FACTORS INFLUENCING BLACKBIRD AND EUROPEAN STARLING DAMAGE AT LIVESTOCK FEEDING OPERATIONS

JAMES F. GLAHN, U.S. Fish and Wildlife Service, Denver Wildlife Research Center, Kentucky Research Station, 334 15th Street, Bowling Green, KY 42101
DAVID L. OTIS, U.S. Fish and Wildlife Service, Denver Wildlife Research Center, Building 16, Denver Federal Center, Denver, CO 80225

Abstract: The association of environmental and management factors with blackbird (Icterinae) and European starling (*Sturnus vulgaris*) damage on livestock feed was analyzed with categorical modeling procedures using data collected from 288 Tennessee livestock operations during the winter of 1979–80. Although blackbird damage was sparse, it appeared to be influenced by ground feeding of livestock and the proximity of large blackbird roosts. Starling damage was influenced by proximity of starling roosts, snow and freezing temperatures, and the number of livestock on feed. These analyses create the potential for predicting and alleviating damage.

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Economic losses caused by wintering blackbirds and European starlings have been reported in cattle and swine feeding operations from various locations in the United States (Besser et al. 1968, Palmer 1976, Dolbeer et al. 1978, Gough and Beyer 1982). This problem is of concern in the southeastern United States because the majority of blackbirds and starlings that winter in North America are concentrated there (Meanley 1977). Although the overall economic impact of these birds is difficult to assess, serious damage problems appear to be isolated (Glahn 1983). Information on the underlying factors influencing bird damage at livestock feeding operations is needed to help determine when and where damage is likely to occur so that appropriate control strategies can be implemented.

We report here on a survey conducted on blackbird and starling damage at livestock feeding operations in 6 Tennessee counties during the winter of 1979–80. Our primary objective was to identify environmental and feedlot management factors associated with blackbird and starling damage.

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METHODS

Survey Areas and Data Collection

Six Tennessee counties (Giles, Henderson, Maury, McMinn, McNairy, and Monroe) were selected for study based on distribution within the state, high livestock density, previous distribution of major winter blackbird and starling roosts, and past histories of bird damage at livestock farms. Approximately 50 livestock operations (dairy, beef cattle, or swine feeding ≥ 20 animals) were selected in each county by locating all operations within 3–8 randomly selected 65-km^2 study areas. Each selected operation was observed intensively for 1 day between 1 December 1979 and 1 March 1980, the principal damage season. Blackbird and starling entries into livestock feed sites having the most birds on flush counts were estimated from 4 0.5-hour observations to provide an index of bird damage for each operation. Further details concerning methods of sampling livestock operations and bird activity are described in Glahn (1983).

Information on livestock feeding practices was gathered by observation and questioning farm operators at the 288 inspected operations. Data included number of cattle and pigs on feed, hours of daylight feed exposure, type and surface area of trough or feeder used, and type of feed ration and supplements fed/day or in storage. The estimated amount of grain or grain products in feed rations that was palatable to birds also was recorded.

Livestock densities were determined from the total number of cattle and hogs on all farms within each 65-km^2 study area. Blackbird and starling populations within a 30-km radius of each study area were located by following evening flightlines to the roost sites. In addition, barns and other structures at all study sites were examined for roosts by looking for accumulated droppings and observing bird use. Once locat-

ed, population size and species composition were estimated for each roost approximately every 2 weeks (see Dolbeer et al. 1978). Study areas were small in relation to the normal foraging ranges of blackbirds and starlings. Therefore, we gave equal weight to the effects of roosting populations on all livestock operations in the same study area by measuring the average map distance (to the nearest 1.6 km) from the roost site to the center of each study area.

Weather data, including amounts of precipitation and snow cover, were collected on site during inspection and were supplemented with mean daily temperatures from the weather station nearest the study area.

Data Analysis

Bird damage and other variables could not be measured accurately from a single farm inspection (Glahn 1983). Consequently, all variables were categorized and ultimately reduced to 1 of 2 categories to achieve reasonable sample sizes. Class intervals of the originally continuous data were predetermined based on both biological relevance (e.g., presence or absence of snow cover or above or below freezing temperatures) and the frequency distribution of each variable. Roosting bird populations were reduced to the presence or absence of a roost ≤ 15 km of the study area in which the farm was located. Based on previous economic assessment of 2-hour bird entry data (Glahn 1983), the 2 categories of no damage and damage were assigned to <100 and ≥ 100 entries, respectively.

