FINAL REPORT

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Is Cross Fostering a Feasible Management Technique for Kirtland's Warbler?

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Introduction

This study examined cross fostering as a possible management tool for the endangered Kirtland's Warbler, Dendroica kirtlandii. In previous phases of the study, the congeneric Yellow Warbler, Dendroica petechia, was chosen as a surrogate, and the Chipping Sparrow, Spizella passerina, was chosen as the foster parent.

In 1980, 64 eggs and 13 nestlings of Yellow Warblers were placed in nests of Chipping Sparrows at a single locality, the Western Michigan University campus. These yielded 34 mature nestlings and 11 fledglings known to have reached 24 days old (about 2 weeks out of the nest). At this age the young Yellow Warblers seem able to survive independent of parental feeding, so these 11 birds probably represented the pool of cross-fostered young potentially available for migration southward and later return.

This report covers the work of 1981, the primary aim of which was to study any returning young. Secondarily, certain questions of breeding biology of the two species related to cross fostering success were investigated. The specific questions the 1981 observations were designed to answer were

(1) Will the cross-fostered young return to the locality where they were produced?

(2) Will they pair with other Yellow Warblers or will they have been sexually imprinted on Chipping Sparrows in the cross-fostering process and, thus, attempt to mate with them?

(3) Will habitat choice be modified by cross-fostering?

The Early Part of the 1981 Season

Intensive observations began on and around the WMU campus in late April. Chipping Sparrows were already present at that time. To help us anticipate the return of Yellow Warblers on the campus, we monitored two areas of prime warbler habitat elsewhere in the county, at Coldbrook Park and the Kalamazoo Nature Center.

No Yellow Warblers were seen on or around the WMU campus through 27 April. On the following day, 28 April, 3 males were observed. These birds were unbanded, not the result of the cross-fostering project. They were in typical Yellow Warbler habitat along Arcadia Creek which had also supported native Yellow Warblers in 1980. (At the Kalamazoo Nature Center, the first Yellow Warblers were seen on 27 April and several males were present on 28 April.)

During the next several days, general patrols around the WMU campus were made to detect Yellow Warblers and, in addition, several areas were intensively searched. These included all the sites frequented by the cross-fostered fledglings in 1980 and all the localities containing even marginally characteristic Yellow Warbler habitat within about one mile of the WMU campus. Tape-recorded Yellow Warbler songs were broadcast in these areas. Observations on breeding biology of Chipping Sparrows took us into all parts of the WMU campus.

Yellow Warbler populations continued to increase at such locales as Coldbrook Park until about 15 May. By this date or shortly thereafter, about 18 Yellow Warbler males had been found in various sites in Yellow Warbler habitat within about a mile of the WMU campus. None of these was banded. Some were migrants or birds which only briefly defended a territory. Of birds which remained a substantial part of the summer, we were able to observe the associated female in five instances. None of the females was banded.

Not until 20 May was a returning cross-fostered bird observed. It was found at 8:45 AM along Arcadia Creek next to the Conrail tracks at the edge of the WMU campus. The bird, a male, was banded red on the right leg and aluminum on the left, corresponding to the two birds from nest 23. This nest had been in a blue spruce at the edge of the Kalamazoo College football field. The area where the returning bird was found had been visited the preceding day, so he probably arrived the night of 19-20 May.

The bird had inserted itself between two territories that were among the earliest formed (28 April). Over the next 4 days, the bird was observed repeatedly Some pertinent observations follow:

On 20 May, there were repeated fights between the banded male and the resident male to the south (male 2), which was mated. The banded male sang almost continually except when fighting or chasing. It seems evident that the banded male had forced itself into the portion of the resident male's territory that contained the nest. Another male (male 1) that had occupied a territory originally contiguous with that of male 2 was not observed in any aggressive encounters with the banded male. He was no longer present the following day. The general appearance of the aggressive encounters on this day was that when the female was in male 2's territory, the banded male would immediately chase male 2. When the female was in the banded male's territory, male 2 would initiate a chase but generally after a lapse of several minutes. The songs of the banded male was recognizable as that of a Yellow Warbler. Tape recordings of the songs will be subjected to more detailed analysis.

