# PHENOLOGY OF RED-WINGED BLACKBIRD USE OF FIELD CORN IN CENTRAL NEW YORK

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## INTRODUCTION

Crop depredations by red-winged blackbirds *(Agelaius phoeniceus)* have been a problem since colonial times (Cardinell and Hayne 1945, Weatherhead and Bider 1979, Dolbeer 1980). Today, tens of millions of dollars worth of corn are consumed yearly by blackbirds (Stone et al. 1972, Dolbeer 1980, Tyler and Kannenberg 1980) and the problem appears to be increasing. Most of the initial efforts to reduce blackbird damage to corn and other crops focused on techniques to reduce redwing populations or on chemical and mechanical repellents and frightening devices (Dyer and Ward 1977). The inconsistent effectiveness of these techniques, however, has indicated the need for an integrated approach to understanding the ecological relationships between redwings and corn (Dolbeer 1980, Dolbeer et al. MS).

Although many researchers have reported that blackbird damage occurs primarily during the milk or soft dough stages of corn development (Cardinell and Hayne 1945, Hintz and Dyer 1970, Stone and Mott 1973), only recently have studies attempted to quantify the phenology of red-winged blackbird damage to corn (Bridgeland 1979; Dolbeer et al. 1982, MS; Bridgeland and Caslick 1983). Though these studies measured the progression of damage with respect to corn development, they did not quantify the actual pattern of redwing use of field corn. Because redwings have been reported to consume both insects (Bridgeland 1980a, Mott and Stone 1973) and weed seeds (Bridgeland 1980a, Gartshore et al. 1982) in cornfields, it is important to know the phenology of redwing visitation in this crop in relation to the availability of insects, weed seeds and corn.

## METHODS

We conducted this study in central Cayuga County, New York (Fig. 1). This county has consistently been the leading producer of corn in New York (New York Crop Reporting Service 1981) and is predominated by small to medium-sized dairy farms. Our work was completed in cornfields located 2-7 km east to southeast of Montezuma National Wildlife Refuge (MNWR). This refuge is located at the north end of Cayuga Lake and encompasses large areas of cattail *(Typha glauca)* marsh, which contain a large fall blackbird roost of up to 6 million blackbirds and starlings *(Sturnus vulgaris)* (Cutright 1973, Johnson 1979, and Hayes 1983).

To determine the phenology of foraging activity by red-winged blackbirds in field corn, we surveyed 50 cornfields using two roadside survey routes. These routes were run 6-10 times per week from 12 July through 29 August 1982. The fields ranged in size from 1.2-10.8 ha and all were easily visible from the roadside.

Most surveys (59 of 92) were started 1 hour after sunrise and lasted 2.5 to 3 hours. The remainder of the surveys were completed at various later times up to 1 hour before sunset. Surveys were begun from a randomly selected starting point along the route. Stops were made at each of the 50 cornfields which were then observed with binoculars for 2-3 minutes from either the roof of a vehicle or the top of a step ladder. If a flock was noted, a shellcracker was discharged over the field. This inevitably flushed the flock and allowed us to estimate the number and species composition of the birds. We believe that few flocks were missed using this method. We checked fields for the presence of fresh blackbird damage when flocks were seen in fields near the milk-stage of corn development. The number of redwings seen in other habitats was also noted.

On 5 dates at approximate 1-week intervals starting on 21 July 1982, bird droppings, % silking, and blackbird damage to corn were sampled in each of the 50 fields. Eight sampling stations were located regularly to cover each section of the field. At each station, droppings were counted on 5 consecutive corn plants. In addition, droppings on the ground were counted in a plot approximately 10 m long by 1 row wide. Only droppings greater than 1 cm in diameter were included in the analysis as we believe the smaller droppings were usually from smaller birds such as tree swallows *(Tachycineta bicolor)*, house sparrows *(Passer domesticus)* and song sparrows *(Melospiza melodia)*. These species, though much less common than redwings, were sighted frequently in cornfields and were observed to leave smaller droppings (see also Bridgeland 1980a). Percent silking was estimated by recording the number out of 20 ears that had visible silk at each station. From these data, the date when 50% of the ears in a field had silk (hereafter referred to as "half-silk") was estimated as in Bridgeland (1980b). We sampled corn damage (when present) by visual estimation of the % biomass removed (Woronecki et al. 1980) on 10 consecutive top ears along a row at each station.

