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ABSTRACT. The behavior of red-winged blackbirds (*Agelaius phoeniceus*), common grackles (*Quiscalus quiscula*), brown-headed cowbirds (*Molothrus ater*), and juvenile European starlings (*Sturnus vulgaris*) feeding on ears of corn was studied in an aviary. The species differed significantly in their propensity to attack (penetrate the husk and feed on kernels) ears of corn. Redwings and starlings were more active attackers than grackles and cowbirds. Female redwings were generally more active attackers than males, but less efficient at opening husks and damaging ears. Redwings and starlings used primarily the gaping technique to penetrate husks and expose kernels. Redwings more commonly penetrated the side of the husk, whereas starlings gaped through the silk channel. Grackles did not gape; rather they pecked through the husk, keeping the bill closed. Cowbirds used gaping, but were the least efficient at penetrating the husk. The findings of this study suggest that by increasing the thickness and strength of the husks and the extension of the husk beyond the ear tip, varieties of corn can be made more resistant to damage by birds.

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INTRODUCTION

Three species of endemic blackbirds (Icterinae) and the introduced European starling often associate together in nocturnal roosts in eastern North America. In late summer these birds enter cornfields near their roosts, opening the husks of ripening corn and sometimes doing substantial damage (Dolbeer 1980). Red-winged blackbirds are the most serious depredators; corn can comprise over 50% of their diet in late summer (Hintz and Dyer 1970, Mott et al. 1972, Williams and Jackson 1981). Male redwings, about 40% larger than females, apparently have a greater tendency than females to feed on ripening corn (McNicol et al. 1982). Common grackles can also be important depredators in certain situations (Stone et al. 1973, Dolbeer 1980). Brown-headed cowbirds are not considered serious depredators although they may feed on ripening corn (Williams and Jackson 1981). The role of starlings in corn depredations is not clear. Stewart (1973) and Potvin et al. (1976) claimed starlings, although often feeding on insects in cornfields, did not damage the corn. However, Whitney (1954) observed starlings feeding on milk stage corn; Somers et al. (1981) found fresh corn in the gullets of five of six starlings collected in cornfields. Woronecki and Dolbeer (1983) found that starlings in an aviary ate 2.6 times as much corn from unhusked ears as did redwings.

Although considerable research has examined ways to repel birds from cornfields, little has been published on the methods these species use to open corn husks and eat corn. Recent research has indicated that the development of corn varieties resistant to bird damage is a promising means of reducing damage (Weatherhead and Tinker 1983, Dolbeer et al. 1986). Therefore, a description of the feeding behavior of each species on ripening ears of corn might provide insight into morphological characteristics of the husk and ear that are important for resistance.

The objective of this study was to describe and quantify the behavior of four species of birds (and both sexes of one of these species) in opening corn husks and feeding on the ripening kernels.

METHODS

Birds were caught in July, 1983 in mist nets or decoy traps in Erie and Lucas counties, Ohio, and placed in either of two outdoor cages (2.4 × 2.4 × 1.8 m) to adjust to captivity. During 1-7 August birds were placed, six to a cage, in 24 hanging cages (1.5 × 0.5 × 1.0 m) in an outdoor pavilion isolated from human activity (Dolbeer et al. 1986). There were eight cages containing adult (1 yr and older)

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male red-winged blackbirds, and four cages each containing the other groups—adult female redwings, common grackles (two adult males, two adult females, two juveniles), brown-headed cowbirds (four adult males and two adult females), and starlings (six juveniles, sex unknown). The cages were identically supplied with perches, water, grit, and feeders containing a mixture of sunflowers, millet, cracked corn and pullet starter (starlings only).

To present corn to the caged birds, we used wooden racks set on cage floors in which eight freshly picked ears, with husks intact, were secured 20 cm apart, each at an angle of 30° from the vertical and oriented as on the plant. Ears of field corn 25 to 35 d after silking date were generally used, but in some cases a combination of sweet and field corn, distributed evenly among cages, was used. We made our observations with binoculars from an automobile parked 15 m from the cages on seven days from 19 August to 21 September 1983. Observations were started within 5 min of placing the corn in cages (usually at 0900) and lasted 1 to 4 h. All other food, but not grit and water, was removed from cages during observation periods. Cages to be observed were randomly selected daily. All cages of birds were presented with corn on at least five dates before observations began to acclimate them to the experimental setup.

