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# AGRICULTURAL IMPACT OF A WINTER POPULATION OF BLACKBIRDS AND STARLINGS

RICHARD A. DOLBEER, PAUL P. WORONECKI, ALLEN R. STICKLEY, JR., AND  
STEPHEN B. WHITE

The major concentration of blackbirds and Starlings (*Sturnus vulgaris*) in North America occurs in the southeastern United States where an estimated 350 million Red-winged Blackbirds (*Agelaius phoeniceus*), Common Grackles (*Quiscalus quiscula*), Brown-headed Cowbirds (*Molothrus ater*), and Starlings congregate in winter roosts (Meanley 1971, 1975, 1977). An estimated 75–100 major (containing >1 million birds) roosts form in the southeastern states each year.

Increasing attention is being given to many of these roosts because of nuisance problems, reputed health hazards, and agricultural damage associated with them. Although considerable effort has been directed toward developing methods for reducing roosting populations (Lefebvre and Seubert 1970), field applications of such methods have met with considerable public opposition (Graham 1976). Unfortunately, little effort has been directed to ecological studies of the various roosting species during the winter months.

The objectives of this study were: (1) to document food habits, habitat preferences and use, and general feeding and roosting behavior of the various blackbird species and Starlings using a large winter roost; and (2) to undertake a preliminary survey of the impact that this large roosting population has on agriculture within a 40 km foraging radius of the roost.

## STUDY AREA AND METHODS

The study area included a large concentration of blackbirds and Starlings that roosted during the winter of 1975–76 about 7 km east of Milan, Tennessee, on the Milan Army Ammunition Plant site near the Gibson-Carroll county border. The roost, bounded by highway and pastures, was in a 21-year-old, 4.5 ha loblolly pine (*Pinus taeda*) plantation with little understory. The birds had been roosting each winter at various sites on the ammunition plant since at least 1969. The birds foraged primarily in Gibson County. This roost has been a center of controversy since the winter of 1974–75 when the Army attempted to reduce the bird population by spraying the roost with a wetting agent (Russell 1975).

Gibson County is a leading agricultural county in western Tennessee (Hobson 1976). In 1975, over 48,000 ha were planted to soybeans; 14,000 ha to cotton; and 11,000 ha to corn. Production of wheat, historically a minor crop in the county, increased from 3200 ha in 1973 to over 8000 ha in 1975. The county had the largest hog and cattle population in western Tennessee in 1973–75, averaging about 55,000 and 50,000 head, respectively.

*Population numbers and species composition.*—Between 1 November 1975 and 5 March 1976, 28 estimates of numbers and 18 estimates (at least once weekly) of the species composition of blackbirds and Starlings roosting near Milan were obtained usually by 2

observers. We made population estimates by block-counting (Meanley 1965) birds in all major flight lines as they left the roost. To estimate species composition, we stood under the flight lines of departing birds in the morning or returning birds in the evening. At least 100 random binocular sightings were made for each estimate of species composition; the first bird that entered the field of view was identified and recorded.

*Bird census for habitat use.*—Five automobile routes totaling 80 km were established on secondary roads 3 to 30 km from the roost. The routes were in zones where major flight lines from the roost have traditionally occurred and where complaints of damage to crops have been most prevalent (Russell 1975).

On 24 days between 30 October and 3 March, bird censuses were conducted on these routes by 2 observers in 1 automobile starting 0.5–1 h after sunrise and ending before 15:30 (CST). The starting route and direction were randomly selected each day; the remaining routes were run in the most expeditious order. Routes were driven at 15–45 km/h. The vehicle could be stopped for up to 1 min if necessary to observe a flock of birds through binoculars. Numbers, species, composition, and associated habitat types were recorded for all observed groups of 2 or more Starlings and/or blackbirds.

The 12 habitat types were: (a) pasture (includes cemeteries and unimproved pastures with broomsedge); (b) cornfields and corn stubble; (c) wheat; (d) legumes; (e) soybean fields and soybean stubble; (f) feedlots (must include feeding apparatus or closely-fenced livestock); (g) woodlots, forest, or brush; (h) buildings; (i) thoroughly plowed (little evidence of previous crop type); (j) cotton; (k) fallow (weedy fields not in cultivation or pasture previous growing season); and (l) miscellaneous.

We ran 1 to 4 habitat surveys monthly on the census routes from late October to early March to determine the relative proportions of the 12 habitat types. We recorded the habitat type on each side of the road at 0.16 km intervals. Thus, 1000 sample points were recorded for each survey.

*Food habits.*—Between 14 November and 29 February, usually once weekly, we collected 50 to 75 birds by shotgun as they settled into the roost at dusk. Each bird was identified, sexed, and weighed before stomach and esophageal contents were placed in a vial containing 5% formalin.

