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Using Aerial Marking for Assessing Population Dynamics of Late Summer Roosting Red-winged Blackbirds

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ABSTRACT—We aerially marked red-winged blackbirds (*Agelaius phoeniceus*) roosting in cattail (*Typha* spp.) marshes in North Dakota to determine population turnover rates, size, and movements. We estimate that 250,700 red-winged blackbirds used four roosts marked in 1986. Daily turnover rates averaged 9.9% (SE = 2.4) in these roots. Four roosts marked in 1988 harbored 91,900 red-winged blackbirds. These roosts exhibited high turnover rates, averaging 16.7% (SE = 4.8) per day throughout the study. Marked birds were recovered a median distance of 10.0 km (range = 1.7 - 54.3) from their roost. Numbers and turnover rates of birds using a given late summer roost may be dependent on ecological factors such as the quality of roosting habitat (e.g., marsh size, density and areal coverage of cattails, water depth), and location and maturity of sunflower fields.

Key words: *Agelaius phoeniceus*, aerial marking, blackbird, cattail marshes, dispersal, red-winged blackbird, sunflower

Blackbirds (Icterinae) often roost in dense cattail (*Typha* spp.) marshes located near sunflower fields where they may cause heavy damage (Linz et al. 1984, Twedt 1991, J. Homan unpubl. data, North Dakota State University, Fargo). In 1979 and 1980 red-winged blackbirds (*Agelaius phoeniceus*), yellow-headed blackbirds (*Xanthocephalus xanthocephalus*), and common grackles (*Quiscalus quiscula*) consumed $3,600,000 and $6,500,000, respectively, of the sunflower crop in North Dakota (Hothem et al. 1988). Red-winged blackbirds are the most numerous (1.1 million breeding pairs) of the Icterinaes in North Dakota (Besser 1985, C. Nelms unpubl. data, North Dakota State University, Fargo) and probably cause the most damage to sunflower (Besser 1978).

Otis et al. (1986) and Knittle et al. (1987) studied dispersal patterns, turnover rates, and total numbers of red-winged blackbirds using three spring migratory roosts in South Dakota, Minnesota, and Missouri. These birds dispersed over 1.8 million km^2 during the breeding season (Knittle et al. 1987). Thus, lethal control of these roosting populations probably would not substantially reduce sunflower damage in North Dakota.

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A second strategy for reducing sunflower damage is to identify and manage blackbird populations that roost near sunflower fields during late summer, thereby impacting those birds most likely to damage sunflower fields (Cummings and Schafer 1989, Linz et al. 1991). However, information is needed on the population dynamics of blackbirds using late summer roosts before methods of control (lethal and nonlethal) and the optimal timing of their application can be recommended (Weatherhead et al. 1980, Weatherhead 1981, Cummings and Schafer 1989, Linz et al. 1991).

In August and September 1986 and 1988, we aerially marked roosting blackbirds in North Dakota with fluorescent particle marker to determine turnover rates and total numbers of red-winged blackbirds. Additionally, local movements of red-winged blackbirds in a sunflower growing area were assessed in 1988.

STUDY AREAS AND METHODS

In 1986 we marked red-winged blackbirds roosting in three cattail marshes in Benson County and one in Ramsey County, and, in 1988, four populations were marked in Nelson County (Fig. 1). Sizes of the study marshes varied greatly in 1986: Ibsen (520 ha), Pelican (300 ha), Mikes