Habitat availability along the survey routes was assessed by recording the habitat type present 30 m from both sides of the road at each 0.16 km interval. Habitats were placed into 1 of 10 types: (1) corn; (2) woods and brush; (3) buildings and residential (in-

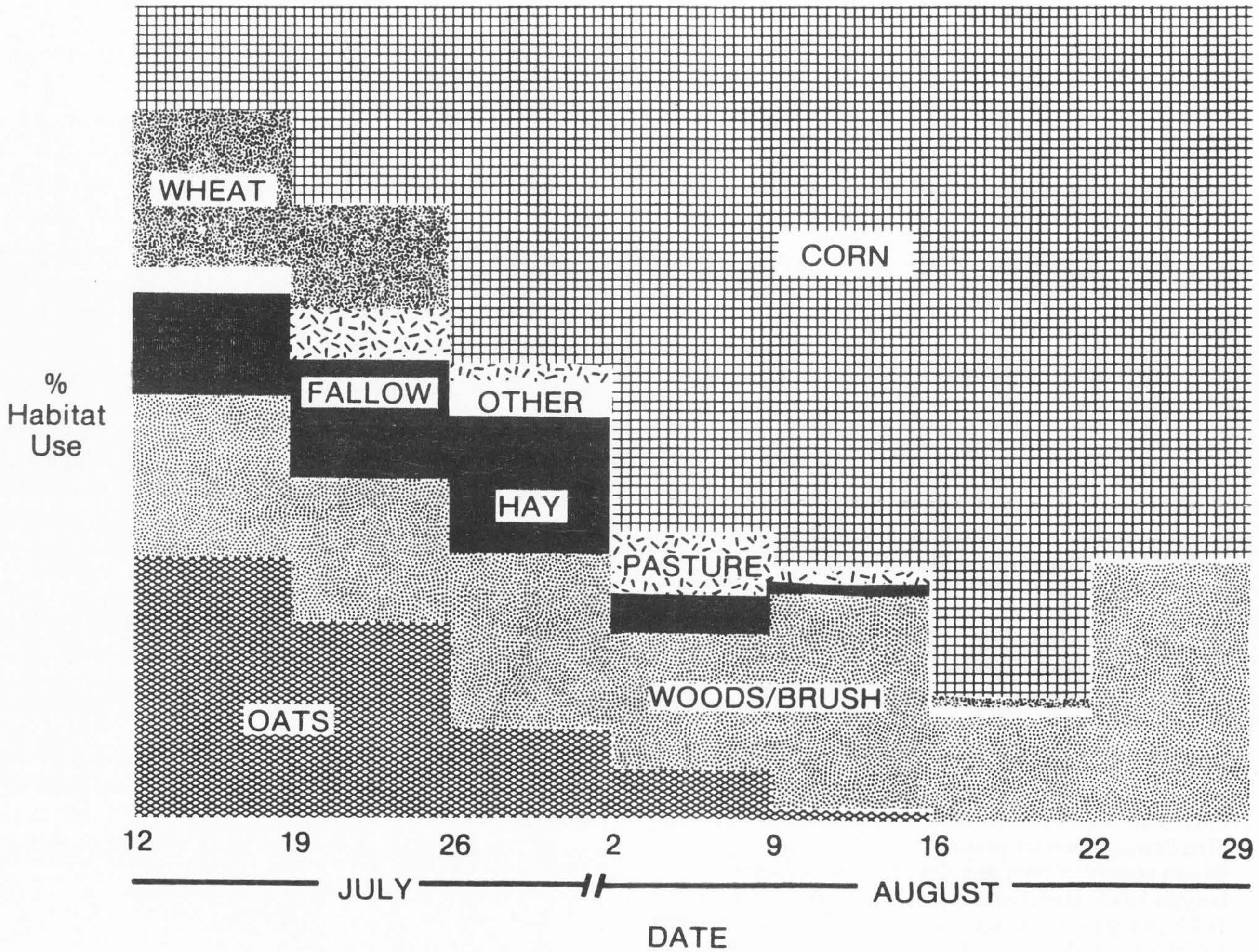


*Figure 1. Red-winged blackbird habitat use (in %) during 7-day intervals from 12 July through 29 August as measured along the two survey routes in Cayuga County, N.Y., 1982.*

cluding farm yards); (4) pasture; (5) hay [primarily alfalfa *(Medicago sativa)*]; (6) old fields (weedy fields not grazed or cultivated); (7) oats; (8) wheat; (9) other; and (10) unknown. These habitat types remained constant throughout the study except for a few wheat and oat fields that were plowed in mid to late August.

## RESULTS

### HABITAT USE

Redwings showed a definite shift in habitat preference during this study (Fig. 1). They used primarily small grains (i.e., oats and wheat) during mid-July and steadily shifted to corn in late July and early August. The preference for small grains during the early part of this study is especially apparent since oats and wheat comprised only 3% of the available habitat (Fig. 2). By late August, however, over 70% of all redwings were seen in corn. Use of all other habitats (except woods and brush) generally declined throughout the course of the study. Buildings and residential areas were rarely used.