For the analysis of food items, the formalin solution was drained from each vial and the vial contents were placed in a drying oven (40°C) for several hours. Each sample was then placed in a Petri dish containing five 1-mm dots symmetrically placed 2 cm apart in the form of the center and end points of an "X." The dish was shaken and stopped at random and the food item resting on or nearest each dot was recorded. This procedure was repeated 5 times per sample for a total of 25 recordings per sample. The total for each food item (corn, wheat, sorghum, weed seeds, tree fruits, and insects) was multiplied by 4 to obtain a percentage estimate based on surface area.

This food-habits analysis is biased toward foods that are difficult to digest (e.g., corn, certain weed seeds); thus, the percentage estimates obtained should be viewed in light of this limitation. In addition, birds were collected only in the evening; thus, any diurnal pattern in food selectivity was ignored. Nonetheless, we believe this analysis provides a general view of the dominant foods of the various bird species.

*Waste corn.*—Random areas of harvested cornfields in Gibson County were searched for corn at intervals during the winter to determine the amount of waste corn available to birds. In each field, 2 strips 0.75 m by 55 m were searched. All cobs and pieces of cobs bearing kernels were collected. In addition, 2 randomly-selected areas 0.75 m by 0.75 m in each strip were searched for loose kernels. These loose kernels were collected,

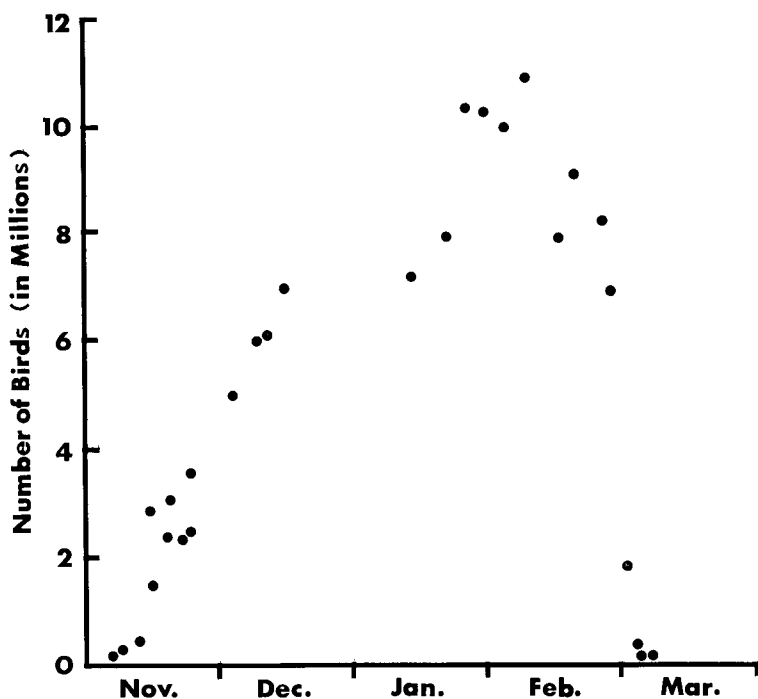


FIG. 1. Estimated number of blackbirds and Starlings using roost near Milan, Tennessee, November 1975-early March 1976.

and together with cob samples, removed from the fields. All kernels were removed and weighed to the nearest gram. Kilograms of available corn per ha were then calculated.

*Feedlots: bird censuses and observations.*—On 9 days between 29 January and 2 March 1976, we censused blackbird and Starling populations at 19 to 25 cattle and hog feedlots within 40 km of the Milan roost in the main area of foraging by the roosting population. Censuses were made from 10:00 to 15:00 CST. Each lot was observed for 5–10 min and the number and species composition of blackbirds and Starlings in the lot were estimated. In addition, we made extended observations at several lots to study the feeding behavior of the various birds species.

#### RESULTS

*Size and species composition of roosting population.*—The roost formed in early November and disbanded in early March. The roosting population estimates indicated a smooth growth to a peak population of around 11 million blackbirds and Starlings in January and early February and a sudden reduction in late February (Fig. 1). The species composition remained fairly constant between November and February (Table 1) with an overall mean

TABLE 1  
AVERAGE MONTHLY SPECIES COMPOSITION (%) OF BIRDS AT MILAN, TENNESSEE ROOST,  
NOVEMBER 1975 THROUGH EARLY MARCH 1976<sup>1</sup>

Species	Nov.	Dec.	Jan.	Feb.	Early March	Mean
Common Grackle	70 (2.5) <sup>2</sup>	75 (5.2)	63 (6.7)	57 (6.3)	47 (0.2)	64
Red-winged Blackbird, Brown-headed Cowbird, and Rusty Blackbird	20 (0.7)	15 (1.0)	33 (3.5)	34 (3.7)	4 (<0.1)	27
Starling	10 (0.4)	10 (0.7)	4 (0.4)	9 (1.0)	49 (0.2)	9

<sup>1</sup> Red-wings, cowbirds, and Rusty Blackbirds are lumped together because of our inability to distinguish during species composition estimates.