Categorical analysis methods of Grizzle et al. (1969) were used to model feedlot damage as a function of the independent environmental (extrinsic) and farm practice (intrinsic) variables. This approach is similar to multiple regression analysis except log-linear model approximates are used for categorical data. The FUNCAT routine in the Statistical Analysis System package (Helwig and Council 1979) was used to perform the calculations after screening a large set of independent variables to derive a small subset of variables that satisfied these criteria: (1) each variable in the subset appeared to be associated with the incidence of damage, (2) the variables could be considered mutually independent (i.e., not intercorrelated), and (3) the subset had a sufficiently small number of variables to satisfy the data requirements of the Grizzle et al. (1969) modeling procedure. Although 2-way Chi-square tests of association were initially used for selecting the subset, a more objective method (Higgins and Koch 1977) was employed to supplement and verify subsets selected. This method is a stepwise approach that uses different types of Chi-square tests and methods of combining variables to best fit the model.

RESULTS AND DISCUSSION

Association of Factors with Bird Damage

The 1st step in the variable selection process was to identify all variables that were associated with damage although they were not necessarily mutually independent. Blackbird and starling damage occurred at 28 (10%) and 60 (21%) of the 288 farms, respectively. The distribution of blackbird and starling damage between cattle and swine operations has been discussed previously (Glahn 1983).

Blackbird and starling damage was examined in separate analyses. The sparsity of observed blackbird damage limited the extent and validity of the Chi-square results but provided at least preliminary insight into the problem. The most significant factor ($\chi^2 = 9.17$, $P < 0.005$) contributing to blackbird damage was the practice of feeding livestock (primarily swine) on the ground in an area ≥ 9 m^2. Our observations of blackbirds (primarily brown-headed cowbirds [*Molothrus ater*]) indicated that they mostly fed on spillage or manure on the ground and were less likely than starlings to use feed troughs and feeders. Besser et al. (1968) observed similar differences in trough use by starlings and red-winged blackbirds (*Agelaius phoeniceus*) in Colorado. Our data suggest that eliminating the practice of feeding livestock on the ground could reduce the amount of damage caused by blackbirds. The only other significant variable ($\chi^2 = 9.01$, $P < 0.005$) associated with blackbird damage was the presence of a blackbird and starling roost of $\geq 100{,}000$ birds ≤ 15 km of a livestock farm. Association between blackbird damage and weather factors was not evident.

In contrast, weather was a primary factor associated with starling damage (Table 1). This relationship was identified previously by Bailey (1966) and Stickley (1979). Both the presence of snow cover and a mean temperature <0 C were associated with starling damage ($P < 0.005$). To reduce the number of factors in our

Table 1. Factors associated with the presence or absence of starling damage at Tennessee livestock farms during winter, 1979–80.

Factors	Categories 1	Categories 2[a]	χ^2	P
Environmental				
Roost flightline in study area	absent	present	14.19	<0.005
Roost ≤15 km[b]	absent	present	19.91	<0.005
Snow cover	absent	present	14.07	<0.005
Temp	>0 C	≤0 C	17.21	<0.005
Snow or temp <0 C	absent	present	14.85	<0.005
Cattle fed in study area	<1,000	≥1,000	14.60	<0.005
Farm practices				
Head on feed	<150	≥150	7.87	<0.005
Feed trough area	<9 m²	≥9 m²	8.71	<0.005
Feed grain exposed all day	<227 kg	≥227 kg[c]	10.89	<0.005
Silage fed	<all day	all day	11.77	<0.005
Protein pellet fed	<all day	all day	4.25	<0.05
Protein supplement fed	<all day	all day	3.08	<0.10

[a] Category 2 represents increased incidence of damage.
[b] Roost populations ranged from 1,800 to 329,000 starlings.
[c] Approximate metric equivalent of 500 lb.

