

KIRTLAND'S WARBLERS ON THE NESTING GROUNDS DURING THE POST-BREEDING PERIOD

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ABSTRACT.—Eighty-four Kirtland's Warblers (*Dendroica kirtlandii*) were caught 122 times during 8809 net-h at five study areas on the breeding grounds in northern lower peninsular Michigan during the post-breeding seasons (16 August–30 September) from 1984–1987. This more than quadruples the known number of post-breeding season records for the species at the nesting colonies. Combined with older records within and south of the breeding grounds, this information indicates that a substantial number of breeding birds remain in Michigan through September, and a few individuals probably remain into early October. Mean capture rate per 100 net-h was 1.4 warblers at the principal study area for the post-breeding period. Males were captured more frequently than females. Most hatching year (HY) birds had completed Prebasic I Molt by the end of August whereas Basic Molt occurred throughout the 16 August–30 September study period in after hatching year (AHY) birds. Subcutaneous fat deposition was low for both sexes in the two age classes prior to migration. Migration apparently consists of two waves—an early departure (mid-August to early-September) of HY birds, and late departure (late September) of AHYs. These late-season birds may face some man-induced stresses after the traditional 1 May–15 August breeding area closure. An extension of the closure through mid-September is recommended. *Received 12 Jan. 1989, accepted 20 Feb. 1989.*

Because the endangered Kirtland's Warbler (*Dendroica kirtlandii*) breeds within a highly restricted range centered in a six-county region in northern lower peninsular Michigan (Walkinshaw 1983), great care has been taken to protect the bird and its habitat during the period it remains in the state. The Kirtland's Warbler Recovery Team (Byelich et al. 1976, 1985) stressed the need to restrict human use of all state and federal forest lands used by the warbler for nesting (95–97% of current nesting areas; Ryel 1984, Weise 1987) from 1 May to 15 August each year, embracing the mid-May to mid-July nesting period (Mayfield 1960). These closure dates include time before and after the known nesting period to buffer the birds from undue stresses which might affect survival. The original recovery plan further indicated that a review of "all land use plans" should be made "in order to avoid conflicts which may be detrimental to the birds" (Byelich et al. 1976, p. 25).

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Biologists working with Kirtland's Warblers have concentrated their efforts during the breeding period, when adult males are highly vocal and conspicuous and nests are easily found. By mid-July most singing has ceased, most chicks have fledged, and the birds become more cryptic in plumage and behavior, requiring increased effort to find them (Mayfield 1960, Walkinshaw 1983). By August, the first Kirtland's Warblers have returned to the Bahamas (Hundley 1967, Wallace 1968, Robertson 1971). It has been widely assumed that most of the warblers leave the nesting areas in August (Mayfield 1960; Walkinshaw 1983; Byelich et al. 1976, 1985), as relatively few published records exist (11 for the second half of August and 13 for all of September); only one record is later than 1933 (Table 1).

In 1984 we began banding Kirtland's Warblers in the post-breeding season. We were initially surprised to capture five birds in September in a modest banding effort. Since the presence of large numbers of Kirtland's Warblers on the breeding grounds during the post-breeding season would alter our understanding of their post-breeding and migratory behavior, and also have major implications for their management, we decided to obtain information on the numbers, age, sex, and locations of these late-summer early-fall birds.

STUDY AREAS AND METHODS

Study areas in 1984 were east of Grayling in Crawford County, Michigan, and included: (1) "Bald Hill" (Sect. 20, T-27-N, R-1-W) north of North Down River Road, two net sites, 23 nets; and (2) "Bucks Crossing" (Sect. 8 and 9, T-27-N, R-2-W) along Lewiston grade on Camp Grayling Artillery Range (Michigan National Guard), three net sites, 39 nets. Study areas in 1986 included: (1) "Bald Hill," four net sites, 48 nets; and (2) "McKinley" (Oscoda County, Sect. 10, T-26-N, R-4-E); 2 net sites, 14 nets. Study areas in 1987 were in the vicinity of Grayling and Mio and included: (1) "Bald Hill," six net sites, 91 nets; (2) "Muskrat Lake" (Oscoda County, Sect. 13, T-27-N, R-1-E) north of County Road 608, three net sites, 26 nets; and (3) "Mack Lake" (Oscoda County, Sect. 21 and 22, T-25-N, R-3-E) west and east of U.S. Forest Service Road 4147 in the southcentral part of the 1980 Mack Lake Burn (Simard et al. 1983) on the Huron National Forest, two net sites, 27 nets. When a study area was used for more than one field season (Bald Hill) the same net sites and net lanes were used each year, with new net sites and lanes being added as needed.