<sup>2</sup> Values in parentheses are peak monthly population estimates ( $\times 10^6$ ).

of 64% grackles, 27% Red-wings and cowbirds, 9% Starlings, and a trace % of Rusty Blackbirds (*Euphagus carolinus*). (Red-wings and cowbirds were lumped together because they were difficult to distinguish during the species composition estimates. Based on our general observations, the bird censuses along roadsides, and the species composition of birds collected for food habits, we believe that Red-wings were more numerous than cowbirds.)

Grackle populations peaked in January whereas Red-wing, cowbird, and Starling populations peaked in February (Table 1). Grackle, Red-wing, and cowbird populations decreased rapidly in late February before Starling populations dispersed.

*Daily habitat use.*—The number of blackbirds and Starlings seen per census

TABLE 2  
NUMBER OF BLACKBIRDS AND STARLINGS RECORDED AND SPECIES COMPOSITION OF THESE BIRDS ON CENSUS ROUTES, LATE OCTOBER 1975 THROUGH EARLY MARCH 1976, MILAN, TENNESSEE AREA

Month	No. days census run	Species composition of birds observed (%)					Avg. birds recorded per 80 km census
		Grackles	Red-wings	Cowbirds	Starlings	Rusty BB	
Oct.	1	0	23	<1	76	0	1565
Nov.	12	82	8	1	8	0	5430
Dec.	5	54	22	5	19	<1	4537
Jan.	2	20	28	2	50	0	2404
Feb.	3	53	17	13	17	<1	7622
March	1	89	2	6	3	<1	2191
Total	24	62	17	4	16	<1	

TABLE 3

AVERAGE % OF GRACKLES, RED-WINGS, COWBIRDS, AND STARLINGS OBSERVED BY HABITAT TYPE FOR NOVEMBER 1975 THROUGH FEBRUARY 1976, IN MILAN, TENNESSEE AREA

Habitat type	Avg. % of total habitat (Nov.-Feb.)	Grackles	Red-wings	Cowbirds	Starlings
Pasture	23	4	2	6	31
Corn	4	35	26	11	5
Wheat	5	9	5	<1	5
Soybeans	21	4	36	3	11
Feedlots and legumes	<1	6	3	65	23
Woods	13	36	16	12	11
Buildings and miscellaneous	12	1	3	1	10
Plowed	3	2	6	2	1
Cotton	8	<1	2	0	2
Fallow	11	2	2	0	<1

fluctuated considerably from day to day, primarily in response to weather conditions (e.g., during inclement weather more birds were usually seen). The species composition of birds seen (grackles 62%, Red-wings 17%, Starlings 16%, cowbirds 4%, Rusty Blackbirds <1%) was similar to the estimates obtained at the roost (Tables 1 and 2).

The major habitat types along the census routes were pasture (23%) and soybeans (21%) followed by woods (13%), buildings and miscellaneous (12%), and fallow (11%) (Table 3). The relative proportions of the various habitat types remained rather stable from November through February.

The various bird species had conspicuous differences in habitat use during the winter months (Table 3). The majority of grackles were seen in cornfields and woods which made up only 4% and 13% of the habitat, respectively. Red-wings were the only species commonly recorded in soybeans; 36% of the Red-wings were seen in soybeans (21% of the habitat). Red-wings also commonly used cornfields. We observed most cowbirds (65%) at feedlots which made up <1% of the habitat. Habitat types most used by Starlings were pasture (31%), feedlots (23%), and woods (11%). They were also the only species commonly seen around buildings and urban areas.

Some major changes in habitat use occurred during the winter (Fig. 2). Starling use of wheatfields declined as the winter progressed. The use of feedlots was rather constant throughout the winter for cowbirds; however, it increased for Red-wings, Starlings, and grackles as winter progressed.

*Food habits and body weights.*—Corn (averaging 77%) was the dominant food for grackles during each month, November through February (Table 4).

