 1974 census), received the most attention in this study. It was an area composed predominantly of planted red pines (*Pinus resinosa*) 21 years of age. All nests were confined to three square mile sections. It was located only two miles east of Mack Lake Campground and contained the largest single colony of Kirtland's Warblers in red pines.

All three areas were covered by blueberries (*Vaccinium spp.*), bearberry (*Arctostaphylos Uva-ursi*), sandcherry (*Prunus pumila*), and sweetfern (*Comptonia peregrina*). Grasses, particularly bluestems (*Andropogon spp.*), were also prevalent.

TABLE 1  
1974 SUCCESS OF KIRTLAND'S WARBLER PAIRS

Area	Number of Nests	Number <sup>1</sup> Eggs Laid	Eggs Hatched	Young Fledged	Eggs Per Set	KW Young Fledged Per Nest	KW Young Fledged Per Pair
PC	5*	21	15	15	4.20	3.00	3.00
MLM	12**	43	40	33	3.58	2.75	3.60
ML	4***	20	19	19	5.00	4.75	4.75

PC = Pere Cheney Area; MLM = Mack Lake Management Area; ML = Muskrat Lake

<sup>1</sup> Computed back from number of nestlings if not found in egg stage

\* 3 nests found at nestling stage

\*\* 8 nests found at nestling stage

\*\*\* 4 nests found at nestling stage

NESTS

Twenty-one nests were observed to determine reproductive success. This represents 33 per cent of the 63 nests discovered in 1974 (including Walkinshaw's and Faust's).

Pere Cheney had five nests (see Table 1), Muskrat Lake four, and Mack Lake had 12.

All nests were on the ground near the base of a pine. At Mack Lake, 10 of the 12 nests were located under red pines (83.3 percent). In all, 11 were under red pines (52.3 percent), and 10 were under jack pines (47.6 percent).

Nests ranged from 2.54 cm to 1.22 m from the base of the nearest tree. Average distance was 39.4 cm.

Each nest also had some form of vegetative cover described by Mayfield (1960:78) as a canopy. Dry grasses were especially important for cover in early nests. Table 2 lists the nest canopy vegetation which formed the immediate dome over each nest.

Although there were 21 active nests in this study they were attended by only 18 pairs of warblers. This represents 10.7 percent of the total population of 167 pairs (Mayfield, this issue).

Eggs

Most frequently when nests were located they were in the nestling stage. This was true because it was much easier to find nests when both of the parents were feeding young, and visits with food were frequent.

When computing the number of eggs laid in this study it was necessary to figure back from the number of nestlings if the nest was not found in the pre-incubation or incubation stage. Of the 21 nests found, 15 (71.4 percent) were in the nestling stage (see Table 1).

By using this indirect method, it was found that eight of the nests (38.1 percent) had five eggs, eight nests (38.1 percent) had four eggs, three nests (14.3 percent) had three eggs, and the remaining two nests had two and one egg (4.76 percent) respectively. In all, 84 eggs were laid, with 74 known to have hatched. Mean clutch size was 4.0.

These figures represent the minimum number of eggs laid. There was likely egg removal by cowbirds and predators, and possibly other eggs

TABLE 2  
NEST CANOPY VEGETATION

Cover	Frequency of Occurrence Above All Nests	Percent Composition of All Cover
Blueberries ( <i>Vaccinium brittoni</i> ) ( <i>V. angustifolium</i> )	85.7	28.0
Grasses mainly ( <i>Andropogon spp.</i> )	80.9	26.5
Bearberry ( <i>Arctostaphylos Uva-ursi</i> )	42.8	14.0
Sand Cherry ( <i>Prunus pumila</i> )	28.5	9.30
Sweetfern ( <i>Comptonia peregrina</i> )	23.8	7.80
Wintergreen ( <i>Gaultheria procumbens</i> )	14.3	4.70
Pine needles ( <i>Pinus resinosa</i> )	9.50	3.10
Bracken fern ( <i>Pteridium aquilinum</i> )	9.50	3.10
Cinquefoil ( <i>Potentilla sp.</i> )	4.70	1.50
Club Moss ( <i>Lycopodium sp.</i> )	4.70	1.50

were laid that did not survive to the nestling stage. In addition, five cowbird eggs were laid of which four hatched.

FLEDGING

The average nestling period as found by Mayfield (1960:110) is nine days. A bird was recorded as fledged if I witnessed the bird leaving the nest, estimated it to be at least seven days old when last seen, or observed the fledgling in the field. Some nestlings left the nest on the seventh or eighth day when banded. I was later able to observe parents feeding most of these birds. For this reason, I tried to band young on the sixth day. All nestlings were banded on the right leg. A total of 60 young were banded.