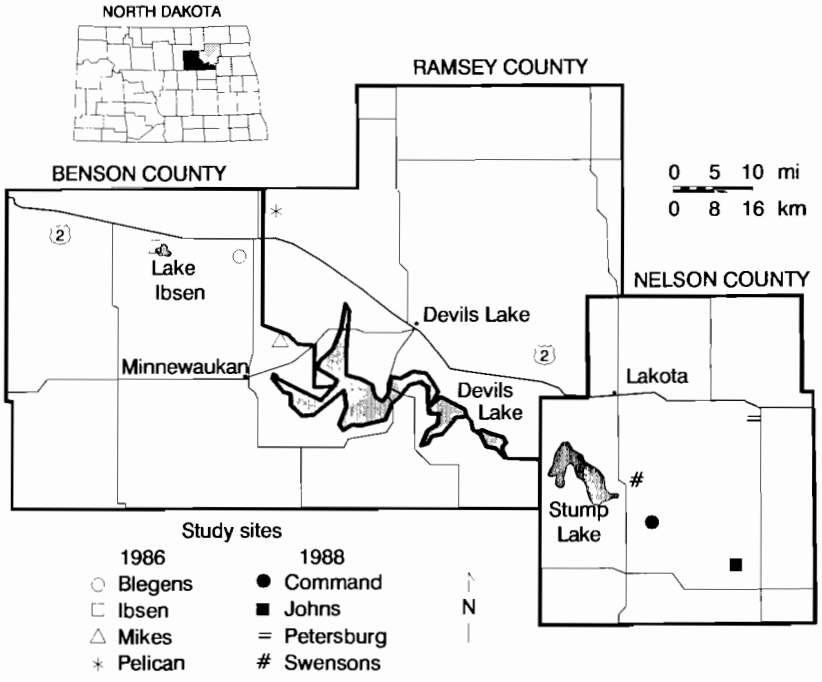

Figure 1. Red-winged blackbirds were aerially sprayed with fluorescent particle marker in eight cattail marshes in North Dakota in 1986 and 1988.

(176 ha), and Blegens (15 ha). In 1988, Petersburg (22 ha) was the largest roost, followed by Command (9 ha), Johns (6 ha), and Swensons (4 ha).

The study area is located in the prairie pothole region, which is characterized by up to 62 wetlands per km^2 (Stewart 1975). This area receives 77% of its annual precipitation between April and September (North Dakota Agricultural Statistics 1990). Long-term average monthly precipitation and temperature during those months in Devils Lake, a city centered in the middle of the study area, are 5.4 cm and 14.6 °C, respectively. Monthly precipitation was 4.2 cm higher than average in 1986 and 0.9 cm below average in 1988. Average monthly temperatures were only 0.1 °C warmer than normal in 1986, whereas the temperature was 2.5 °C above normal in 1988 (National Oceanic and Atmospheric Administration 1986, 1988). Farmers in Benson, Nelson, and Ramsey counties planted an average of 93,459 ha of wheat, 33,293 ha of barley, and 22,225 ha of sunflower in 1986 and 1988 (North Dakota Agricultural Statistics Service 1990).

The marking formulation consisted of 50% carboset 514H (acrylic resin adhesive), 25% propylene glycol (antifreeze), 0.2% alkylaryl polyether alcohol (surfactant), 0.2% colloid 675 (defoamer), 2.0% fluorescent particle-marker (organic resin pigment), and approximately 23% water. This formulation was sprayed from a fixed-winged aircraft, flying 15 - 20 m above the roosting blackbirds, during 20 to 30 minutes immediately after sunset.

In 1986 we marked blackbirds at intervals of 8 - 12 days, up to four times per roost. All roosts sprayed on a particular date were sprayed with the same color, and a different color was used on each date (Table 1). In 1988, three blackbird roosts were sprayed once and one roost (Command) was sprayed twice (Table 2). A unique color was used for each spray to establish dispersal patterns of marked birds for each roost.

We calculated total numbers and turnover rates of red-winged blackbirds using mark and recapture estimation methodology developed by Otis et al. (1986). They defined 'total numbers' as the number of different individuals using the roost between the first sample and last sample. 'Turnover rate' is defined as 1 minus the probability that a bird remained a member of the roosting population from the first sampling occasion to the next sampling occasion. Daily turnover rates are obtained by calculating 1 - N^{th} root of the total turnover rate, where N equaled the number of days between collections.

Population size, total number of birds collected, and number of collected birds found marked (both old and new marks if roost was sprayed more than once) were recorded for each sample occasion. Population size was determined by estimating the number of blackbirds passing between two points as they exited the roost in the morning (Arbib 1972, Meanley 1965). Percentage of red-winged blackbirds in the population was estimated by randomly selecting and identifying about 100 birds as they entered the roost in the evenings (Dolbeer et al. 1978).