On 21 May, a similar situation existed except that male 2 seemed to have shifted most of his activities southwest, away from the area were disputes were apt to occur. The banded male spent more time in the north part of its territory, similarly away from the boundary. The banded male often responded aggressively to the female when he caught sight of her. This had not been evident on 20 May. The male continued to sing incessantly and to remain highly visible.

On 22 May, the amount of singing by the banded male had dropped greatly.

On 23 May, the amount of singing had again dropped. Male 2, on the other hand had increased his singing. A female was twice seen associated with male 2.

On 24 May, male 2 was in possession of the area occupied the preceding four days by the banded male. The banded male was either gone or, possibly, was staying very inconspicuous. If he was not absent on 24 May, he was gone soon after since on no subsequent day in many hours of observation was he seen again. The female was busy disassembling a nest as though preparing to re-nest following a failure.

We found no other returning birds.

Our tentative reconstruction of this series of events is as follows: The yearling probably returned late, as is not infrequently the case with young birds. It managed to insert itself between two other males, one of which may have been unmated. The area that it claimed contained the nest of the female associated with the other male. The lack of synchrony between the banded male, interested in territorial establishment and courtship, and the female, who was probably egg-laying or incubating, prevented the development of a pair bond. The female simply tried to escape the new male rather than acting so as to appease his aggressiveness. When he, in effect, failed to attract a female (it is possible that the presence of the first female was a deterrent to a second one settling), the male's activity declined, and he left.

Other possibilities exist, including death of the banded male by predation or accident. It is likely that we can never be certain of the exact chain of events. It will, however, be worthwhile to survey the area next spring in case the banded bird returns as a two-year-old.

Implications of the Behavior of the Returning Bird

Many of the questions to which this study was directed seem to be answered although, of course, the behavior of a single returnee is not necessarily indicative of the behavior of every cross-fostered young. The bird which returned settled in typical Yellow Warbler habitat, sang a Yellow Warbler song, behaved territorially toward other Yellow Warblers and chased female Yellow Warblers as males do during the early stages of courtship (Bent 1953, Mayfield 1960, Nolan 1978). These results indicate that fears that cross-fostering would affect behavior in a way that would interfere with later normal reproduction probably were unfounded.

There is one element in the cross-fostering process at nest 23 that needs review. Two Yellow Warbler eggs were substituted for 4 Chipping Sparrow eggs on 9 June 1980. On 19 June, the nest held one Yellow Warbler about 3 days old; the second egg was missing. We transferred in a second Yellow Warbler nestling about 4 days old on 20 June, banded both young with the same combination of color and aluminum bands the following day, and both young fledged. One of the young was not seen after age 25 (days); the other young was seen through age 32. We cannot be sure whether the returning male was the bird transferred as an egg or as a 4-day old nestling. It is possible, accordingly, that the bird could have had both visual (the eyes open at 3 or 4 days of age) and auditory experience typical of Yellow Warblers during a brief period if it was the bird transferred as a nestling.

It is unlikely that such exposure, if it occurred, is important either from a theoretical or management standpoint. Most studies on birds suggest that nesting habitat selection is not influenced very greatly by early experience (e.g. Klopfer and Hailman 1965). If modification does occur, it is probable that it occurs at some time later than the nestling stage (Lohrl 1959). Most evidence bearing on the learning of songs (in species where the song is learned rather than innate) suggests that the song is learned during a sensitive period

that begins at an age several days beyond hatching. In the White-crowned Sparrow, Zonotrichia leucophrys, the sensitive period is from about 10 to 100 days of age (Marler 1970).

Probably, then, any experience by a Yellow Warbler nestling in the nest of its genetic parents during the first few days would not be important in its later predilections. Of course, even if the bird that returned was the one transferred during the egg stage, innateness of the behavioral traits mentioned is not proved because they could have been learned during some sensitive period shortly after reaching independence. The bird might have moved to new habitats, heard other vocalizations, and showed a genetic predisposition to learn those that were "correct." Whether the tendencies are innate or learned, the findings indicate that cross-fostered Yellow Warblers will

(1) return to the general area where reared,

(2) recognize other Yellow Warblers as conspecific for territorial purposes and

(3) recognize other Yellow Warblers as conspecifics for reproductive purposes, at least up to the early stages of courtship.

Other 1981 Observations

In addition to the observations on this bird, we were able to make extensive observations on the nesting biology of Chipping Sparrows that bear on their abilities as foster parents and, in lesser amount, observations on the nesting biology of Yellow Warblers that bear on their requirements as foster young.