Netting operations were conducted from 8 August–6 September 1984, 13 August–13 September 1986, and 1 July–29 September 1987. The post-breeding period in this paper refers to 16 August to 30 September. This 46-day period has been subdivided into three intervals for analysis; 16–31 August, 1–15 September, and 16–30 September. Birds were captured with black nylon ATX 4-shelf, 12 × 2.6-m tethered mist nets with 36-mm mesh stretched between two 3-m-high pieces of galvanized electrical thin-walled conduit. Each net had its own set of support poles. Net configurations, conforming to vegetative cover and topography, consisted of single nets, nets end to end in line, and in T and L configurations, right angle crosses, etc.

Netting was generally conducted during the morning, as winds and/or high temperatures

made afternoon or early evening netting impractical on most days. No netting was attempted during rainy weather. We generally did not operate the same net sites on consecutive days in an attempt to prevent birds from acclimating to the nets. Nets were checked and birds removed every 15–30 min. All Kirtland's Warblers were released at the same net where captured after being banded, aged (adult = after hatching year—AHY; immature = hatching year—HY), sexed, and checked for molt. Birds were checked for subcutaneous fat using the system developed by Helms and Drury (1960) with the following fat classes: 0 = no fat, 1 = trace of fat in furculum, 2 = furculum lined with thin layer of fat, 3 = $\frac{1}{4}$ to $\frac{2}{3}$ furculum full of fat, 4 = furculum full of fat but not bulging, 5 = furculum bulging and fat along sides, etc. If an individual was captured more than once, fat class for the latest date captured was the value used in this paper. Handling of the warblers was completed as quickly as possible. Birds were transported and held in soft white open mesh nylon delicate-fabric laundry bags (36 × 45 cm with 4 × 4 mm mesh) with zippers across one end. All birds were uniquely color banded, two bands per leg, with red, light green, light blue, or yellow plastic butt-end size 1 bands bonded with a drop of acetone in combination with a size 1 U.S. Fish and Wildlife Service band.

The sex and age ratios, and proportion of birds with fat were compared using contingency table analyses. Capture rates were assumed to follow a Poisson process and were compared among time periods using the normal approximation of Cox and Lewis (1978).

RESULTS

During the post-breeding season, 84 different Kirtland's Warblers were caught 122 times. Twenty-five of these birds were recaptured a total of 38 times. Each bird was tallied only once in each of the three time intervals used in our analysis, even if caught more frequently. This resulted in the addition of 23 recaptures to our data set (Table 2). These 107 records are comprised of 57 males, 39 females, and 11 sex-undetermined HY birds.

There was a continuing drop in the number of individuals of both age classes (HY = 38 to 0 and AHY = 25 to 11) from late August to late September, with a significantly greater decrease ($\chi^2 = 13.65$, $P < 0.0002$, $df = 1$) for HYs than for AHYs during this period (Table 2). HY birds made up 49% ($N = 52$) of the total captures (includes recaptures) throughout the post-breeding season. HY birds constituted a majority (60%, $N = 38$) of birds netted during 16–31 August, decreasing to 42% ($N = 14$) from 1–15 September, and strikingly, to 0% from 16–30 September.

The netting effort (8809 net-h for the five study areas) is summarized in Table 3. Our effort increased each year of the study. Only at Bald Hill (with 76% of the total net-h) did we net in all three years; all other areas were netted during one year. Mean capture rate per 100 net-h at Bald Hill for the 16 August–30 September period was 1.4 (Table 4). This rate was variable from year to year with 3.7, 2.2, and 1.0 birds for 1984, 1986, and 1987, respectively. The annual decline of capture rate over the years at Bald Hill reflects an annual increase in our banding effort later in the season combined with coverage in more marginal sites in an attempt to capture dispersing birds.