In all, 67 young successfully fledged. This represents 79.7 per cent of the original 84 eggs (or young). The reasons for this apparently high success will be discussed later.

Fledging can be viewed in two ways. Calculations were made of the number of young fledged per nest and also the number of young fledged per pair. The latter is a more valuable index of total productivity. It accounts for the added production from double broods and of re-nesting after nest loss.

Fledging success for each area is listed on Table 1. Overall, 3.19 young fledged per nest. Similarly, 1972-1973 Kirtland's Warbler production on Walkinshaw's study area increased to 2.75 young per nest from his 1966-1971 average of 0.81 young, probably due to increased cowbird control efforts (Walkinshaw, 1974).

More significantly, the number of young fledged per pair rose from Mayfield's (1960:200) findings of 1.4 young to 3.72 young fledged per pair (265 percent increase). His findings included a greater percentage of nests in the egg stage, though.

#### DOUBLE BROODS

A limited number of Kirtland's Warblers were discovered in 1974 attempting to raise a second brood. Mayfield (1960:79) reported only two instances of "re nesting after fledging of young," both occurring in 1954. Radabaugh (1972) found seven additional cases from 1963-1971, with never more than two cases in any single year.

During 1974 at Mack Lake one pair of adults successfully raised five young from their first nest which were banded and fledged on 27 June. Three more young fledged from their second nest on 1 August. This nest was 45 m SE of their first nest. There was a total of 35 days between the fledging of their first and second broods.

A second pair from Mack Lake raised three young from their first nest which fledged on 21 June. They were also banded and later were observed being fed by the adults. Their second nest, 164 m to the north, contained three Kirtland's Warbler eggs and a young cowbird (removed). The young hatched but were taken by a predator. They were due to fledge on 28 July, which would have been 37 days between successive fledgings.

The third and final pair, also at Mack Lake, fledged four young from their first nest on 20 June. Their second nest was destroyed by predators on 29 July, having originally contained three young Kirtland's, a cowbird, and a cowbird egg. Young at this nest, 59 m NE of the first, would have fledged by 1 August, 45 days after the first brood had fledged.

Berger and Radabaugh (1968) indicated that 28 June (possibly 30 June) was the latest date from which the fledging of young had been followed by an attempted second brood.

In this study, the average fledging date for first broods was 1 July. Eight nests fledged young before the cutoff date described, for which only three (37.5 per cent) second broods were located.

It was interesting to note that each pair chose to build their second nest under the same type of pine as the first, even though they all had a choice between red pines and jack pines.

#### CAUSES FOR PRODUCTION FAILURES

Nests failed to produce fledglings for three reasons: predation on eggs, predation on young, and failure of eggs to hatch. It is significant that cowbird parasitism was not a factor in nest failure except when considering host egg removal. I removed all cowbird young from nests before they inflicted harm to the remaining warblers.



Kirtland's Warbler. Photographed 18 June 1962 by Arthur L. Carpenter.

During this study, four nests were completely destroyed by predators. Mayfield (1960:182-84) found that approximately two-thirds of all nest destruction was by predators. Main avian predators were suspected to be the Blue Jay (*Cyanocitta cristata*) and the Common Crow (*Corvus brachyrhynchos*). Main mammalian predators were believed to be the Thirteen-lined Ground Squirrel (*Citellus tridecemlineatus*) and the Red Squirrel (*Tamiasciurus hudsonicus*). Thirteen-lined Ground Squirrels were often observed in the three study areas feeding on the bait at the cowbird traps. It was also quite common to see Blue Jays working through the pines.

Avian predators were suspected in the destruction of a nest at Pere Cheney which had contained four eggs two days earlier. The nest was intact and even a small mammal is likely to pull up the lining with its claws.

Mammalian predators were suspected in the destruction of another nest at Mack Lake. It contained a lone warbler when discovered. Its nest mates were probably carried off by a small mammal on previous days. Such a predation pattern is believed to be typical of small mammals. Two days later the remaining nestling had disappeared.

Mammals were again suspect in the second nest loss at Mack Lake. This was an attempted double brood which originally contained three Kirtland's Warblers and one cowbird. I observed the male from a distance feeding young in the nest for two days but after close inspection two days later I found the nest empty. It was slightly pulled up on the bottom. That afternoon I observed a Thirteen-lined Ground Squirrel nine meters from the nest entering a burrow.

