FOOD HABITS AND MOLT OF RED-WINGED BLACKBIRDS IN RELATION TO SUNFLOWER AND CORN DEPREDATION

George M. Linz
Zoology Department
North Dakota State University
Fargo, North Dakota

Gregory Fox
Department of Agronomy
North Dakota State University
Fargo, North Dakota

ABSTRACT

From late July to early November 1979, 1980, and 1982, red-winged blackbirds were collected in sunflower, field corn, and at two roosts in Cass County, North Dakota. Their espophageal contents were examined, and they were also assessed for stage of molt. Both males and females contained a higher proportion of sunflower in sunflower fields than corn in field corn ($P < 0.05$). Male redwings consumed proportionally more sunflower and corn than did females. Females used more weed seeds than did the males.

Redwing depredation in sunflower fields was highest from 26 August through 6 October, making up 71% of male diets and 57% of the female diets. Foxtail seeds made up 17% of the male and 20% of the female diets during this time. In comparison, the proportion of corn found in red-wing diets was highest from 9 September through 6 October. During this time, male diets consisted of 52% corn and 37% weed seeds; females contained 22% corn and 75% weed seeds.

These data suggest that red-wings are able to obtain sunflower easier than corn. Furthermore, weed seeds appear to be a viable alternate food source for red-wings. This food source may be especially important when the birds have difficulty meeting their dietary requirements from sunflower or corn. We suggest, therefore, that if sunflower were energetically expensive for red-wings to obtain, the proportion of weed seeds in their diets would increase.

The annual feather molt of red-wings begins soon after nesting and is completed in 7-9 weeks (in North Dakota from late July through September). The process of molting and regrowing feathers is energy demanding. Red-wings are difficult to "move out" of the fields during molt; this is a time when sunflower need to be resistant to depredation.

INTRODUCTION

Crop losses due to foraging flocks of red-winged blackbirds (*Agelaius phoeniceus*) are often serious and have prompted various, and sometimes questionable, management programs (Dyer and Ward, 1977; Weatherhead and Bider, 1979). Control strategy must be based on knowledge of the diet, feeding behavior, and migratory patterns of the birds. Variations of these factors in different areas may suggest different management strategies.

Food habits of red-winged blackbirds have been studied in corn production areas of Ohio (Williams, 1975), South Dakota (Mott et al., 1972) and Ontario (Hintz and Dyer, 1970; McNicol et al., 1979; Gartshore et al., 1982). Red-winged blackbird food habits also have been studied in the rice growing regions of Arkansas (Meanley, 1971) and California (Crase and DeHaven, 1978). To our knowledge, only Bird and Smith (1964) have published data on red-winged blackbird food habits in a sunflower production area (Manitoba).

Recent investigations of feeding aggregations (flocks) have centered on behavior and management (Martin, 1977; Weatherhead and Bider, 1979; Stone and Danner, 1980). Postnuptial (prebasic) and postjuvenal (first prebasic) molts of redwings coincide with flocking and, at their peak, have a marked effect on the birds' behavior (Allen, 1914; Smith and Bird, 1969; Meanley and Bond, 1970).

Quantitative information on the phenology of redwing molt is sparse. Dunson (1965) and Payne (1969) studied the timing of molt in two nonmigratory, southern populations. Meanley and Bond (1970) estimated the duration of redwing molt in the Patuxent, Maryland area.

During 1979 and 1980 we studied red-winged blackbird food habits and molt progress in southwestern Cass County, North Dakota (46°08'N, 97°04'W). In addition, in 1980 and 1982 the molt progress of a hatching-year (HY, young-of-the-year) redwing population was monitored in Northeastern Cass County (46°51'N, 96°50'W).

Our objectives were: (1) to study foods consumed by various sex and age groups of red-winged blackbirds in an area where sunflower and corn are grown and (2) to determine the relation of redwing molt and migration. These data may be used to redesign management programs aimed at reducing blackbird damage.

METHODS AND MATERIALS

Study Area

Southwestern Cass County is on the east edge of the Drift Prairie physiographic region. The numerous wetlands in this agricultural area provide both daytime resting sites and night roosts for blackbirds (Icterinae). A principal roost is located in the Alice U.S. Fish and Wildlife Service Waterfowl Production Area, which includes an approximately 300 ha cattail (*Typha* spp.) marsh. The surrounding land is intensively farmed, with 90% under cultivation. In 1980, 39% of the cultivated area was planted to wheat, 20% corn, 17% sunflower, 14% barley, and 10% other crops (oats, soybeans, edible beans, flax, rye, millet, and sugar beets). On a county basis, sunflower acreage was 38% higher in 1980 than in 1979; wheat and barley, 27% lower.