TABLE 1
PUBLISHED RECORDS OF KIRTLAND'S WARBLERS ON THE BREEDING GROUNDS AFTER MID-AUGUST

Date	Locality	Age ^a	Sex ^b	Type of record ^c	Collector or observer	Reference ^d
20 Aug 1903	Near junction of N. Branch Au Sable Riv., Crawford County	U	U	Sighting	J. A. Parmalee	Wood and Frothingham 1905
20 Aug 1933	Red Oak, Oscoda County	U	M	Specimen UMMZ 97791	A. D. Tinker	Wood 1951
25 Aug 1904	Roscommon County	U	M	Sighting	—	Frothingham 1906
26 Aug 1933	SE of Lovells, Crawford County	U	M	Specimen UMMZ 72366	A. D. Tinker	Wood 1951
26 Aug 1933	SE of Lovells, Crawford County	U	M	Specimen UMMZ 155,431	A. D. Tinker	Wood 1951
27 Aug 1915	Near Luzerne, Oscoda County	A	M	Specimen UMMZ 125,703	M. M. Peet	Wood 1951
30 Aug 1916	Near Luzerne, Oscoda County	I	F	Specimen UMMZ 125,705	M. M. Peet	Wood 1951
30 Aug 1916	Near Luzerne, Oscoda County	A	F	Specimen UMMZ 125,706	M. M. Peet	Wood 1951
30 Aug 1916	Near Luzerne, Oscoda County	A	F	Specimen UMMZ 125,707	M. M. Peet	Wood 1951
30 Aug 1916	Near Luzerne, Oscoda County	A	M	Specimen UMMZ 125,708	M. M. Peet	Wood 1951
31 Aug 1916	Near Luzerne, Oscoda County	A	M	Specimen UMMZ 125,709	M. M. Peet	Wood 1951
1 Sep 1915	Near Luzerne, Oscoda County	A	M	Specimen UMMZ 125,704	M. M. Peet	Wood 1951
1 Sep 1930	3 mi. SE Lovells, Crawford County	A	F	Specimen UMMZ 65993	A. D. Tinker	Wood 1951
3 Sep 1904	Near junction of N. Branch Au Sable Riv., Crawford County	U	U	Sighting	J. A. Parmalee	Wood and Frothingham 1905
4 Sep 1916	Near Luzerne, Oscoda County	A	M	Specimen UMMZ 125,710	M. M. Peet	Wood 1951
5 Sep 1916	Near Luzerne, Oscoda County	A	F	Specimen UMMZ 125,711	M. M. Peet	Wood 1951
6 Sep 1916	Near Luzerne, Oscoda County	I	M	Specimen UMMZ 125,712	M. M. Peet	Wood 1951
6 Sep 1916	Near Luzerne, Oscoda County	A	F	Specimen UMMZ 125,713	M. M. Peet	Wood 1951
7 Sep 1916	Near Luzerne, Oscoda County	A	F	Specimen UMMZ 125,714	M. M. Peet	Wood 1951
8 Sep 1916	Near Luzerne, Oscoda County	A	F	Specimen UMMZ 125,715	M. M. Peet	Wood 1951

TABLE 1
CONTINUED

Date	Locality	Age ^a	Sex ^b	Type of record ^c	Collector or observer	Reference ^d
8 Sep 1916	Near Luzerne, Oscoda County	A	M	Specimen UMMZ 125,716	M. M. Peet	Wood 1951
9 Sep 1916	Near Luzerne, Oscoda County	A	M	Specimen UMMZ 125,717	M. M. Peet	Wood 1951
28 Sep 1919	7 mi. S of Houghton Lake Village, Roscommon County	A	M	Specimen UMMZ 125,718	M. M. Peet	Wood 1951
29 Sep 1975	Mack Lake Mgt. Area, Oscoda County	U	U	Sighting	P. F. Schempf	Schempf 1976

^a A = adult, I = immature, U = unknown.

^b F = female, M = male, U = unknown.

^c Specimen data at the Univ. of Michigan Museum of Zoology (UMMZ) courtesy of Janet Hinshaw.

^d Complete references listed in Lit. Cit. section.