models, we combined these 2 variables into a single variable (Snowtemp) which corresponded to either the presence of snow cover or a mean temperature <0 C. Either of these conditions reduces the availability of invertebrates and other natural food for starlings. Two other significant ($P < 0.005$) environmental factors associated with starling damage were presence of a blackbird and starling roost flightline entering the study area (Flight) and roosting starling populations ≤15 km of the farm (S0to15). Preliminary analysis revealed that the size of roosting starling populations was not an important factor even though encountered populations varied from 1,800 to 329,000 birds. The presence of damage, as defined, did not necessitate a great number of starlings at the farm or roost. The other extrinsic factor that appeared to influence damage at a farm was the density of cattle (≥1,000 cattle fed) in the 65-km² study area in which the farm was located. This finding suggests that the presence of other cattle feeding operations in the vicinity may influence damage at a particular operation. Other extrinsic or environmental factors that showed no association with either blackbird or starling damage were rain occurrence, presence of trees ≥6-cm diameter at breast height ≤100 m of feed sites, and the presence of natural water sources ≤100 m of feed sites.

There was a significant ($P < 0.005$) association between farms with ≥150 animals on feed (Head) and starling damage. Herd size was a function of the quantity of feed provided each day and the area over which feed usually was exposed. Similarly, trough size ≥9 m² and all-day exposure of ≥227 kg of grain or grain products to livestock (Feed) were associated with starling damage. Unlike blackbird damage, feeding livestock on the ground did not appear to be associated with starling damage. This was probably because whole corn (a food less readily accepted by starlings) was the primary feed exposed in this manner. Preferences of starlings for certain types of livestock feed were suggested by the association of feed types with damage. When all-day exposure of various feed types was considered, the most significant ($P < 0.005$) type was corn silage. Starlings may not be able to subsist on corn silage, but it may be suitable if supplemented with other higher protein foods. Although categorized as being accessible to birds, the types and amounts of feed in storage did not show any association with starling damage. Possibly because stored feed usually is enclosed more than that fed to livestock, starlings were not observed to use these storage areas to any large extent.

Interrelation of Factors

Of the extrinsic factors evaluated, the only significant ($P < 0.0001$) interrelation was between S0to15 and the density of cattle in the 65-km² study area. This finding suggests that roosting starling populations may be associated with the food base provided by cattle feeding

Table 2. Chi-square values and coefficient estimates for categorical models of selected intrinsic and extrinsic factors affecting the presence or absence of starling damage in Tennessee during winter, 1979–80. (The presence of each factor increases the incidence of damage.)

Model	Factor	df	χ^2	P	Coefficient estimate
1	S0to15[a]	1	16.88	≤0.0001	0.67
	Snowtemp[b]	1	16.80	≤0.0001	0.66
	Head[c]	1	9.76	0.0018	0.51
	Residual	4	0.68	0.9500	
2	Snowtemp	1	15.82	≤0.0001	0.64
	S0to15	1	13.00	0.0003	0.58
	Feed[d]	1	7.77	0.0053	0.48
	Residual	4	0.81	0.9375	
3	Flight[e]	1	16.6	≤0.0001	0.70
	Snowtemp	1	11.4	0.0007	0.56
	Head	1	8.1	0.0044	0.50
	Residual	4	3.4	0.4927	

[a] Presence or absence of roosting starling populations ≤15 km of the study area in which the farm was located.
[b] Presence or absence of snow cover or mean temperature ≤0 C on the day of farm inspection.
[c] Presence or absence of ≥150 head of livestock on feed at farm.
[d] Presence or absence of all-day exposure of ≥227 kg of grain or grain products fed to livestock.
[e] Presence or absence of roost flightline entry into the 65-km^2 study area in which farm was located.

operations and/or the grain or pastureland cultivated in these areas to support this industry.

All of the intrinsic factors (farm characteristics) and feeding practices appeared to be interrelated probably because they were related to the food base provided by the livestock operations.

Categorical Models

Based on our analytic procedure, important variables that should be contained in a model of starling damage are: (1) S0to15, (2) Snowtemp, and (3) Head or Feed. The Higgins and Koch (1977) procedure yielded a similar subset of variables including: (1) Flight, (2) Snowtemp, and (3) Head.

Categorical models were generated with and without interaction terms. Because none of the interaction terms proved significant, only main-effect models are presented (Table 2). The model that best fits the data, judged by the least residual χ^2 (0.68), contained S0to15, Snowtemp, and Head. This model suggests that the 2 main factors equally influencing damage are starling roosts ≤15 km and snow cover or below freezing temperatures on the day of inspection. The 3rd factor, number of head on feed, has slightly less influence as judged by the coefficient estimate. The next best model contained Feed instead of Head. The similarity of these 2 models is not surprising considering that Head and Feed were highly interrelated ($P < 0.0001$). The model generated from the Higgins and Koch (1977) procedure using Flight instead of S0to15 also fits the data well but did not provide as good a fit as the best models generated from our more intuitive approach.