Methods

The esophageal contents of 917 male and 444 female red-winged blackbirds were analyzed. They were collected by shooting throughout daylight hours, from late July to early November 1979 and 1980, in sunflower fields and corn fields, with light to heavy weed growth. In addition, in 1980 redwings were collected at the Alice roost from mid-July through August (Linz et al., 1983). The birds were collected in large feeding flocks (100 - 10,000). From any single collection (the birds obtained from one flock), no more than five of each age-sex class were randomly chosen for analysis of esophageal contents. The contents were air-dried until all the ethanol had evaporated and oven-dried for 24 hrs at 70°C. Samples of less than 0.01 g total dry weight were excluded from further analyses.

Analysis of variance on arcsin-transformed data was used to compare the proportion of various food items consumed by the different age-sex classes. Duncan's multiple range test was used to separate the means; $P < 0.05$ was accepted as significant. Further details on methods used in the food habits study may be found elsewhere (see Linz et al., 1983).

From July through October 1979, 1980, and 1982, redwings were collected by shooting, decoy traps, and mist nets and assessed for stage of molt. Plumages of redwings have been described by Dwight (1900), Selander and Giller (1960), and Meanley and Bond (1970). All remiges are normally replaced during the postnuptial and postjuvenal molts. Primaries are replaced in sequence from 1 (inner-most) through 9. Information on the phenology of molt of after hatching-year (AHY) redwings has been reported elsewhere (see Linz et al., 1983). Therefore, we will report only on the molt of hatching-year redwings.

Each primary of the right wing was assigned a numerical value using a five-point scoring system similar to that of Evans (1966), Newton (1966), and Sealy (1979). A "0" was assigned an old feather, "1" a missing or small pin feather, "2" a feather up to 1/3 grown, "3" up to 2/3, "4" up to 3/4 grown, and "5" a nearly complete or complete feather.

The functional relationship of the increase in primary scores (dependent variable, Y) with time (independent variable, X) is assumed to be linear ($Y = a + bX$). The increase in primary scores with time (slope, b) and Y-intercept (a) were determined by means of regression analysis (Evans, 1966; Newton, 1966; Payne, 1969). Regression values were used to estimate the beginning and end of molt. Potential bias in the regression estimates due to nonlinearity (Evans, 1966; Newton, 1966) was reduced by only including data collected while 90% of the birds were molting. This occurred from 26 August through 7 October. Duncan's multiple range test was used to determine whether or not the mean number of primary feathers growing simultaneously were significantly different between dates; a *t*-test was used to determine whether or not the means were different between sexes.

RESULTS

Red-winged Blackbirds in Sunflower Fields

There were no differences ($P > 0.05$) between AHY and HY red-winged blackbirds in the percentage of various food items consumed in sunflower fields. Male redwings, collected in sunflower fields from 29 July-4 November 1979 and 1980, contained more sunflower seeds (sunflower) and less foxtail (*Setaria* spp.) than the females ($P < 0.05$) (Table 1). During this period, 93% of the males and 86% of the females contained sunflower, which comprised 69% and 57% of the male and female diets, respectively. Concurrently, foxtail made up 18% of the male and 31% of the female diets and occurred in 65% of the males and 72% of the females. Insects made up 4% of the male and 5% of the female diets during this time.

Red-winged Blackbirds in Corn Fields

From 12 August-20 October 1979 and 1980, red-winged blackbirds were collected in corn fields. Males collected in corn fields contained more corn and less foxtail than the females collected in corn fields ($P < 0.05$) (Table 2). There were no differences ($P > 0.05$) between AHY and HY birds in the percentage of various food items consumed in corn fields. The proportion of corn in the esophagi of the males collected in corn fields was highest from 26 August-6 October, when corn was found in 70% of the birds and made up 51% of their diet. During the same period, corn was found in 44% of the females and comprised 18% of their diet. Concurrent with peak corn use, 73% of the males and 90% of the females contained foxtail, which made up 38% and 71% of the male and female diets, respectively.

Red-winged Blackbirds Collected at the Alice Roost

From 15 July-25 August, redwing males contained more sunflower and small grains (wheat, barley, oats, and proso millet) and less foxtail than the females ($P < 0.05$) (Table 3). The proportion of sunflower was highest in both males and females from 12-25 August. During this time, sunflower made up 67% of male and 21% of female diets. During 12-25 August, corn was found in 13% of the males and comprised 11% of their

diets. Concurrently, corn made up 8% of the female diets and occurred in 17% of the birds.