TABLE 2
KIRTLAND'S WARBLERS CAPTURED DURING 15/16-DAY INTERVALS IN THE POST-BREEDING
SEASON 1984, 1986, AND 1987^a

Sex/age ^b	Number of birds by period			Total
	16-31 Aug	1-15 Sep	16-30 Sep	
Male	30	20	7	57
HY	17	8	0	25
AHY	13	12	7	32
Female	25	10	4	39
HY	13	3	0	16
AHY	12	7	4	23
Sex undetermined HY	8	3	0	11
Total individuals	63	33	11	107

^a Individuals captured in each 15/16-day interval were counted only once for that interval (although some were captured more frequently).

^b HY = hatching year bird; AHY = after hatching year bird.

Capture rates at Bald Hill for the late-breeding season (1 July–15 August) compared to the post-breeding season (16 August–30 September) are presented in Table 4. Using data for all three years, the capture rates during the late-breeding period were higher than during the post-breeding period ($Z = 4.11$, $P < 0.0001$). Within the post-breeding period, data from all three years were used to compare late August with early September, but only 1987 data were available to make comparisons with late September. Capture rates did not differ between late August and early September ($Z = 0.51$, $P = 0.6080$), but rates for both periods were higher than that of late September ($Z = 3.01$, $P = 0.0026$ and $Z = 1.98$, $P = 0.0479$). Sample sizes from other study areas in 1987 and earlier were too small for statistical analyses.

The late recaptures (1 September or later) in 1987 totalled 11 individuals (Fig. 1). These birds were assumed to be present in the vicinity continually at least until the last date shown, as all initial bandings of the 11 birds and all subsequent recaptures were within the same study areas. Some of these birds were probably present later than we recorded them. The late recaptures consisted of 18% HYs (1 male, 1 sex undetermined) and 82% AHYs (7 males, 2 females). All birds initially banded in September 1987 were subsequently recaptured in the same month. The last date on which a Kirtland's Warbler was recaptured (29 September 1987 at Bald Hill) equals the latest published record (Schempf 1976) for the species on the breeding grounds.

The sex ratio of the captures when sex was determined (89%) was 1.4 males to 1 female, but this was not significantly different from 1:1 ($\chi^2 =$

TABLE 3
MIST NETTING EFFORTS AND KIRTLAND'S WARBLER CAPTURE RATES IN MICHIGAN DURING THE POST-BREEDING PERIOD

Period*	Study areas															
	Bald Hill		Mack Lake		Muskrat Lake		Bucks Crossing		McKinley							
	Total net-h	Capture rate/100 net-h (N)	Total net-h	Capture rate/100 net-h (N)	Total net-h	Capture rate/100 net-h (N)	Total net-h	Capture rate/100 net-h (N)	Total net-h	Capture rate/100 net-h (N)						
1984																
(16 Aug-6 Sep)																
16-31 Aug	275	3.6	10				132	1.5	2		407					
1-15 Sep	78	3.8	3				42	4.8	2		120					
Total	353	3.7	13	0		0	174	2.3	4	0	527					
1986																
(16 Aug-13 Sep)																
16-31 Aug	743	2.4	18							0	743					
1-15 Sep	557	1.8	10							102	659					
Total	1300	2.2	28	0		0	0			102	1402					
1987																
(16 Aug-29 Sep)																
16-31 Aug	2246	1.4	31	340	0.3	1	226	0.4	1		2812					
1-15 Sep	924	1.3	12	671	0.3	2	165	1.8	3		1760					
16-30 Sep	1842	0.5	9	231	0.4	1	235	0.4	1		2308					
Total	5012	1.0	52	1242	0.3	4	626	0.8	5	0	6880					
Study area total	6665	1.4	93	1242	0.3	4	626	0.8	5	174	2.3	4	102	1.0	1	8809

* Dates in parentheses are inclusive for data used in this paper.

TABLE 4
COMPARISON OF CAPTURE RATES OF KIRTLAND'S WARBLERS BY YEARS FOR BALD HILL
STUDY AREA FOR LATE-BREEDING AND POST-BREEDING SEASONS

Year	Late-breeding season			Post-breeding season		
	1 July–15 August			16 August–30 September		
	Total net-h	No. birds captured	No. birds/100 net-h	Total net-h	No. birds captured	No. birds/100 net-h
1984	201	8	4.0	353	13	3.7
1986	119	3	2.5	1300	28	2.2
1987	1989	58	2.9	5012	52	1.0
Total	2309	69	3.0	6665	93	1.4

2.42, $P = 0.1198$, $df = 1$) (Table 2). This preponderance of males was found in both HY and AHY age classes and for each of the three post-breeding season intervals.