Procedures to describe and quantify feeding behavior were developed during preliminary observations. We determined that the feeding behavior of a bird could be described through 12 discrete activities under three general categories: non-feeding, ear access, and kernel feeding (Table 1). Whenever a behavior was observed in the ear access or feeding category, we also noted the position of the bird's beak relative to its feet and the location on the ear, in 10% intervals from the tip of the husk, where the beak contacted the ear. We also noted those occasions where the bird's feet were involved in tearing the husk.

During observations, we recorded the activity, at 30-s intervals, of any bird perching on a randomly selected ear of corn in the cage under observation. A 5-s observation period was used, during which time the predominant activity of a bird interacting with the selected ear was recorded. Ten consecutive observation periods (at 30-s intervals) were made on the same ear in a cage before observing another randomly selected cage. We chose to focus attention on a particular ear and to quantify the behavior of the birds interacting with it rather than focus on an individually marked bird, because: (1) it proved difficult to follow an unmarked bird within a cage, and (2) several markers that were tried prompted uncharacteristic behavior, such as excessive preening.

To obtain another measure of the tendency of each species to feed on corn, we recorded the total number of birds perched on the eight ears in a cage at the start of each 5-s observation period. We also noted the number of these perched birds actually engaged in an access or feeding activity. For this measure, we recorded the behavior of the birds for only that instant and not for the entire 5-s, as the situation frquently changed within the 5-s period.

Two observers usually were present, one recording activity relative to the randomly selected ear and one recording the situation for all eight ears. Occasionally, only one observer was present, and only one type of data was collected. A cassette tape recorder played a tape with musical tones to signal the beginning and end of each 5-s observation period at 30-s intervals.

RESULTS

PROPENSITY TO ATTACK EARS. Two sets of data were examined to measure the propensity of each species to attack (i.e., engage in access or feeding activities) ears of corn: 1) the percentage of 5-s observation periods in which the ear under observation was attacked; and 2) the percentage of observations with three or more of the six birds in a cage attacking ears at the same time. Differences among species were tested for significance ($P = \leq 0.05$) using a chi-square (X^2) test.

There were significant ($P < 0.01$) differences among species for both measures of propensity to attack. Generally, starlings and redwings were the most active attackers of corn followed by grackles and cowbirds (Tables 2 and 3). For redwings, females appeared to be more active than males, attacking the individual ears under observation significantly ($P < 0.01$) more frequently (55%) than did males (40%) ($X^2 = 5.87$, 1 df).

The relative tendency for each species to attack corn is probably a good indicator of its corn-damaging potential. However, some species may have more effective methods for exposing and feeding on kernels. On two dates, we observed a cage of each species and compared the access and feeding frequency with the estimated damage to kernels at the end of the observation period. Although male and female redwings and starlings spent an equal amount of time attacking ears, the male redwings and starlings did twice the damage to kernels as the female redwings. Grackles and cowbirds spent significantly ($P < 0.01$) less time attacking as did the other species, and their overall damage was therefore lower. However, grackles actually had the highest feeding efficiency (amount of damage per time spent attacking); cowbirds were similar to male redwings and starlings (Table 4).

EAR ACCESS AND FEEDING TECHNIQUE. Male redwings and starlings appeared to be the most skillful in gaining access to the kernels under the husk. These two

TABLE 1

Categories of behavior and activity codes under each category for birds gaining access through the husk and feeding on kernels of corn in an aviary.

Code	Category	Activity
A.	Non-feeding	
1.		No bird perched on corn ear.
2.		Bird perched on corn ear.
B.	Gaining access to kernels through husk	
1.		Pecking at husk or silk with beak closed or only slightly open, but not resulting in grasping, flipping, or levering.
2.		Head flip (dorsally directed) of husk or silk with upper beak surface.
3.		Head pull (ventrally directed) of husk or silk with lower beak surface.
4.		Sideways head flip or pull with side of beak.
5.		Gaping open husk or silk channel by opening beak.
6.		Grasping of husk or silk with beak.
7.		Head lever with forward rotation of head pivoting around tip of beak.
C.	Feeding on kernels	
1.		Feeding peck beneath or behind husk or silk.
2.		Feeding peck directly through existing hole or slit in husk or silk channel, not behind or beneath husk but in contact with husk or silk.
3.		Feeding peck completely unencumbered by husk or silk.