The proportion of small grains (wheat, barley, oats, and proso millet) and foxtail in male diets decreased 23% and 38%, respectively, from mid-July to the third week in August. During the same period, female use of small grains decreased 8% and foxtail 12%. Redwing use of animal matter (largely insects) was highest 29 July-11 August, accounting for 15% of male diets and 16% of female diets. This amount decreased to 5% for both males and females by 12-25 August.

Molt of Hatching-Year Redwings

No differences in rate of molt in points per day were found between HY males and HY females at Alice and Harwood ($P > 0.05$); therefore, the sexes were combined for regression analysis. We found that, except at the beginning and end of molt, males grow more primaries simultaneously than do females ($P < 0.05$); the difference is equal to about 1/2 of a feather (Fig. 1). Differences in the calculated duration of molt were noted between locations. The duration of molt of the Harwood population, as determined by regression analysis, was essentially the same in 1980 and 1982 (Table 4). This was 12-13 days shorter than the duration of molt of the 1979 Alice male population and 42-43 days shorter than the duration of molt of the 1980 Alice population. The percentage of molting HY redwings tended to be higher at Alice than at Harwood throughout the period of molt (Fig. 2).

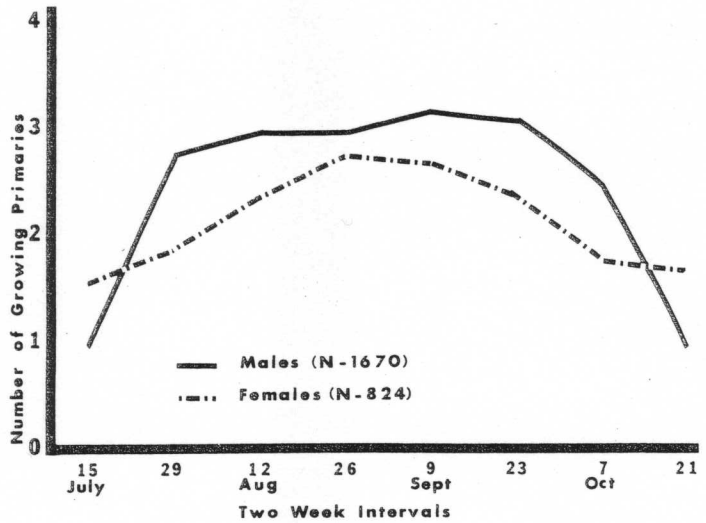

FIGURE 1. The average number of primaries growing simultaneously by hatching-year red-winged blackbirds throughout the period of molt at the Alice and Harwood roosts, Cass County, North Dakota.

At Alice (1979 and 1980) the interval between the first redwing collected while molting and first with completed flight feather replacement was 79 days (15 July-2 October). In contrast, at Harwood (1980 and 1982) the first HY bird found molting was on 24 July and the first having completed molt was on 18 September, a duration of 56 days.

In 1982, 3 females and 3 males previously banded and released while molting were subsequently recaptured after a combined total of 101 days in the wild. The calculated mean duration of molt for these birds was 53 days.

To test the hypothesis that later molting birds grow more primaries simultaneously than earlier molting birds, we held the number of new primaries constant with time and

plotted the number of primaries growing versus time (Fig. 3). For example, during 12-25 August males collected with two or three new primaries averaged 2.9 primaries growing simultaneously (N = 40); males collected from 23 September-6 October with two or three new primaries averaged 3.8 primaries growing simultaneously (N = 26). Before 9 September males and females with 6 new primaries averaged 2.3 growing primaries (N = 8); after 9 September they averaged 3.0 growing primaries (N = 441). All HY redwings collected with 7 or 8 new primaries were growing primaries 8 and 9. Apparently individual redwings that start molt in July and August tend to have fewer primaries growing simultaneously than those that start molt in September and October.

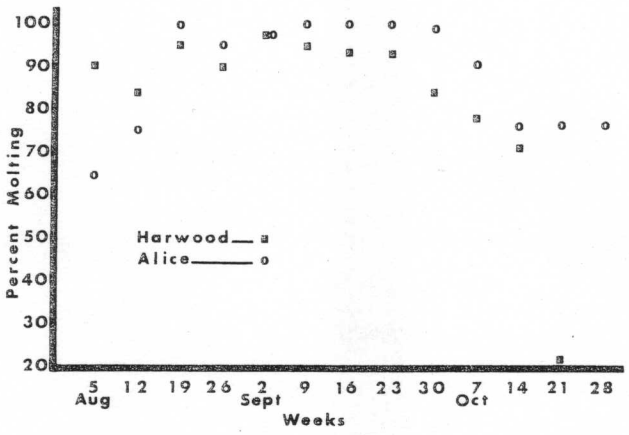

FIGURE 2. The percentage of hatching-year red-winged blackbirds molting at the Harwood and Alice roosts in Cass County, North Dakota.