The fourth nest, also at Mack Lake, was destroyed by a small mammal. Two of the three nestlings disappeared two days before the remaining warbler was taken. The nest was torn and mammalian feces was found in the bottom. Pieces of cowbird egg from the nest which had failed to hatch were scattered around the immediate area.

Failure of Kirtland's Warbler eggs to hatch successfully also contributed to lowered reproduction. Discounting the four eggs lost to predation, six additional eggs failed to reach the nestling stage. Two of these disappeared from successful nests. Mayfield (1960:183) speculated that this may be attributed to egg removal by cowbirds which failed to return to lay or to the removal of broken eggs or dead young from the nest by parents. The remaining four may have been inviable or damaged by cold temperatures. They were collected for pesticide analysis by the U. S. Fish and Wildlife Service.

Although speculative, one final contributing factor to nest loss might be correlated with tree height. By computing the mean heights of the three closest trees to each nest, the mean for Mack Lake was 3.3 m, for Pere Cheney 2.1 m, and for Muskrat Lake, 1.2 m. Of the four nests destroyed, three were at Mack Lake and one was at Pere Cheney. All three parasitized nests were at Mack Lake. Taller trees would provide less protection for ground nesting birds dependent upon cover, a view suggested by Walkinshaw (pers. comm.).

#### REASONS FOR SUCCESS

When viewing the high breeding success of the Kirtland's Warbler in this study, many factors must be kept in mind. The actual fledging success may have been pushed up for several reasons.

One such factor which would tend to bias results would be the failure to locate all nests in the egg laying or early incubation stage. Mayfield (1960:190) found that survival from the nestling stage was higher than that of the egg stage, with as high as 76 percent fledging success from the nestling stage (without cowbird interference). As previously stated, 15 of the 21 nests were in the nestling stage, with the average age of the nestling being nearly five days.

Further increasing the apparent breeding success would be the failure to account for destroyed nests which would have been very difficult to locate. Similarly, eggs removed by predators or cowbirds from nests used in calculating reproductive success would be excluded from the production data. Such nest or egg loss would not be used in computing success, and results would therefore be biased towards an apparently higher figure.

Although results for overall productivity may have actually been lower than reported, the figures for the number of young fledged per nest and per pair remain accurate since they do not involve calculations from the egg stage.

The biggest single factor responsible for high productivity was probably the removal of 4075 cowbirds (Shake, this issue) from the nesting grounds by the U. S. Fish and Wildlife Service. This significantly de-

creased parasitism and proportionately increased fledging success. Mayfield (1960:204) believed that production would be over 60 per cent higher without cowbird interference. Recent studies suggest that the actual figure may be higher than this estimate.

Production was further increased through the removal of cowbird young from parasitized nests.

The second step taken by the U. S. Fish and Wildlife Service was the capture of 389 Blue Jays. This effectively reduced what could very well have been the main nest predator. One Blue Jay was observed in 1974 by Walkinshaw and Faust raiding a Kirtland's nest (pers. comm.). Predation, like parasitism, is directly related to the welfare of the young warblers.

#### PARASITISM

Three nests out of the 21 found were parasitized (14.3 percent). This is higher than the 9.52 percent level for all of the 63 nests examined in 1974 (Shake, this issue).

These figures contrast with the 55 percent level of Mayfield (1960:147) and the 78 percent nest parasitism found by Cuthbert (unpublished) on selected study areas.

All three parasitized nests were at Mack Lake (25 percent), an area composed predominantly of planted red pines. I was able to locate five nests there in less than seven hours of continuous field observation. It is the belief of Walkinshaw and others that areas planted in rows tend to form travel lanes making nest location easier for predators. This may also hold true for cowbirds watching traveling warblers.

One final inference may be made concerning parasitism. Two of the three second broods were parasitized. It is possible that this shows an increased chance of parasitism due to the trap shyness of remaining cowbirds. If they remained uncaptured this late in the season their chances of being caught were greatly reduced. Since there were fewer Kirtland's and all other species nesting at this time the chances that existing nests would have been parasitized was increased due simply to host nest availability.

#### SUMMARY

Studies were made in 1974 on the breeding success of the Kirtland's Warbler at the Mack Lake, Pere Cheney, and Muskrat Lake nesting grounds in Michigan.

Twenty-one nests, all on the ground near pines, were observed in order to determine reproductive success. Eleven (52.3 percent) were located under red pines and 10 (47.6 percent) were under jack pines.