TABLE 2

Number of 5-s observations on randomly selected ears of corn involving activities by male (M) and female (F) red-winged blackbirds (RW), common grackles (CG), brown-headed cowbirds (CB), and European starlings (ST).

Category/Activity*	Number (%) of responses for each activity				
	RW (M)	RW (F)	CG	CB	ST
A. Nonfeeding/					
1. Not perched on corn	107 (74)	23 (64)	53 (66)	65 (86)	87 (79)
2. Perched on corn	38 (26)	13 (36)	27 (34)	11 (14)	23 (21)
Total nonfeeding response	145(100)	36(100)	80(100)	76(100)	110(100)
B. Access to ear/					
1. Pecking-bill closed	8 (20)	3 (23)	8 (57)	2 (13)	9 (14)
2. Bill up	3 (7)	2 (15)	1 (7)	1 (6)	1 (2)
3. Bill down	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
4. Bill side	1 (2)	1 (8)	1 (7)	1 (6)	1 (2)
5. Bill gaping	18 (44)	3 (23)	0 (0)	5 (31)	43 (67)
6. Bill grasping	2 (5)	0 (0)	2 (14)	3 (19)	4 (6)
7. Bill pivoting	9 (22)	4 (31)	2 (14)	4 (25)	6 (9)
Total access responses	41(100)	13(100)	14 (99)	16(100)	64(100)
C. Feeding on kernals/					
1. Peck beneath husk	35 (64)	21 (68)	10 (50)	18 (64)	37 (77)
2. Peck through husk	13 (25)	3 (10)	8 (40)	8 (29)	7 (15)
3. Peck-husk removed	6 (11)	7 (22)	2 (10)	2 (7)	4 (8)
Total feeding responses	54(100)	31(100)	20(100)	28(100)	48(100)
Grand total for responses	240	80	114	120	222

*See Table 1 for description of each activity.

TABLE 3

Propensity of male (M) and female (F) red-winged blackbirds (RW), common grackles (CG), brown-headed cowbirds (CB), and European starlings (ST) to attack ears of corn in an aviary.

Activity	Bird species					X^2 Value
	RW (M)	RW (F)	CG	CB	ST	
% of observations of ear with bird attacking* ear (no. of observations)	40 (240)	55 (80)	30 (114)	37 (120)	50 (220)	19.6**
% of observations of cage with 3 or more birds attacking ears (no. of observations)	45 (300)	53 (150)	27 (150)	18 (180)	65 (270)	121.3**

*Engaged in ear access or feeding activity.
**$P < 0.01$

TABLE 4

Percent of observations with three or more birds attacking ears in a cage compared to the mean damage per ear in the cage during two, 6-h test periods. Each cage contained six birds and eight ears of corn during each 6-h period.

Species or Sex group	No. of observations	% observations with three or more birds attacking ears	% of ears damaged	Mean % damage/ ear*	Mean % damage/ ear/hour of attacking behavior**
Starling	90	55	75	28.1	8.5
Redwing (M)	100	55	69	23.5	7.1
Redwing (F)	100	55	44	12.9	3.9
Grackle	100	10	25	8.2	13.7
Cowbird	100	4	19	1.8	7.5
X^2 value		121.4***			

*Percent of surface of ear damaged (Woronecki et al. 1980) after 6 h.
**(Mean % damage/ear)/(fraction of observations with 3 or more birds attacking × 6 h).
***$P < 0.01$

species usually opened the husk by inserting their beaks into the husk or silk channel and spreading their beaks apart (gaping action) to tear the husk. Gaping comprised 67% of all access activity for starlings and 44% for male redwings (Table 2, code B5). Grackles were not observed gaping. Rather, they pecked through the husk with the bill closed (57% of access activity). No single access activity dominated for cowbirds; bill gaping (31%) and pivoting (25%) were the most common actions.