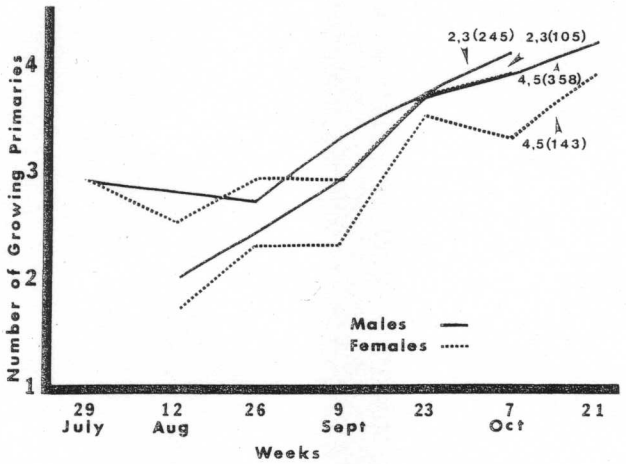

FIGURE 3. The average number of primaries grown simultaneously by hatching-year red-winged blackbirds in Cass County, North Dakota plotted versus time, while the number of new primaries (outside parenthesis) are held constant with time (sample size in parenthesis).

DISCUSSION

Food Habits of Redwings

Studies comparing the food habits of male and female red-winged blackbirds have produced conflicting results. Mott et al. (1972), Williams (1975), and McNicol et al. (1982) have shown that males consumed proportionally more corn than did females. Gartshore et al. (1982), however, found no differences in the amount of corn consumed by male and female red-winged blackbirds.

This study indicates that both sexes consumed a higher proportion of sunflower in sunflower fields than corn in corn fields. Males used 12% more sunflower and 29% more corn than did females. The percentage of sunflower in the males' diets remained about the same throughout the sample period, while the percentage of sunflower in the females' diets decreased as the sunflower matured. In comparison, the proportion of corn in both the male and female diets decreased as the corn hardened.

These differences may be related to the relative availability of sunflower and corn, and to morphological and behavioral differences between the males and females. Corn is protected by husks and after the seeds mature becomes difficult to remove and consume (Dolbeer, 1980). In contrast, sunflower seeds are unprotected, easy to remove from the head, and as they mature become only slightly more difficult for the birds to dehull and obtain the kernel. Unlike corn, sunflower heads are susceptible to seed loss due to wind and bird activity, particularly after some seeds are removed. Hence, a large number of sunflower seeds fall to the ground. We observed red-winged blackbird feeding behavior in sunflower fields and in enclosed sunflower plots. Males appear to spend more time removing seeds from the heads and less time foraging on the ground than the females. Similar differences in feeding behavior may occur in corn fields. The females, however, would not encounter corn on the ground in corn fields as often as sunflower seeds on the ground in sunflower fields.

The male's larger size and larger bill (Orians, 1961) may enable him to slit the husks of the corn and handle the dry kernels more effectively than can the female. His advantage may be less with sunflower, where the female has relatively easy access to the seeds in the head and on the ground and may be able to shell the seeds almost as readily as the males.

We conclude that males are largely responsible for damage in sunflower fields and corn fields. Females have the potential to cause a significant amount of damage to sunflower. We do not know, however, what portion of the sunflower in their diets was waste grain taken on the ground. Further studies are needed to assess the depredation potential of females in sunflower fields.

In areas of high red-winged blackbird concentrations, growers are advised to implement various management programs (Meanley, 1971; Besser, 1978; Dolbeer, 1980). One suggested option is to plant alternate crops that are less attractive to the birds. This strategy is not well received in our study area, because it would entail deleting both sunflower and corn from the crop rotation. A second option is to plant blackbird-resistant crops (Dolbeer, 1980). Hybrids of corn with long husks have been shown to be resistant to bird depredation (Linehan, 1977). Recent progress on the development of a blackbird-resistant sunflower has been encouraging (Fox and Linz, 1983). This experimental sunflower, now ready for large-scale field testing, possesses morphological characteristics that make it difficult for the birds to remove seeds.

Our research program is now focusing on the behavior of red-winged blackbirds when presented with bird-resistant sunflower. Our food habits data suggest that the birds will conserve energy by seeking the closest alternate food source(s). Depending on local crop patterns, these may include susceptible sunflower, corn-swathed grains, and harvested fields.