### CHRONOLOGY OF REDWING USE OF CORN

The rapid increase and subsequent leveling off of redwings seen per route (RW) over time closely matched the pattern of fields entering the "damage stage" (DAMFLD, see Fig. 3). In addition, we found a highly significant positive correlation between these two variables (Table 1, Pearson's $r = 0.89$, $P < 0.01$). Only surveys started 1 hour after sunrise were used to calculate RW, as significantly fewer redwings (t-test, $P < 0.0001$) were seen on evening surveys, and these later surveys were not evenly distributed over the course of the study. The "damage stage" was defined for any given field as beginning either 15 days after half-silk or when blackbird damage was first noted, whichever was earlier. Fifteen days post-silking was used because this was the mean maturity at first damage for the 24 fields for which we are confident of the date of first damage.

The chronology of the mean dropping count/field (DROP, also shown in Fig. 3), though not as similar, was also positively correlated with both the number of redwings seen/route and the number of fields entering the damage stage (Table 1). Closely paralleling DROP

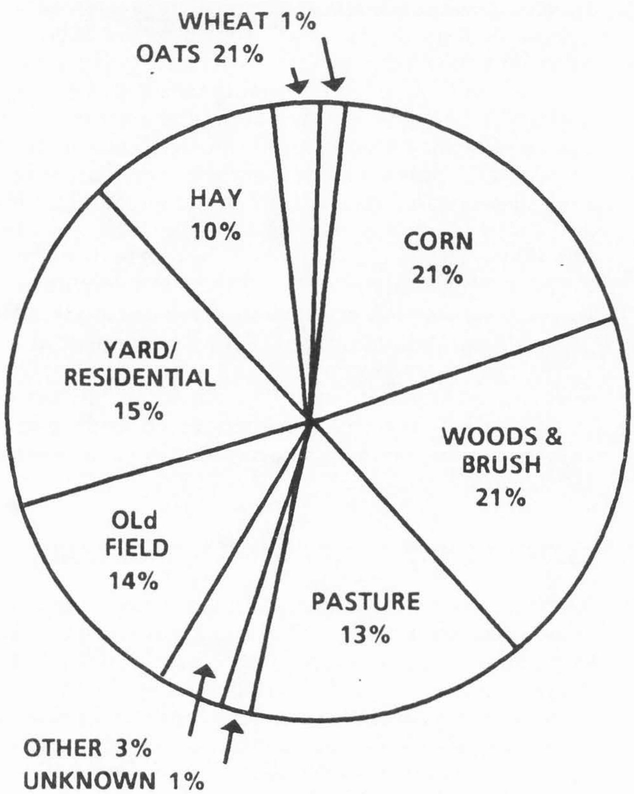


*Figure 2. Habitat availability (in %) along the two survey routes in Cayuga County, N.Y., 1982.*