Our study of molt in this species during the post-breeding period has just commenced, so the results presented are preliminary. The Prebasic I Molt (Postjuvenile Molt, body plumage only; see Mayfield 1960) in HY birds ($N = 37$ different individuals) was generally completed by the end of August. However, there was a wide range of variability among individuals, as some had completed their Prebasic I Molt by 16 August, while others extended to the end of August (32%) and a few to 10 September. We did not observe any sign of molt in remiges and rectrices of HY birds after the end of August. The Basic Molt (Postnuptial Molt) in AHY birds ($N = 38$ different individuals) spanned the length of our study period, 16 August through 29 September. As with HY birds, the start and completion of molt was highly variable among individual AHYs. Two AHY males required more than 30 days, and that for an AHY female exceeded 28 days. Although the work presented in this paper does not extend long enough into the fall to encompass the entire Basic Molt, it may prove similar in length to the 39–42-day period that Nolan (1978) found for the Prairie Warbler (*D. discolor*).

Fat classes were determined for 26 Kirtland's Warblers (12 HYs, 14 AHYs) in 1986 and 50 warblers (25 HYs, 25 AHYs) in 1987. In 1986, the percentages of individuals for the fat classes (0 [none], 1, 2, 3, 4, and 5 [highest value]) were 31, 50, 15, 4, 0, and 0, respectively and for 1987, the percentages were 40, 4, 24, 26, 6, and 0, respectively. Combining classes 0 and 1 into a low fat group and classes 2–5 into a high fat group showed that proportionally more high fat birds were caught in 1987 than in 1986 ($\chi^2 = 9.41$, $P = 0.0022$, $df = 1$). This difference may be a result of more late captures in 1987.

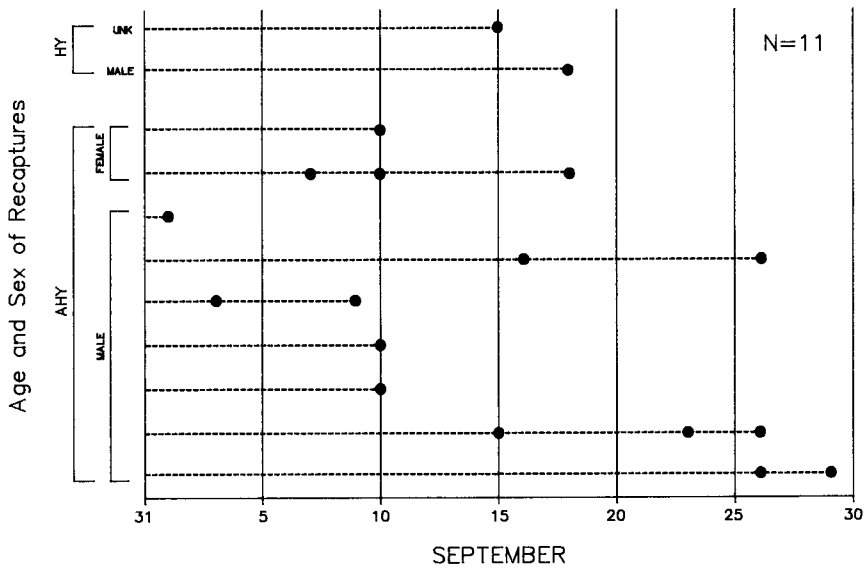


FIG. 1. Late recaptures of Kirtland's Warblers in 1987. Each solid dot represents a recapture; dashed lines indicate the birds were probably present in the vicinity.

DISCUSSION

Our study reveals that a substantial portion of the Kirtland's Warbler population remains on the breeding grounds in Michigan at least through September. Also, from 18 August–12 September 1985, biologists with the Michigan Department of Natural Resources made eight observations of 10 unmarked (4 in September) Kirtland's Warblers on the breeding grounds (E. S. Carlson and J. A. Weinrich pers. comm.). We infer that a few birds may remain to the first half of October. The published records of migrant Kirtland's Warblers ($N = 15$) in areas south of the breeding grounds after 1 September support this hypothesis (Table 5). Five Kirtland's Warblers (33%) were located within 310–460 km of the breeding area from 2–25 October.