Red-winged blackbird management programs in sunflower and corn production areas should include: (1) blackbird-resistant sunflower and corn, (2) reduction of insects and weeds in all crop field so that they will not attract birds before the crop is susceptible to

damage, (3) leaving some fields unprotected and uncultivated so that weeds such as foxtail may grow and thus act as a "lure" crop, (4) delayed plowing of harvested fields, and (5) harassment of the birds with scare devices.

Molt of HY Redwings

Data from banded-recaptured HY redwings suggest that those birds that begin molt in late August complete molt within eight weeks. A similar duration of molt was noted by Meanley and Bond (1970) in the Patuxent, Maryland area. Payne (1969) determined by regression analysis that individuals in a nonmigratory population in California completed molt in nine weeks. The rate of molt of individuals may depend on the timing of the onset of molt (Dolnik and Gavrilov, 1980), i.e. birds that begin molt in mid-July tend to molt at a slower rate than those that begin molt in early September. The rate of molt can be increased by growing individual feathers faster or alternately by growing more feathers simultaneously. Our data indicate that HY redwings that begin molt in September grow more primaries simultaneously than those that begin molt in July. The growth rate of individual feathers appears to be independent of the timing of the onset of molt (Chilgren, 1978). Thus the rate of molt must be dependent upon the number of feathers that are growing simultaneously (Evans, 1966; Newton, 1966). With this evidence in mind, we suggest that the duration of molt of HY redwings in North Dakota varies among individuals, ranging from seven to nine weeks, and is largely dependent upon the timing of the onset of molt. This tends to synchronize the completion of molt in the population.

Redwing males are one-third larger than females (Orians, 1961); their linear dimensions are 20% longer than the females' (Searcy and Yasukawa, 1983). We expected, *a priori,* that the longer primary feathers of the males grow relatively faster than the primaries of the females, thus accounting for their apparent equal rate of molt. We found, however, that males grow 19% more primary feathers (about 1/2 of a feather) simultaneously than the females. It appears that males maintain the same rate of molt as the females, at least in part, by growing more primaries simultaneously.

The molt schedules of the Harwood and Alice populations show obvious differences. The observed and calculated molt schedules of the Harwood population indicate a molt duration of eight weeks, agreeing with the mark-recapture data. On the other hand, the molt duration of the Alice population exceeds our estimate of seven to nine weeks for individuals to complete molt.

Redwings normally remain within 200 km of their breeding area until molt is complete (Dolbeer, 1978). Dolbeer's analysis of banding returns, however, indicates that birds meeting in western Canada may migrate during August and September. Molt would not be complete during the earlier part of this period.

We attribute the differences in the estimated duration of molt between the Alice and Harwood population to the amount of migratory movement within each population. The Alice population consisted of many feeding flocks of HY and AHY redwings. Located along a major migration route within the Drift Prairie physiographic region, this population is presumably made up of both local breeding birds and transients. The Harwood population is located 60 km east of the Drift Prairie. This population appeared to consist of a single flock of 5,000 to 10,000 HY redwings, probably of local origin.

Meanley and Bond (1970) suggest that primaries 8 and 9 must be at least 2/3 grown before they will migrate. If environmental conditions are favorable, however, birds that have completed molt early may remain with the flock, thus maintaining flock integrity. Throughout the period of molt, the percentage of molting birds remained higher at Alice than Harwood. Apparently, flocks of redwings leave the Alice area upon completion of molt or just before the completion of molt, and flocks consisting of birds less advanced in molt arrive from the north during the same period (Linz et al., 1983). The Harwood population may be less dynamic than the Alice population with fewer birds migrating into or out of the area; that is, birds that have completed molt may tend to stay with the flock. On the other hand, redwings may leave Harwood upon completion of molt and are replaced by birds in a similar stage of molt.

From mid-August through September, HY redwings are growing peak numbers of primaries. Flocks of redwings, characterized by a ragged "moth eaten" appearance, are often seen feeding in sunflower and corn fields during this time. Efforts by growers to "scare" these flocks of redwings from the fields are often futile. We suggest that the birds' need for high energy food and reduced flying efficiency due to missing flight feathers are at least partially responsible for the growers' difficulties.

SUMMARY

This study indicates that sunflower and corn fields provide suitable feeding sites for red-winged blackbirds. Both male and female redwings contained a higher proportion of sunflower in sunflower fields than corn in corn fields. Males consumed more sunflower in sunflower fields and more corn in corn fields than did the females; females used more foxtail seeds in both habitats than did the males.