MANAGEMENT IMPLICATIONS

Although this simplistic model requires experimental verification, it does suggest categorical factors associated with starling damage at livestock farms and provides clues to damage reduction strategies. The general model predicts that damage is likely to occur when large livestock farms, exposing an ample amount of grain, are located in proximity to winter starling roosts during severe weather conditions. Because both starling damage and proximity of winter roosting populations were associated with the number of cattle on feed in a given area, damage may be more likely to occur in larger cattle producing areas. A similar relationship may exist for swine producing areas but was not identified in this study. The presence of an agricultural food base provided by a high density of livestock farms may influence the distribution of winter roosting starlings and resulting damage problems. In view of these factors, several basic damage control strategies appear evident and need further testing. First, eliminating ground feeding may help reduce blackbird damage problems. Limiting the exposure of palatable feed would seem the best long-term strategy for controlling starling damage. Second, the selective control of starling populations roosting near feedlots may be warranted, especially when a large number of livestock feeding operations are in close proximity to these roosts. Using the model, management decisions on starling control could be based on the number of livestock feeding operations of suitable size likely to be impacted adversely.

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BIRD NESTING IN IOWA NO-TILLAGE AND TILLED CROPLAND

NANCY S. BASORE, Department of Animal Ecology, Iowa State University, Ames, IA 50011
LOUIS B. BEST, Department of Animal Ecology, Iowa State University, Ames, IA 50011
JAMES B. WOOLEY, JR., Iowa Conservation Commission, Chariton, IA 50049

Abstract: Nesting of birds was studied in 355 ha of nontilled (no-tillage) and 129 ha of tilled cropland. No-tillage treatments included corn planted into corn residue, corn planted into sod residue, and soybeans planted into corn residue. A control treatment was corn planted into tilled cropland. Twelve bird species (excluding brown-headed cowbirds [*Molothrus ater*]), with an average density of 36 nests/100 ha, nested in no-tillage fields; only 3 species, with an average of 4 nests/100 ha, nested in tilled fields. Nests in no-tillage fields were located in crop residue that was shorter but of similar coverage to that in random locations within the fields. Nests in tilled fields were positioned in locations where crop residue was more concentrated but of a height similar to that in random locations. Twenty-two percent of all nests in crop fields were successful, 54% were lost to predators, and <6% were destroyed by farming implements. Nesting success probably was below levels needed to sustain viable populations without influx from other areas.

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The amount of land devoted to row-crop agriculture in the midwestern United States has increased over the last 50 years, often at the expense of higher quality wildlife habitat. From 1939 through 1972, 30% of northcentral Iowa's fencerows were removed, and the crop composition shifted from mostly small grains, hay, and pasture to mostly corn and soybeans (Mohlis 1974). In 1982, 66% of the farmland in Iowa was planted to corn and soybeans (Iowa Crop and Livest. Rep. Serv. 1983). Similar land-use changes have occurred in other agricultural states; e.g., Vance (1976) and Taylor et al. (1978).

Among the land-use practices receiving increased acceptance by farmers are those that leave crop residue on the soil surface. Such practices are being promoted to combat soil erosion which may be 100× greater on fields not covered with residue than on those with residue (Triplett and Van Doren 1977). One system for leaving maximum amounts of residue on field surfaces is to plant directly through crop residue without tilling the soil. Land in Iowa farmed by such no-tillage methods has increased 5-fold in 5 years; in 1983, Iowa had 168,000 ha of no-tillage cropland (U.S. Soil Conserv. Serv., unpubl. data). Crop residue left on these areas may enhance their use by ground-nesting birds.

Literature describing bird use of cornfields and soybean fields is quite limited, perhaps because bird densities in cropland are low. The occurrence of birds in no-tillage cornfields and soybean fields in fall, winter, and summer has been documented by Castrale (1983, unpubl. data) and Warburton and Klimstra (1984). On the basis of periodic bird counts, they concluded independently that bird densities were greater in no-tillage fields than in tilled fields. Neither project documented nesting within fields, however, and in Warburton and Klimstra's study, treatment fields were not repli-