HY birds appear to leave the breeding grounds earlier than adults, because proportionally fewer young of the year are found in September. This apparent decrease could result from HY birds migrating earlier than AHY birds, from higher mortality of HY birds during this period, from post-breeding dispersal by HY birds, or from temporally based changes in capture probabilities. We feel that HY birds, in general, migrate earlier than adults. Nolan (1978) found this to be true with Prairie Warblers. Also, during the post-breeding period, HY birds complete their wing and tail molt by the end of August, while in adults this extends through

TABLE 5
FALL KIRTLAND'S WARBLER RECORDS ADJACENT TO THE BREEDING GROUNDS AFTER 1 SEPTEMBER

Region	Date	Locality	Age ^a	Sex ^b	Type of record	Reference ^c
Southern Michigan	24 Sep 1965	Bloomfield Hills, Oakland County	I	M	Sighting	Nickell 1965
	29 Sep 1951	Muskegon	U	U	Sighting	Whelan 1952
Southern Ontario	14 Sep 1948	Pickering, Durham County	U	U	Sighting	Walkinshaw 1983
	2 Oct 1915	Point Pelee, Essex County	I	M	Specimen	Harrington 1939
Northern Illinois	2 Sep 1948	Loves Park, Winnebago County	A	M	2 sightings	Smith and Parmalee 1955
	4-5 Sep 1966	Chicago	U	U	Sighting	Peterson 1968
Northern Indiana						No records
Northern Ohio	2 Sep 1935	Near Hilliard Bridge, Cleveland	U	U	Sighting	McQuown 1944
	8 Sep 1940	Cleveland	U	U	Sighting	McQuown 1944
Ohio	22 Sep 1929	Springfield Township, Lucas County	U	U	Sighting	Campbell 1940
	26 Sep 1943	Rocky River Valley, Cuyahoga County	U	U	Sighting	Williams 1943a, b
	28 Sep 1969	Bowling Green	U	U	Sighting of 2 birds together	Clench 1973
	5 Oct 1941	Rocky River Valley, Cuyahoga County	U	U	2 sightings	Williams 1941a, b
	7 Oct 1934	Near Hilliard Bridge, Cleveland	U	U	2 sightings	McQuown 1944
	14 Oct 1886	Cleveland	U	U	Found dead	Davies 1906
	25 Oct 1969	Cleveland	U	U	Sighting	Clench 1973

^a A = adult, I = immature, U = unknown.

^b M = male, U = unknown.

^c Complete reference listed in Lit. Cit. section.

September. Furthermore, Berger (1968) found migratory restlessness in captive (hand reared) HY Kirtland's Warblers ($N = 9$) between 25 August–8 September.

Of the August records in the Bahamas, one Kirtland's Warbler was listed as an adult female (Wallace 1968), two males and a female were listed with age unspecified (Hundley 1967), and another was listed with age and sex unspecified (Robertson 1971). Our experience with Kirtland's Warblers leads us to question the reliability of aging and sexing this species at this time of year unless examined in hand. The more subdued plumages of the two age groups in the fall made it difficult to distinguish between age/sex classes. However, a few (but not all) adult males retain some trace of black in the region of the lores, and these individuals can be aged and sexed in the field if seen at close range under good lighting conditions. Given these conditions, the age and sex for the August sight records in the Bahamas may not be reliable.

Our data suggest that Kirtland's Warblers tend to migrate alone in the fall rather than in groups. This is supported by published accounts of migrating individuals with no mention of conspecifics (Mayfield 1960, Clench 1973, Walkinshaw 1983). Hence, most HY birds probably make their first southward migration alone in the absence of adults with prior experience.