From mid-August through September, redwings in North Dakota are molting peak numbers of feathers. Their energy needs are high and their flying efficiency is reduced during this time. A population using a given roost may be more or less dynamic; that is, some populations may exhibit more migratory movement than others.

We suggest that management strategies should be based on the knowledge of (1) the crop being depredated (e.g. sunflower, corn, or both), (2) the availability of alternate foods, and (3) the nature of the population (e.g. sex ratio, age ratio, large or small turnover of birds, etc.).

ACKNOWLEDGEMENTS

S. Bolin, J. Crawford, L. Linz, L. Mettler, S. Mossbarger, R. Nelson, M. Schwartz, M. Smaby, and D. Vakoch assisted in the laboratory and field. We thank W. J. Bleier, J. F. Cassel, and R. B. Carlson for valuable suggestions during the early stages of this project. Appreciation is extended to the many sunflower and corn growers who allowed us access to their land. Support was provided by the North Dakota Experiment Station and by the U.S. Fish and Wildlife Service (Project 14-16-0009-79-037).

LITERATURE CITED

Allen, A. A. 1914. The Red-winged Blackbird: a study in the ecology of a cat-tail marsh. Abstract, Proc. Linnaean Soc. New York 24-25: 43-128.

Besser, J. F. 1978. Birds and sunflower. *In* J. F. Carter (ed.), Sunflower science and technology. American Society of Agronomy, Madison, Wisconsin, pp. 263-278.

Bird, R. D. and L. B. Smith. 1964. The food habits of the Red-winged Blackbird, *Agelaius phoeniceus,* in Manitoba. Can. Field-Natur. 78:179-186.

Chilgren, J. D. 1978. Effects of photoperiod and temperature on postnuptial molt in captive White-crowned Sparrows. Condor 80:222-229.

Crase, F. T. and R. W. DeHaven. 1978. Food selection by five sympatric California blackbird species. Calif. Fish and Game 64:255-267.

Dolbeer, R. A. 1978. Movement and migration patterns of Red-winged Blackbirds: a continental overview. Bird-Banding 49:17-34.

_____. 1980. Blackbirds and corn in Ohio. U.S. Fish and Wildl. Ser. Res. Publ. 136. 18pp.

Dolnik, V. R., & V. M. Gavrilov. 1980. Photoperiod control of the molt cycle in the Chaffinch (*Fringilla coelebs*). Auk 97:50-62.

Dunson, W. A. 1965. Physiological aspects of the onset of molt in the Red-winged Blackbird. Condor 67:265-269.

Dwight, J. 1900. The sequence of plumages and moults of the passerine birds of New York. Ann. New York Acad. Sci. 13: 73-360.

Dyer, M. I. and P. Ward. 1977. Management of pest situations. *In* J. Pinowski and S. C. Kendeigh (ed.), Granivorous birds in ecosystems. Cambridge University Press, pp. 267-300.

Evans, P. R. 1966. Autumn movements, moult and measurements of the Lesser Redpoll, *Carduelis flammea carbaret.* Ibis 108:183-216.

Fox, G. and G. M. Linz. 1983. Blackbird resistant sunflower. Proc 5th Sunflower Forum, Minot State College.

Gartshore, R. G., R. J. Brooks, J. D. Somers, and F. F. Gilbert. 1982. Feeding ecology of the Red-winged Blackbird in field corn in Ontario. J. Wildl. Mgmt. 46:438-452.

Hintz, J. V. and M. I. Dyer. 1970. Daily rhythm and seasonal change in the summer diet of adult Red-winged Blackbirds. J. Wildl. Mgmt. 34:789-799.

Linz, G. M., D. L. Vakoch, and J. F. Cassel. 1983. Food of Red-winged Blackbirds collected at a roost in late summer in Cass County, North Dakota. Prairie Nat. 15:75-78.

Linz, G. M., S. B. Bolin, and J. F. Cassel. 1983. Postnuptial and postjuvenal molts of Red-winged Blackbirds in Cass County, North Dakota. Auk 100:206-209.

Linehan, J. T. 1977. Resistance to bird attack in 265 field corn hybrids. Proceedings of the Northeastern Corn Improvement Conference. 32:19-31.

Martin, M. L. 1977. Flocking and roosting activities of the Red-winged Blackbird in southern Quebec. Unpublished M.S. thesis. Montreal, Quebec, McGill Univ.

McNicol, D. K., R. J. Robertson, and P. J. Weatherhead. 1982. Seasonal, habitat and sex-specific food habits of Red-winged Blackbirds: implications for agriculture. Can. J. Zool. 60:3282-3289.