Briefly summarized, the observations suggest that Chipping Sparrows feed cross-fostered young a diet and at a rate allowing apparently normal development. A difference exists in the length of time that the two species feed their own young out of the nest. We have observations on 7 broods of Yellow Warblers (not cross-fostered) over the age of 25 days. Six of these were still being tended by the adults; we were not able to answer the question of how much past 25 days feeding continues but it is sometimes--possibly usually--beyond 30 days. We have data on 9 broods of Chipping Sparrows in which we were able to pinpoint th age at which the adults stopped feeding them. The range was 22 to 27 days, with a median of 25.

Chipping Sparrows continued feeding cross-fostered Yellow Warbler young considerably longer than they fed their own fledglings. Nine young were fed at 27 days of age or older (including one that was fed when 40 days old). It is, nonetheless, possible that the conflicting drives for continuing to feed one brood and for beginning the process of producing another could affect the qualify of care given to the foster young.

Our data indicate that the survival of cross-fostered Yellow Warbler young is much poorer than the survival of non-cross-fostered Chipping Sparrow young.

Chipping Sparrows that had been cross-fostered into other Chipping Sparrow nests would, of course, be a better control. The comparison is made in Table 1. The discrepancy exists for survival during incubation and becomes more pronounced at each succeeding stage. The period at and immediately after fledging seemed to be a particularly vulnerable time for the young Yellow Warblers but not for the young Chipping Sparrows.

Most of the difference in survival lay in differential predation rates. Why the eggs of Yellow Warblers should be less secure in a Chipping Sparrow nest than Chipping Sparrow eggs eludes us. Nestlings of Yellow Warblers match the color of Yellow Warbler nests closely, so it is likely that the nestlings are more vulnerable to predators in Chipping Sparrow nests, which they do not match. Two reasons for the spectacularly higher predation rate on fledglings seem possible: the young warblers may fail to respond to parental signals, e.g., warning notes in the presence of predators. Or the young may be poorly adapted to escaping notice or capture or both in the parkland habitat used in this study.

Management Implications

In this study we have shown that Chipping Sparrows are able to raise Yellow Warblers to independence and that the cross-fostered warblers will, at least sometimes, return to the area where they were reared and behave, insofar as could be determined, like Yellow Warblers. If these results can be applied to Kirtland's Warblers (and I see no reason why they cannot), Chipping Sparrows could be used as foster parents to introduce Kirtland's Warblers into areas of seemingly suitable habitat where they do not currently live. This will be discussed in more detail below. In an intensively monitored population of Kirtland's Warblers, cross fostering could also be used in another, minor, application. Our results indicate that salvaging of eggs from deserted nests (assuming the eggs are still viable) or eggs or nestling from nests where the female or both parents have been lost would be a productive endeavor. They could be placed in Chipping Sparrow nests (from which the sparrow eggs or young were removed) or, judging from the results of an earlier pilot study, in Field Sparrow nests.

The stages involved in cross fostering and our comments as to implementation are as follows:

Introduction of eggs or nestling. Acceptance of either was never a problem. We recommend transferring only two warbler eggs into each nest to reduce intra-brood competition. Using only a single egg in each nest might be a possibility but it may be important for the young warbler to see a conspecific as either a sibling or a parent.

Incubation. No special problems were encountered; however, consideration might be given to using a predator-proof cage around each cross-fostered nest (with an opening large enough for the parents to enter).

Nestling period. No problems were countered at this stage except that when three or more warblers were cross-fostered the sparrow nest seemed overfull in the last few days of the nestling period. After young were banded, the Chipping Sparrow parents generally tried to throw the bands out of the nest. They rarely succeeded but consideration should be given to omitting banding in a cross-fosterin operation using Kirtland's Warblers.

On two occasions, one involving a Yellow Warbler and one a Chipping Sparrow, the foot of an older nestling became entangled in the hair lining the nest and the bird perished when it failed to fledge at the same time as its siblings. Although a minor source of mortality, this mishap should be guarded against.

During nestling life, at fledging, and during the fledgling period predation was high. We would recommend stringent predator control during any cross fostering attempt with Kirtland's Warblers. The control should include not just animals traditionally considered predators such as hawks, owls, and snakes but also Blue Jays, grackles, and ground squirrels.