Table 1. Estimated daily turnover rates between sample dates and total numbers of red-winged blackbirds using four roosts in Benson and Ramsey Counties, North Dakota in 1986.

Roost	Sample Dates	Daily Turnover Rate (%)	SE
Ibsen	30 August[a]	23.3	
	7 September[b]	3.6	3.2
	19 September[c]	2.3	2.2
	1 October[d]	2.3	1.9
	7 October	31.9	1.1
	Weighted Mean	11.8	1.2
	Total Population	142,100	13,600
Blegens	30 August		
	7 September	3.2	1.9
	19 September	4.6	1.1
	1 October	15.6	1.1
	7 October	7.9	2.5
	Weighted Mean	8.3	0.7
	Total Population	46,300	3,200
Mikes	30 August		
	7 September	14.7	0.7
	19 September	3.0	1.9
	7 October	6.5	2.4
	Weighted Mean	7.1	1.3
	Total Population	36,200	1,800
Pelican	7 September		
	19 September	7.4	2.5
	1 October	-1.0	3.5
	7 October	21.2	6.0
	Weighted Mean	6.8	2.1
	Total Population	26,100	2,600

[a]Ibsen, Blegens, and Mikes were sprayed on 29 August with flesh-pink marker.
[b]Ibsen, Blegens, Mikes, and Pelican were sprayed on 6 September with fire-orange marker.
[c]Ibsen, Blegens, Mikes and Pelican were sprayed on 18 September with Saturn yellow marker.
[d]Ibsen, Blegens, and Pelican were sprayed on 30 September with arc-yellow marker.

All birds were examined for fluorescent marker under ultraviolet light within two days.

Estimates of turnover rates and total numbers of red-winged blackbirds were made with the following assumptions (Otis et al. 1986): (1) all bird collections were treated as one instantaneous sample, (2) no marks were lost, (3) samples represent the population, (4) birds suffer independent fates, (5) mortality was low, (6) the probability that the bird abandons the roost was independent of the length of time in the roost, (7) no bird returned to the roost after emigrating, and (8) the population counts had a consistent proportional bias.

In practice, (1) we shot and collected red-winged blackbirds with mist nets at the roost over 1-2 days on each sample occasion (supplementing our sample by following birds up to 7.0 km from the roost and collecting them opportunistically), (2) red-winged blackbirds undergo a complete annual molt during late summer (Linz et al. 1983), thus an unknown but

Table 2. Estimated daily turnover rates between sample dates and total numbers of red-winged blackbirds using four roosts in Nelson County, North Dakota in 1988.

Roost	Sample Dates	Daily Turnover Rate (%)	SE
Command	21 August[a]		
	30 August	14.7	1.6
	15 September[b]	3.6	1.7
	24 September	20.3	1.4
	29 September	-3.9	6.4
	Weighted Mean	10.7	1.5
	Total Population	58,146	3,131
Swensons	24 August[c]		
	1 September	15.9	3.4
	8 September	12.6	6.1
	Weighted Mean	14.4	3.4
	Total Population	5,133	367
Johns	25 August[d]		
	1 September	48.2	1.5
	Total Population	16,096	39
Petersburg	3 September[e]		
	13 September	24.5	2.5
	Total Population	12,562	284

[a]Sprayed with fire-orange marker on 20 August.
[b]Sprayed with inivisible blue marker on 14 September.
[c]Sprayed with flesh-pink marker on 23 August.
[d]Sprayed with arc yellow on 24 August.
[e]Sprayed with Saturn yellow on 2 September.

presumably small percentage of birds marked in the early stages of molt may have lost all marked feathers before the conclusion of the study, (3) some percentage of birds may have moved to nearby roosts after they were marked, only to return at a later date (Besser et al. 1981), and (4) although experienced biologists counted the birds (Arbib 1972, Meanley 1965) and estimated blackbird species composition (Dolbeer et al. 1978), the accuracy of the counts was unknown.