Subcutaneous fat deposition was surprisingly low for the 76 individuals (1986 and 1987 combined) examined. Many of the birds during 16 August–29 September showed no fat deposition (31% in 1986 and 40% in 1987). There were no birds in 1986 in the two highest fat classes (4 and 5) and only 6% in fat class 4 and none in fat class 5 in 1987. This small sample suggests that most Kirtland's Warblers have not accumulated a large energy reserve by late September prior to initiating migration. Data for HY and AHY birds were similar in this regard. Migratory birds are known to build up fat just prior to migrating (Wolfson 1945, Cherry 1982, Pettersson and Hasselquist 1985, Moore and Kerlinger 1987). The apparent lack of fat accumulation in Kirtland's Warblers prior to migration needs further investigation.

Probst and Hayes (1987) suggested the possibility of an imbalance in the sexes. Although the sex bias in favor of males that we found supports Probst and Hayes, the sex ratio is not significantly different from 1:1. Although there could be higher female mortality, due to incubating the eggs and brooding the young in ground nests, we note here that capture probabilities for males and females may have differed and led to biased sex ratios in the capture data. However, with the Kirtland's Warbler population hovering near 200 singing males for the last 17 years (Ryel 1984, Weinrich 1987), a possible skewed sex ratio in favor of males is cause for concern and should be carefully monitored in the future.

The first posted closure of Kirtland's Warbler breeding grounds on public land was implemented in 1964 at Mack Lake (Huron National Forest), and this management procedure was followed on state forest lands several years later (G. W. Irvine, J. A. Weinrich pers. comm.). The time of closing was set to encompass the entire breeding season. An opening date in mid-August was based upon the supposition that all breeding activities were completed and that most of the warblers had left the nesting areas by late August or early September (Mayfield 1960; Walkinshaw 1983; Byelich et al. 1976, 1985). The mid-August opening date for the warbler areas was further supported by the early Bahama records (Hundley 1967, Wallace 1968, Robertson 1971). Published data would logically lead one to conclude that by late August most of the warblers would have left the Michigan breeding grounds. Aside from the unpublished Michigan DNR records, only one Kirtland's Warbler has been reported on the breeding grounds after 16 August in the last 50 years (Schempf 1976). Males sing only from early May to early July, and the birds become extremely difficult to find by the end of July; it is easy to conclude erroneously that most birds have left by this time or shortly thereafter.

We (pers. obs.) have seen five recently fledged young from three nests being actively fed between 14 and 17 August. Kirtland's Warblers generally care for their young from 29 to 44 days after they leave the nest (Mayfield 1960), so these late young would not be independent until well into September.

We have observed various potentially harmful activities in occupied Kirtland's Warbler habitats following their opening to the public on 15 August. Included were: recreational use of all-terrain vehicles (ATVs), dirt bikes, pickup trucks, and automobiles; firewood cutting and gathering; field training and conditioning of dogs for hunting; cutting, stacking, and hauling of pulpwood; seismic exploration for petroleum deposits; and, starting in mid-September, hunting of snowshoe hares (*Lepus americanus*) and Ruffed Grouse (*Bonasa umbellus*). While there may be little chance of direct harm to individual Kirtland's Warblers from these activities, mortality to the birds could occur. More serious is the threat of fire from people (discarding hot matches, smoking, open camp fires, etc.) and mechanized equipment (hot exhaust systems, sparks, etc.) in jack pine areas that are adapted to burn, particularly in dry years. As an example, in 1987 43% of the Kirtland's Warbler population was found in two areas, and loss of this habitat could have been a disaster to a species with such low numbers.

Because the Kirtland's Warbler is endangered and is a breeding species unique to Michigan, it would seem reasonable to keep the few areas occupied by them closed while the birds are present and while fire danger is still high. The total habitat occupied by the warbler (parts of 54 sections

in six counties, Weinrich 1987) is miniscule compared to the Federal and State forest lands in northern lower peninsular Michigan available for recreational activities enjoyed by the public.

Our efforts indicate that many Kirtland's Warblers remain on the breeding ground longer than previously thought, with a few birds possibly remaining into October. We recommend that all breeding areas having more than ten singing males remain closed until mid-September. This would protect the warblers from human activity as much as possible. The extension would encompass all late nesting activities, provide added protection for late hatched HY birds not yet fully independent, minimize disturbance to molting adults (AHYs), and provide added protection during the critical period when migratory energy reserves are being acquired. Since we do not know what factors are suppressing the population of this endangered species or where these factors occur in the annual cycle, this small modification to present management procedures might prove beneficial to the future survival of this unique parulid.

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