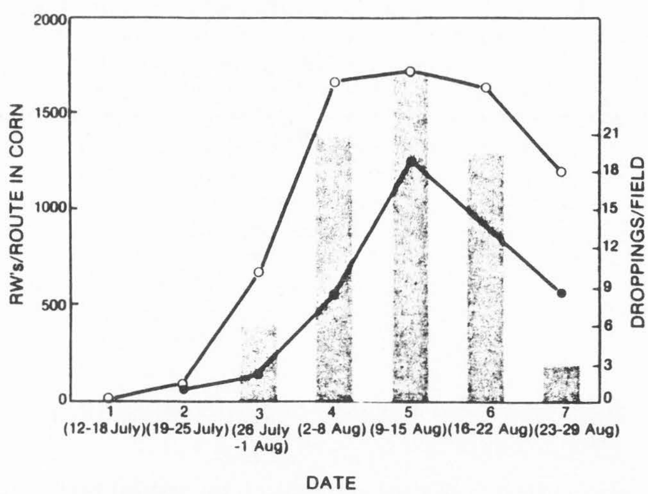


*Figure 3. Relationship between (1) mean no. of redwings seen per route in corn (open circles), (2) mean no. of droppings per field (solid circles), and (3) no. of fields entering the damage period (hatched bars—number of fields shown at top of bar) during weekly intervals in 50 cornfields in Cayuga County, N.Y., 1982.*

(and not shown in Fig. 3), was the progression of damage (Table 1). For these 4 variables, all Pearson's correlation coefficients were positive and greater than 0.58 and all Spearman rank correlations were greater

**Table 1. Correlation matrix for the following variables (calculated for 50 cornfields in Cayuga County, N.Y. during weekly intervals from 12 July through 29 August 1982): (1) mean no. redwings seen/route (RW); (2) no. fields entering "damage" period (DAMFLD); (3) mean no. droppings/field (DROP); and (4) mean total damage/field (DAM).** [a]

| | DAMFLD | DROP | DAM |
|---|---|---|---|
| *RW* | 0.89325*** | 0.84391* | 0.77342 |
| | 0.95499*** | 0.90000** | 0.90000** |
| *DAMFLD* | | 0.80549* | 0.58861 |
| | | 0.70000 | 0.70000 |
| *DROP* | | | 0.94523** |
| | | | 1.00000*** |

[a] Pearson correlation coefficients listed above Spearman rank coefficients.
* P<0.10; ** P<0.05; *** P<0.01

than 0.70. The lack of statistical significance for some of the relationships was probably in large part due to the small sample sizes [DROP and DAM (N = 5), RW and DAMFLD (N = 7)].

## REDWING VISITAITON VERSUS CORNFIELD MATURITY

Although the above analyses show how redwing use of corn varied with date, they do not indicate the pattern of redwing visitation to any given cornfield in relation to its development (i.e., maturity). To determine this relationship, all redwing visitation in the 50 "survey" cornfields was separated by field, and then adjusted to the maturity of that field (in days from half-silk). These data were grouped into 5-day maturity classes, and the mean number of redwings seen per route per field was calculated and plotted for each class (see Fig. 4). As shown, redwing visitation varied greatly with cornfield maturity, peaking in the interval from 15-19 days after half-silk. This interval also encompassed the mean date of first damage (as indicated above) and the beginning of the milk-stage of corn development (Bridgeland 1979).

All surveys were included in this analysis because evening surveys (though not distributed evenly over time) were relatively evenly distributed with respect to cornfield maturity. If only morning routes are included, the curve is almost identical to Figure 4.