Between 21 August and 29 September 1988, we conducted weekly searches of Nelson County and extreme western Grand Forks County for flocks of red-winged blackbirds and collected birds whenever encountered. Birds collected greater than 1.6 km from their marking site were used to establish dispersal patterns.

RESULTS

Numbers and Turnover Rates

In 1986, we marked red-winged blackbirds roosting in large cattail marshes (median = 238 ha, range = 15 - 520), whereas in 1988 we marked birds using relatively small marshes (median = 7.5 ha, range 4 - 22). We estimate that 250, 700 red-winged blackbirds used the four roosts marked in 1986 (Table 1). Daily turnover rates averaged 9.9% (SE = 2.4, range = -1.0 - 31.9) in these roosts. Although turnover rates varied among roosts, they

appeared to be highest in late August - early September and early October (Table 1). For example, Ibsen and Mikes had the highest daily turnover rates from 30 August to 7 September and 1 - 7 October. On the other hand, Blegens had the highest turnover rate from 19 September to 1 October. A negative turnover rate was calculated for the sample taken at Pelican on 1 October, indicating that the proportion of marked birds was higher during that sample occasion than on 19 September.

We estimate that 91,900 birds used the four roosts marked in 1988. Daily turnover rates averaged 16.7% (SE = 4.8, range = -3.9 - 48.2) per day throughout the study (Table 2). The birds essentially abandoned the three smallest roosts (Swensons, Petersburg, Johns) in early September.

Dispersal

In 1988 marked birds were collected over the southern two-thirds of Nelson County and extreme western Grand Forks County (2576 km^2; Fig. 2). We recovered 109 marked red-winged blackbirds more than 1.6 km from their marking site. These birds were marked for a median 13 days (range = 1 - 39) and had moved a median of 10.0 km (range = 1.7 - 54.3) from their marking site before recovery.

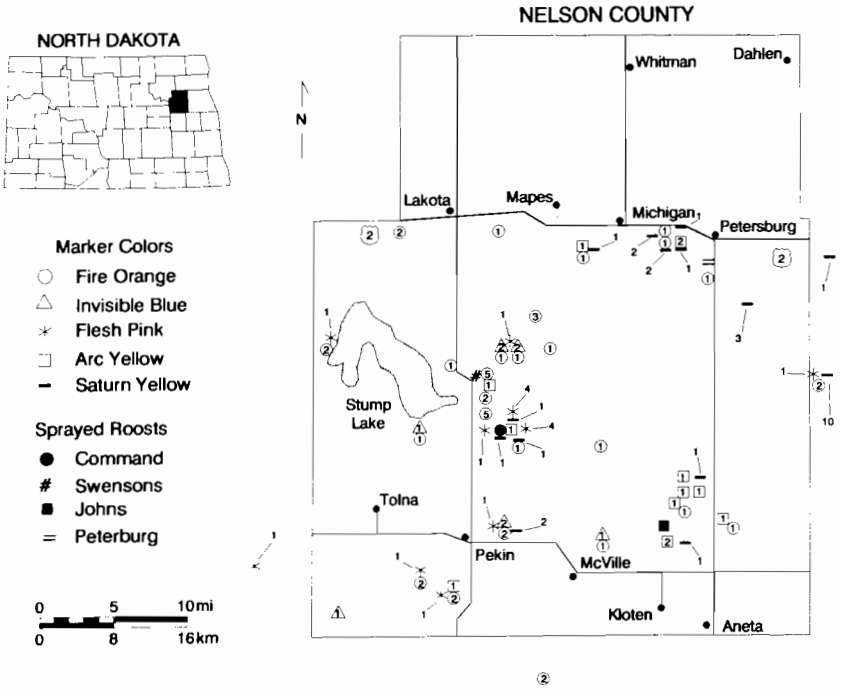

Figure 2. Dispersal pattern or red-winged blackbirds aerially sprayed with fluorescent marker while roosting in four cattail marshes in Nelson County, North Dakota in 1988.