Meanley, B. and G. M. Bond. 1970. Molts and plumages of the Red-winged Blackbird with particular reference to fall migration. Bird-Banding 41:22-27.

Meanley, B. 1971. Blackbirds and the southern rice crop. U.S. Fish and Wildl. Serv. Res. Publ. 100. 64 pp.

Mott, D. F., R. R. West, J. W. DeGrazio, and J. L. Guarino. 1972. Foods of the Red-winged Blackbird in Brown County, South Dakota. J. Wildl. Mgmt. 36:983-987.

Newton, I. 1966. The molt of the Bullfinch *Pyrrhula pyrrhula.* Ibis 108:41-67.

Orians, G. H. 1961. The ecology of blackbird (*Agelaius*) social systems. Ecol. Monogr. 31:285-312.

Payne, R. B. 1969. Breeding seasons and reproductive physiology of Tricolored Blackbirds and Red-winged Blackbirds. Univ. California Publ. Zool. 90.

Sealy, S. G. 1979. Prebasic molt of the Northern Oriole. Can. J. Zool. 57:1473-1478.

Searcy, W. A. and K. Yasukawa. 1983. Sexual selection and Red-winged Blackbirds. Amer. Scientist 71:166-174.

Selander, R. K. and D. R. Giller. 1960. First-year plumages of the Brown-headed Cowbird and Red-winged Blackbird. Condor 62:202-214.

Smith, L. B. and R. D. Bird. 1969. Autumn flocking habits of the Red-winged Blackbird in southern Manitoba. Can. Field-Natur. 83:40-47.

Stone, C. P. and C. R. Danner. 1980. Autumn flocking of Red-winged Blackbirds in relation to agricultural variables. Amer. Midl. Natur. 103:196-199.

Weatherhead, P. J. and J. R. Bider. 1979. Mangement options for blackbird problems in agriculture. Phytoprotection. 60:145-155.

Williams, R. E. 1975. Comparative food habits among Red-winged Blackbirds, Brown-headed Cowbirds, and European Starlings in relation to agricultural production in north-central Ohio. M.S. Thesis. Bowling Green State Univ. 73 pp.

DISCUSSION

Question: Are these food habits data by volume or weight?
Linz: Percent by weight.

Question: What is the relationship of molt to reproduction?
Linz: These were hatching-year birds. The later molting birds replace their feathers more rapidly than the earlier molting birds.

Question: Would difference in bill size between male and female explain the differential food intake? Males have larger bills.
Linz: Yes. It holds for sunflowers as well as corn, though not to the same degree; females can get sunflower seeds almost as well as males.

Question: Are the males under greater physiological stress coming off breeding season and therefore require feeding on sunflowers?
Linz: Sunflower seeds have high oil (energy) content, but we didn't see major weight changes in males or females.

TABLE 1. Percentage of weight and percentage of occurrence of food items in the esophagi of red-winged blackbirds collected in sunflower fields during 1979 and 1980 in southern Cass County, North Dakota.

	Time Period														Totals	
	July 29-August 11		August 12-August 25		August 26-September 8		September 9-September 22		September 23-October 6		October 7-October 20		October 21-November 4			
Sex	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
N	16	10	15	2	32	21	79	31	138	61	108	23	89	9	477	157
Mean Food Weight(g)	0.10	0.08	0.08	0.13	0.22	0.14	0.44	0.32	0.57	0.36	0.46	0.18	0.34	0.22	2.21	1.43
Food Item	Percentage of Weight (Percentage of Occurrence)															
PLANT	94(100)	87(100)	75(93)	72(100)	94(100)	93(95)	97(100)	93(97)	97(100)	97(100)	98(100)	93(100)	91(98)	98(100)	96(99)	95(100)
Sunflowers	71(100)	46(70)	52(73)	40(100)	72(87)	69(86)	67(88)	59(81)	73(96)	56(90)	70(95)	40(77)	60(94)	40(100)	69(93)	57(86)
Corn		3(10)			1(3)		9(16)	<1(6)	2(4)	2(6)	<1(1)		<1(1)		3(4)	1(4)
Other crops[a]		4(10)	<1(7)			<1(5)	7(20)	8(20)	4(17)	2(14)	3(9)	8(9)	3(12)	12(33)	4(13)	5(16)
Foxtail (*Setaria* spp.)	22(50)	34(60)	23(40)	32(50)	21(47)	22(47)	13(52)	25(78)	15(69)	36(77)	22(68)	44(83)	25(78)	46(78)	18(65)	31(72)
Incidental and undentified seeds	1(6)				<1(1)	2(14)	<1(7)	<1(3)	3(9)	<1(10)	3(14)	<1(79)	3(18)		2(11)	1(7)
ANIMAL	6(50)	13(60)	25(73)	28(50)	6(53)	7(43)	3(48)	7(61)	3(72)	3(66)	2(68)	7(87)	9(67)	2(44)	4(64)	5(63)
GRIT[b]	(19)		(21)		(37)	(12)	(22)	(32)	(47)	(34)	(54)	(26)	(43)	(22)	(41)	(26)