Whereas starlings and male redwings commonly employed gaping to expose corn kernels, the approach was still significantly ($X^2 = 11.6$, 1 df) different for the two species (Table 5). Starlings most frequently attacked the ear through the silk channel (61% of the access activities). Male redwings, in contrast, tended to peck through the husk on the ear and then gape to split the husk fibers. Only 27% of male redwing attacking activity took place in the silk channel.

Once access was gained to kernels through the husk, grackles were most inclined to feed by direct pecking; 50% of the feeding observations were direct feeding pecks either through pre-existing holes in the husks, or where the husk had been removed (Table 2, codes C2 and C3). The other species were more inclined to insert the beak beneath or behind the silk channel or husk to feed (Table 2, code C1). Starling feeding activity often involved aggressive poking of the beak beneath the husk. This category (code C1) comprised 77% of the starling feeding activity. At times the starling would force its head beneath the husk, tearing the husk and exposing corn.

Beak placement of feeding birds was usually below or between the feet. Only 4.4% of all observed feeding activities of species other than grackles involved the beak above the feet. Grackles, in contrast, were more likely to be upright, with the beak above the foot position in 31.6% of all observed feeding activity.

Redwing males and females both tore husks with their feet at times while feeding (females, 22.6% of feeding times; males, 17.6% of feeding times). It was possible that much of this tearing was accidental and resulted from casual foot placement. We saw, however, apparently intentional instances of redwings grasping husk strands in one foot and pulling downward, resulting in exposure of kernels. No other species was observed to use the feet in this way.

The appearance of the damaged husk and kernels differed somewhat among species, reflecting the different approaches to feeding. After starlings had fed on an ear, the husk usually had a shredded appearance with the shredded tips curled out and downward. This was also true for male and female redwings, with the amount of shredding generally less than for starlings. Husks opened by grackles had long (5-10 cm), vertical slits without the extensive shredding and curled appearance. Openings in husks made by cowbirds were usually small (<5 cm), vertical slits with only a small amount of damage underneath.

Redwings, starlings, and cowbirds fed by puncturing kernels, removing the milky contents, and leaving the pericarps. When grackles fed, the entire kernels were usually sheared off the cob.

DISCUSSION

Beecher (1951) and Orians (1985) reported that well developed, cranial protractor musculature exists in some icterids and sturnids, allowing the birds to open their bills forcibly against considerable resistance (i.e., to gape). Male redwings and starlings used this technique most effectively to open husks. Starlings are not known to commonly damage corn, although this study demonstrated that even juvenile birds have the capabilities to do so. Starlings apparently are not as efficient as redwings in digesting carbohydrates (Thompson and Grant 1968). Thus, it may be that in late summer they find it advantageous to feed on less plentiful, but more digestible insects and other food sources rather than ripening corn.

Female redwings spent as much or more time attacking corn ears as males; however, they did not demonstrate the same efficiency as males in damaging kernels. One reason for this could be that females, with a shorter bill, do not use the gaping method of opening husks as skillfully as do males. This supports the hypothesis (Gartshore et al. 1982) that female redwings eat more weed seeds and less ripening corn than do males because females have more difficulty husking ears.

Although grackles are known corn depredators, the birds in this study did not exhibit the same ability and tendency to feed on corn as did the juvenile starlings or redwings. The main difference in ability came in opening husks. Grackles were the only species that did not use the technique of gaping to expose the kernels. Instead, they poked the closed bill at the husk. This conforms to Beecher's (1951) findings that, in contrast to many icterids, the cranial protractor musculature of grackles is not well developed. Rather, their adductor musculature is well developed for closing the bill with great strength. Once the husk was open, a grackle was able to do exten-

TABLE 5

Use of the silk channel as a point of entry by red-winged blackbirds, common grackles, brown-headed cowbirds, and European starlings for attacking ear of corn.