We recorded the habitat at the recovery site of 93 birds. Forty-one (43.6%) birds were collected in sunflower fields, 33 (35.1%) were recovered in marshes other than in the marsh where they were marked, and 19 (20.2%) were categorized as miscellaneous (e.g., shelterbelts, small grain fields).

We found 18 (17.0%) of the marked birds between 1.6 and 4.8 km from the marsh were they were marked, 30 (28.3%) were found between 4.9 and 9.6 km, 30 (28.3%) between 9.7 and 19.3 km, and 31 (26.4%) were recovered more than 19.3 km from their marking site. Birds recovered in sunflower fields were a median distance of 14.3 km (range = 1.7 - 32.0) from their marking site.

DISCUSSION

We gathered data on the population dynamics of late summer roosting red-winged blackbirds by using an aerial marking technique developed for studying the dynamics of blackbirds roosting along migratory pathways (Otis et al. 1986, Knittle et al. 1987). There are two differences between spring and late summer roosting blackbirds that may bias estimates of population size and turnover rate of late summer roosts. First, red-winged blackbirds undergo annual feather replacement in late summer (Linz et al. 1986). Thus some birds, particularly those sprayed while in the early stages of molt, may have lost all marked feathers before they were collected. This may result in an over-estimate of roost turnover. Second, summer roosts tend to be smaller and located in closer proximity to each other than spring migratory roosts (Besser et al. 1981, Knittle et al. 1987). This increases the likelihood of marked individuals moving to other roosts and returning to the marsh where they were marked at a later data. If a substantial percentage of marked birds returns to the roost, a negative turnover rate may be calculated. Despite these biases, we believe that this technique yields biologically meaningful data that add to our developing information base. Future studies should be designed to quantify the loss of marks and amount of roost interchange in late summer.

In this study, red-winged blackbird numbers and population turnover rate were highly variable among roosts. Numbers and turnover rates of birds using a given roost may be dependent on ecological factors such as the quality of roosting habitat (e.g., marsh size, density and areal coverage of cattails, water depth), and location and maturity of sunflower fields (Otis and Kilburn 1988). Weatherhead (1981) suggested that red-winged blackbirds may be attracted to roost locations already being used by other species of blackbirds. We speculate that species composition may influence red-winged blackbird population turnover rates.

Turnover rates were higher in 1988 than in 1986, possibly due to a combination of smaller marshes, lower water levels, and an early maturing crop as a result of drought and high temperatures. Large, dense cattail marshes and high water levels may provide more protection for roosting birds (Weatherhead and Hoysak 1984), resulting in more stable populations. Immature sunflower achenes are preferred by red-winged blackbirds

(Cummings et al. 1989). Thus the early (early August) maturing sunflower crop in 1988 may have reduced the availability of a preferred food during the early migration period (mid-August), which may have speeded migration.

The clumped recovery locations (Fig. 2) indicate that red-winged blackbirds were consistently found in the same locations, suggesting that movement patterns are not random. Location, number, size, and stage of maturity of sunflower fields in relation to the location and size of roost may be important factors in determining the distance and direction that red-winged blackbirds travel to feed (Cummings et al. 1987, Otis and Kilburn 1988, Cummings 1989).

FUTURE RESEARCH

We conclude that turnover rates and numbers of red-winged blackbirds are highly variable among late summer roosts in Benson, Ramsey, and Nelson counties, North Dakota. Further, birds wander over these counties to find suitable roosting and foraging locations before migrating south. Their dispersal patterns indicate that they are not moving in a random pattern.

Obviously, ecological data relating sunflower damage to crop patterns and roost characteristics such as marsh size, water depth, cattail density and areal coverage, and blackbird numbers and species, are needed to clarify and predict roosting patterns and behaviors of all blackbird species causing sunflower damage. To meet these data needs, plans are being developed that will utilize geographic information systems (GIS) to facilitate the analysis of ecological data in relation to sunflower damage. These data will be needed before recommendations on optimal management strategies are made.

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