To test for significant differences in the 5-day maturity class means, these data were transformed ($\log_e$) to equalize variances between classes (Fig. 5). In addition, because of the high frequency of zeros in these data, one sixth was added to each response before logarithims were taken, following the recommendations of Mosteller and Tukey (1977:95). When this was done, significant differences in the class means were found ($P < 0.0001$) along with significant linear ($P < 0.0001$) and quadratic ($P < 0.002$) trends.

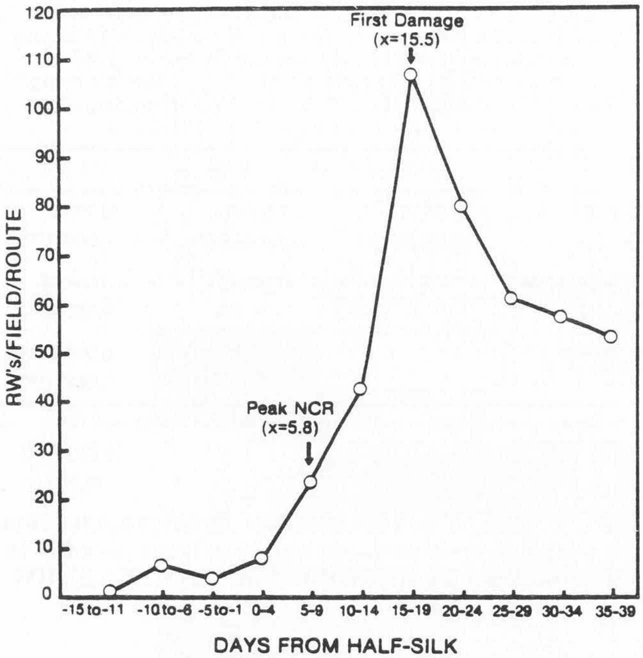


*Figure 4. Numbers of red-winged blackbirds seen in corn (in mean no. of redwings/field/route) versus cornfield maturity (in days from half-silk) for 50 cornfields in Cayuga County, N.Y., 1982.*

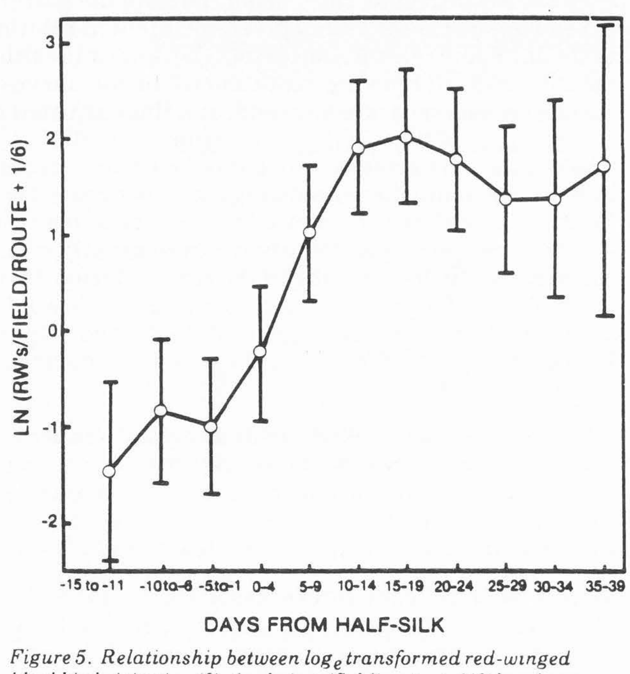


*Figure 5. Relationship between $\log_e$ transformed red-winged blackbird visitation ([ln (redwings/field/route + 1/6)] and cornfield maturity (in days from half-silk) for 50 cornfields in Cayuga County, N.Y., 1982.*