Fledgling period. The time of fledgling and the fledgling period were times of special vulnerability for the cross-fostered Yellow Warblers. If, as we suspect, this was more a matter of the behavior and appearance of the young failing to fit them to the habitat than a matter of parental failure, the cross fostering of Kirtland's Warblers in Chipping Sparrow nests in Kirtland's Warbler habitat should present fewer problems. The predator control advocated above should, in any case, help.

It would probably be desirable to play tape recordings of Kirtland's Warbler songs in the cross-fostering area so that, should a model for song development be necessary, it would be present.

Return of birds. We suppose (see Brewer and Harrison 1975 and Adams and Brewer 1981) that the location of the breeding site is chosen after the young reach independence in the late summer. Some management scheme that kept the young near the cross-fostering site until fall migration would presumably increase the rate of return. We have, however, no useful suggestions on how to do this.

We would recommend a continuation of stringent predator control during the second year (when the cross-fostered birds returned) also.

Evaluation of Cross-fostering as a Management Tool

Of 77 eggs and nestlings transferred, we achieved only a single returning bird. We think that by some of the efforts described above this rate could be substantially improved. We think, for example, that a loss of no more than 50% from egg to independent fledgling is possible, using recommendations in the preceding section, and that a survival rate of 25% from independent fledgling to returning yearly is realistic. Given these values and assuming that all birds returned to the cross-fostering area, 50 transferred eggs would yield 25 birds at independence and 5 returning birds the next spring. These are,

of course, average figures, and in any actual trial the figures might be higher or lower. For example, even if 25 birds were available to migrate south, a .25 survival rate would allow one or no birds to return the following year about one year out of 16.

Although we have demonstrated that Yellow Warblers will return to the area where they fledged and Walkinshaw (1977) has done the same for Kirtland's Warblers it seems clear that there is a strong tendency on the part of young Kirtland's Warblers to disperse to neighboring colonies (Walkinshaw 1977, Ryel 1981). Some of this may be the result of deteriorating habitat in older colonies and of the birds' perception of crowding in successful colonies. It is possible that birds cross-fostered in prime habitat that held no other Kirtland's Warblers would tend not to disperse.

Although most thinking about cross fostering has been directed toward establishing birds in seemingly suitable habitats in areas remote from their current breeding colonies, e.g., in Wisconsin, the fact that colonies tend to recruit yearlings suggests another role for cross fostering. An area of prime but unused habitat within a few miles of existing colonies (especially those with deteriorating habitat) might be "seeded" with a few cross-fostered birds that might serve to induce naturally produced young from neighboring colonies to settle there.

Our tentative conclusions on cross fostering as a mangement tool follows. (The observations made during the last two years are expected to yield several manuscripts that will be submitted to journals for possible publication. These manuscripts and any published versions will be filed as supplements to this report.)

1. Cross fostering would be useful in salvaging eggs or young in predated or deserted nests.

2. Cross fostering could almost certainly be used to establish a breeding population of Kirtland's Warblers in a new area of unused habitat.

3. If such a use were contemplated, cross fostering in unused but prime habitat near existing colonies would be best because of the possibility of recruitment from neighboring colonies.

4. A minimum of 50 eggs (about 12 clutches) and 25 Chipping Sparrow nests would be required for an attempt. Better would be 1.5 to 2 times as many.

5. Removing eggs for cross fostering would probably reduce the number of pairs of Kirtland's Warblers that could produce two broods and thus would probably result in a net loss in the total number of young for the year. Still, relatively few pairs produce second broods (Ryel 1981) so that the loss might not be great. It might be possible to identify individual males or females that seemed never to undertake a second brood (but that would re-nest following disturbance) and use their eggs for cross fostering.

6. If, as Ryel (1981) believes, the population size of the Kirtland's Warbler is limited by events on the wintering grounds, the usefulness of cross fostering as a technique for increasing Kirtland's Warbler numbers would be limited.

Table 1. Comparative Success of Chipping Sparrows Raising Yellow Warblers and Raising Chipping Sparrows.

Species of Young	No. of nests	Percent Mortality		
		Eggs	Nestlings	Fledglings
Yellow Warbler	30	53	47	74
Chipping Sparrow	26	38	20	20

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