Eighteen pairs of Kirtland's Warblers attended the 21 nests, with three nests being double brood attempts.

Fifteen of the nests (71.1 percent) were found in the nestling stage. By computing back from the number of nestlings if not in the egg stage, it was found that eight of the nests (38.1 percent) had five eggs, eight nests (38.1 percent) had four eggs, three nests (14.3 percent) had three eggs, and the remaining two nests (4.76 percent) had two and one egg respectively. Mean clutch size was 4.0.

The 67 young which fledged represent 79.7 percent of the original 84

eggs (or young). This percentage in actuality may be too high due to the late stages of the nests when found and the failure to account for destroyed nests and lost eggs not used in computing success. Overall, 3.19 young fledged per nest and 3.72 young fledged per pair of adults.

Three nests were parasitized by cowbirds (14.3 percent) and four were destroyed by predators.

Production success was attributed to the removal of 4075 cowbirds and 359 Blue Jays from the nesting grounds by the U. S. Fish and Wildlife Service.

Production failure was due to predation on young and eggs and the failure of eggs to hatch.

Although data were few and inconclusive, predation and parasitism may be correlated with tree height and arrangement. It is also possible that there may be an increased probability of parasitism in late nests due to the trap shyness of the cowbirds and limited host nest availability.

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#### LITERATURE CITED

- Berger, A. J., and Radabaugh, B. E. 1968. Returns of Kirtland's Warblers to the breeding grounds. *Bird-Banding* 39:161-186.
- Mayfield, H. F. 1960. The Kirtland's Warbler. *Cranbrook Inst. of Science, Bull.* 40, Bloomfield Hills, Mich.
- Radabaugh, B. E. 1972. Double-broodedness in the Kirtland's Warbler. *Bird-Banding* 43:55.
- Walkinshaw, L. H., and Faust, W. R. 1974. Some aspects of Kirtland's Warbler breeding biology. *Jack-Pine Warbler* 52(2):64-75.

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## Michigan Bird Survey, Winter 1974-1975

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Winter temperatures were relatively mild through much of the state at least through mid-winter. Snowfall, however, was erratic in distribution and quantity. While there was little snow cover in the west part of the state, the southeast suffered the "storm of the century" when 30 or more inches fell in the Detroit area in early December. Somewhat unexpected was the storm which left 32 inches in the Marquette area in late January. A warming trend near the middle of March brought an end to early migrants, but following this interlude winter settled in again with a repetition of the weather pattern of the last few years. At the end of the period there was still a deep snow cover and thick ice in the north.

There was unanimity of opinion regarding the winter's birds; with few exceptions observers found the winter "uninteresting," "dull," "uninspiring," or "quiet." The general lack of winter finches probably contributed to this assessment; except for normal numbers of Evening Grosbeak and good numbers of Purple Finches, these northern birds were virtually absent. Snowy Owls were numerous only in the northeastern part of the Upper Peninsula; at least three were shot in the Seney area. There were scattered reports of Northern Shrikes, very few Red-breasted Nuthatches, and practically no Boreal Chickadees. The Tufted Titmouse invaded the northern part of the Lower Peninsula reported in the fall was evident through the winter, with many reports of birds at feeders where they had not previously been present.

Again the list of birds remaining well beyond normal departure time was a long one; a fair number of reports showed that such birds were able to survive through the winter, even in the north. In the Alpena area many birds were reported into January, including: Great Blue Heron, Baldpate, Thrasher, Robin, Yellow-rumped Warbler, Meadowlark and Rufous-sided Towhee. Belted Kingfishers were reported in January as far north as Dickinson, Leelanau, and Grand Traverse counties. Several unusual species of ducks were recorded in small numbers through the winter in the southern part of the state (Gadwall, Pintail, Green-winged Teal, American Wigeon, and Wood Duck). More unusual were reports of a Gadwall on a Canvasback on the Marquette Christmas Count and of Green-winged Teal in winter in Alpena, Ingham, and Leelanau counties. Other unusual season records include a Common Snipe in Houghton Co. in late January, a Long-billed Marsh Wren in Monroe Co. in late December, a Winter Wren in Thrusch in Lansing in early January, a Palm Warbler in Iosco Co. in late December, a Black-throated Blue Warbler in Berrien Co. in December, and Rusty Blackbirds at a Lansing feeder in December. Small numbers of blackbirds evidently wintered in Dickinson and Marquette counties.

Early migrants appeared at the normal time, with a good number reported in the southeast from February 22 to the 24th; most of these were well-distributed through the state by March 19, augmented by additional