Point of beak entry on corn husk	% of observations					
	Red-winged blackbirds		Common grackles	Brown-headed cowbirds	Eurpoean starlings	X^2 value
	Male	Female				
Silk channel	27	15	21	81	61	
Below silk channel	73	85	79	19	39	
(Total observations)	(41)	(13)	(14)	(16)	(64)	24.3*

*$P < 0.01$

sive damage to the ear with its large beak. These findings lead us to conclude that grackles are more likely to primarily attack ears already damaged by other species (e.g., redwings) in a field situation.

Cowbirds were the least successful corn feeders. They, like grackles, had difficulty in opening husks. Gaping seemed particularly unsuccessful for cowbirds, perhaps because of the large angle of their triangular beak. They usually succeeded in opening only a small area in one or two ears per cage. They tended to eat kernels in these small areas without expanding the opening much further. Cowbirds often fed in the extreme "head down" position. We observed them actually tumble over and off a corn ear several times. Cowbirds may do some damage to ripening corn, but probably only after ears have been opened by another species.

Previous studies have indicated that increased husk weight and increased husk extension beyond the cob tip are negatively correlated with the amount of damage to corn ears by blackbirds (Dolbeer et al. 1982, 1986). The behavioral findings from this study support those results. Increased husk weight (an indicator of increased husk thickness and strength) should reduce a bird's ability to penetrate and gape open the husk. Increased husk extension should also make it more difficult for a bird to enter through the silk channel and reach kernels. Thus, the incorporation of these characteristics into varieties of corn should help to elevate the level of resistance to damage by birds.

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LITERATURE CITED

Beecher, W. J. 1951 Adaptations for food-getting in the American blackbirds. Auk 68: 411-440.

Dolbeer, R. A. 1980 Blackbirds and corn in Ohio. U.S. Fish and Wildl. Serv., Resour. Publ. 136. Washington, D.C. 18 pp.

———, P. P. Woronecki, and R. A. Stehn 1982 Effect of husk and ear characteristics on resistance of maize to blackbird (*Agelaius phoeniceus*) damage in Ohio, U.S.A. Prot. Ecol. 4: 127-139.

———, ———, and ——— 1986 Resistance of sweet corn to damage by blackbirds and starlings. J. Amer. Soc. Hort. Sci. 111: 306-311.

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. Manage. 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. Manage. 34: 789-799.

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.

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. Manage. 36: 983-987.

Orians, G. H. 1985 Blackbirds of the Americas. Seattle: Univ. of Washington Press. 163 pp.

Potvin, N., J-M. Bergeron, and C. Fernet 1976 Regime alimentaire d'oiseaux frequentant un agrosysteme. Can. J. Zool. 54: 1992-2000.

Somers, J. D., R. G. Gartshore, F. F. Gilbert, and R. J. Brooks 1981 Movements and habitat use by depredating red-winged blackbirds in Simcoe County, Ontario. Can J. Zool. 59: 2206-2214.

Stewart, P. A. 1973 Starlings eat larvae on corn ears without eating corn. Auk 90: 911-912.

Stone, C. P., D. F. Mott, J. E. Forbes, and C. P. Breidenstein 1973 Bird damage to field corn in New York in 1971. New York Fish and Game J. 20: 68-73.

Thompson, R. D. and C. V. Grant 1968 Nutritive value of two laboratory diets for starlings. Lab. Animal Care 18: 75-79.

Weatherhead, P. J. and S. H. Tinker 1983 Maize ear characteristics affecting vulnerability to damage by red-winged blackbirds. Prot. Ecol. 5: 167-175.

Whitney, N. J. 1954 Ear rots in hybrid corn in Essex County, Ontario, in relation to damage by birds. Plant Disease Rept. 38: 384-387.

Williams, R. E. and W. B. Jackson 1981 Dietary comparisons of red-winged blackbirds, brown-headed cowbirds, and European starlings in north central Ohio. Ohio J. Sci. 81: 217-225.

Woronecki, P. P., R. A. Stehn, and R. A. Dolbeer 1980 Compensatory response of maturing corn kernels following simulated damage by birds. J. Appl. Ecol. 17: 737-746.

——— and R. A. Dolbeer 1983 Are starlings a potential threat to certain corn hybrids? Proc. Bird Control Semin., Bowling Green State Univ., Bowling Green, Ohio 9: 109-113.