## DISCUSSION

### HABITAT USE

The strong preference for small grains displayed by redwings in mid- to late July followed by a rapid shift to corn indicated a high degree of plasticity in foraging by this species. Because oats matured somewhat before corn in the area, the birds appeared to be effectively tracking resource availability (i.e., milk-stage grains). Flocking probably facilitates both the location of the appropriate patch type (oats or corn) and the switch between types when necessary (Krebs et al. 1972). Similar foraging shifts from oats to corn were observed by Martin (1977), Somers et al. (1981), and Johnson and Caslick (1982). The decline in the use of hay, pasture, and old field habitats through the course of this study perhaps reflects the decline in insectivory which occurs in redwings during this time (Beal 1900, Hintz and Dyer 1970, McNichol et al. 1979). Redwing use of woods and brush was fairly constant throughout the study. This habitat, however, is used primarily as a loafing site when feeding in adjacent areas, primarily corn (Martin 1977, Johnson 1979).

### CHRONOLOGY OF REDWING USE OF CORN

Redwing use of corn displayed a significant quadratic trend through time ($P < 0.01$, $\log_e$ transformed data) that appeared to be related to the availability of milk-stage corn (Fig. 3). This is supported by the strong correlation between the average number of redwings seen per route (RW) and the number of fields entering the damage stage (DAMFLD, $r = 0.89$, $P < 0.01$). In addition, 2 other indices of redwing activity (mean dropping count/field and damage/field), were both positively correlated with DAMFLD ($r = 0.81$, $P < 0.10$ and $r = 0.59$, $P < 0.30$ respectively). We believe these relationships would have been stronger but the DAMFLD "curve" reflects the onset of the damage period only, and thus the beginning of the milk-stage of corn development. Redwings continued to damage corn past the milk-stage (Bridgeland and Caslick 1983, Dolbeer et al. MS), so that as the season progresses, more corn is available for redwing feeding than is indicated by the number of fields entering the damage stage. This probably explains why redwing use is still high in the last week of the study when only 2 fields entered the damage stage. Martin (1977) found a similar pattern of redwing use of cornfields in southern Quebec, and Bridgeland (1979) stated that "the bird's feeding activity is related in some way to the overall availability of corn in the milk stage."

### REDWING VISITATION VERSUS CORNFIELD MATURITY

The pattern of redwing visitation to cornfields shown in Fig. 4 suggests a preference for corn in the milk stage, which is consistent with previous reports that damage occurs primarily during this stage of maturity (Cardinell and Hayne 1945, Hintz and Dyer 1970, Bridgeland 1980). Dolbeer et al. (MS), however, reported that redwings "showed no distinct preference for any particular stage of maturity." We found that the $\log_e$ transformed data did not show such an obvious peak in visitation during the milk-stage (Fig. 5) and revealed no significant differences between maturity class means from 5-39 days after half-silk ($P < 0.05$, Duncan's multiple range test). When we tested for significant differences among this subset of maturity classes (5-39 days after half-silk), however, the 2 maturity classes from 15 to 24 days after half-silk had significantly higher redwing visitation than the other maturities ($P < 0.05$, Duncan's multiple range test). This period encompasses most of the milk-stage. Untransformed data were used in this analysis, as variances were approximately equal between maturity classes of this subset. Thus, though our data are somewhat ambiguous, they indicate that redwing visitation is highest during the milk-stage.

These data also indicate that visitation was relatively high both before and after this period. Before the milk stage, insects, especially northern corn rootworm beetles, probably reach their peak biomass (see Fig. 4) and redwings collected in cornfields during these maturities were eating primarily insects. After the milk stage, redwings are eating primarily corn in dough and early dent stages, with increasing amounts of weed seeds (Bridgeland 1980) that tend to ripen at this time.

The relationship between redwings and corn is, therefore, not simply a matter of damage during the milk-stage of development. Though visitation does appear to be greatest during this period, redwings visit cornfields in substantial numbers before the corn ripens (eating primarily insects), and continue to visit cornfields after the milk stage. In addition, redwings may reduce certain corn insect pests such as the European corn borer [*(Ostrinia nubilalis)* Bendell et al. 1982], and the northern corn rootworm beetle.

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