[a]Includes Wheat, Barley, Oats, and Proso Millet

[b]Grit not included in food weight

TABLE 2. Percentage of weight and percentage of occurrence of food items in the esophagi of red-winged blackbirds collected in corn fields during 1979 and 1980 in southwestern Cass County, North Dakota.

	Time Period											
	August 12-August 26		August 26-September 8		September 9-September 22		September 23-October 6		October 7-October 20		Totals	
Sex	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
N	15	21	25	16	95	54	87	90	84	61	306	242
Mean Food Weight (g)	0.17	0.14	0.32	0.41	0.45	0.20	0.44	0.35	0.33	0.29	1.71	1.39
Food Item	Percentage of Weight (Percentage of Occurrence)											
PLANT	82(100)	82(95)	87(96)	94(100)	96(100)	92(100)	98(100)	98(100)	98(100)	95(98)	96(99)	95(99)
Corn	15(27)	3(5)	52(64)	7(38)	54(84)	20(41)	47(67)	20(47)	21(40)	10(33)	45(62)	16(38)
Sunflower	7(20)	<1(9)	1(12)	1(6)	3(6)	12(20)	12(20)	3(11)	21(38)	9(18)	8(20)	6(15)
Other crops[a]		7(14)	1(4)		<1(1)	<1(2)	<1(2)	1(2)	8(20)	8(18)	2(8)	3(14)
Foxtail (*Setaria* spp.)	60(73)	71(86)	33(56)	86(94)	38(75)	58(89)	38(74)	72(89)	46(79)	66(87)	40(81)	69(89)
Incidential and undentified seeds			<1(4)		1(15)	2(13)	1(5)	2(7)	2(14)	2(11)	1(13)	1(9)
ANIMAL	18(43)	18(76)	13(56)	6(81)	4(68)	8(64)	2(61)	2(56)	2(44)	5(56)	4(57)	5(62)
GRIT[b]	(7)	(23)	(12)	(6)	(22)	(13)	(32)	(18)	(21)	(10)	(23)	(14)

[a]Includes Wheat, Barley, Oats, and Proso Millet

[b]Grit not included in food weight

TABLE 3. Percentage of occurrence and percentage of weight of food items in the esophagi of red-winged blackbirds collected during 1980 as they entered a night roost in Cass County, North Dakota.

	Time Period							
	July 15-July 28		July 29-August 11		August 12-August 25		Totals	
Sex	Males	Females	Males	Females	Males	Females	Males	Females
N	56	12	47	21	31	12	134	45
Mean Food Weight (g)	0.17	0.19	0.24	0.15	0.18	0.29	0.59	0.63
Food Item	Percentage of Weight (Percentage of Occurrence)							
PLANT	88(98)	86(100)	85(98)	84(90)	95(100)	95(100)	88(98)	89(95)
Sunflowers	1(2)		11(15)	5(10)	67(70)	21(42)	19(22)	10(16)
Corn	7(9)		6(8)		11(13)	8(17)	7(10)	3(5)
Other crops[a]	36(62)	14(17)	33(62)	11(24)	13(19)	6(17)	30(52)	10(20)
Foxtail (*Setaria* spp.)	42(84)	72(92)	31(77)	68(81)	4(32)	60(83)	29(69)	66(84)
Incidental and unidentified seeds	2(17)	<1(8)	4(28)				2(17)	<1(2)
ANIMAL	12(62)	14(83)	15(75)	16(57)	5(58)	5(67)	12(66)	11(67)
GRIT[b]	(9)	(17)	(6)	(14)	(6)		(7)	(11)

[a]Includes Wheat, Barley, Oats, and Proso Millet

[b]Grit not included in food weight

TABLE 4. The phenology of molt of hatching-year red-winged blackbirds at two roosts in Cass County, North Dakota, as determined by regression analysis.

Location	Year	N	Rate of molt (pts./day)	Mean start date	Mean completion date	Duration of molt (days)
Alice	1979*	275	.68	10 August	15 October	66 ± 2
	1980	443	.47	12 July	15 October	96 ± 1
Harwood	1980	382	.83	12 August	5 October	54 ± 2
	1982	502	.84	18 August	10 October	53 ± 2

*Males only