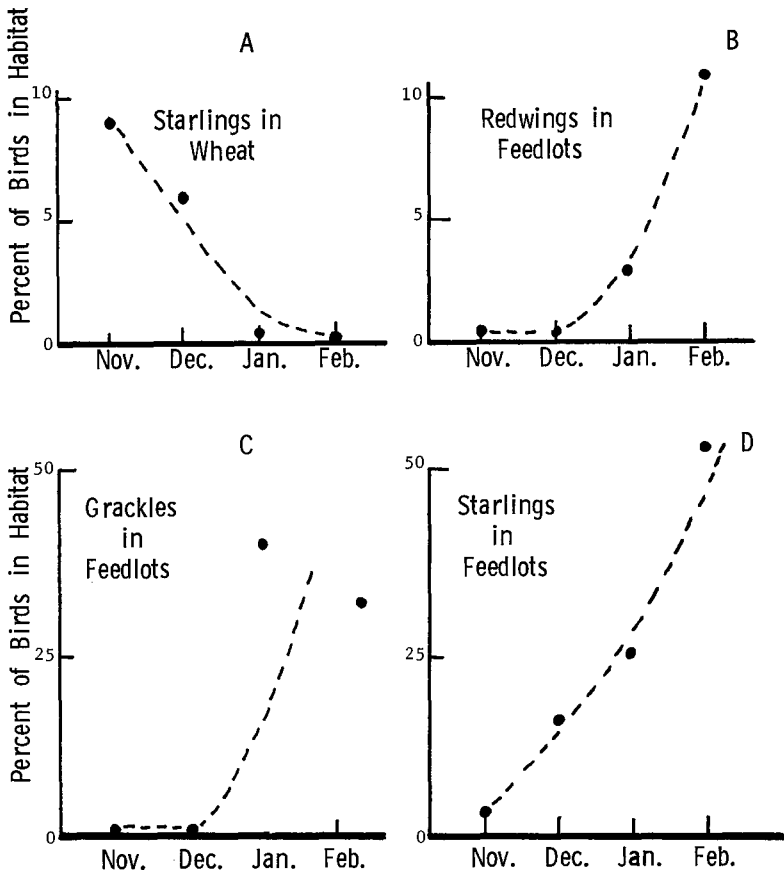


FIG. 2. Percent of (A) Starlings observed in wheatfields, (B) Red-wings observed at feedlots, (C) Grackles observed at feedlots, and (D) Starlings observed at feedlots during bird censuses, November 1975 through February 1976, Gibson County, Tennessee.

Only in November, when acorns (*Quercus* spp.) made up 29% of the food items, was the percentage of corn <75% for grackles. The most common weed seed found was ragweed (*Ambrosia* sp.). Grackles, the only species with sufficient numbers collected of both sexes to examine sex-specific food habits, had no apparent sex-specific differences.

Corn (38%) and weed seeds (36%) were the dominant foods for Red-wings (Table 4). Weed seeds commonly consumed were Johnson grass (*Sorghum halepense*), cocklebur (*Xanthium strumarium*), chickgrass (*Digitaria ischaemum*), dropseed (*Sporobolus* sp.), smartweed (*Polygonum* sp.), and pigweed (*Amaranthus* sp.).

TABLE 4  
 PERCENT OF VARIOUS FOOD ITEMS (BY SURFACE AREA) IN GRACKLES, RED-WINGS, STARLINGS, AND  
 COWBIRDS COLLECTED AT MILAN, TENNESSEE ROOST, NOVEMBER 1975 THROUGH FEBRUARY 1976

Food item	Grackles			Red-wings			Starlings			Cowbirds			CG RW ST CB			
	Nov.	Dec.	Jan. Feb.	Nov.	Dec.	Jan. Feb.	Nov.	Dec.	Jan. Feb.	Nov.	Dec.	Jan. Feb.	4-month average			
Corn	56	85	89 77	32	40	53 27	8	29	- 10	38	54	- 92	77	38	16	46
Wheat	0	0	0 0	T*	T	0 0	41	5	- 11	0	0	- 0	0	T	19	0
Sorghum	T	0	0 0	1	2	0 3	0	0	- 0	7	0	- 0	T	2	0	4
Weed seeds	6	5	4 7	44	32	26 40	26	29	- 33	44	24	- 8	6	36	29	34
Tree seeds	29	3	0 T	1	1	0 1	16	17	- 1	0	0	- 0	8	1	9	0
Insects	1	T	T 1	T	T	0 1	2	2	- 6	0	0	- 0	1	T	3	0
Unidentified and miscellaneous	8	7	7 15	22	25	21 28	7	18	- 39	11	22	- 0	8	23	24	16
Number of birds in sample	129	82	31 91	103	70	18 27	21	7	0 27	9	5	0 1	269	218	55	15

\* Trace (<1%).



TABLE 5  
 AVERAGE BODY WEIGHTS IN GRAMS ( $\pm 1$  S.E.) FOR BLACKBIRDS COLLECTED AT MILAN,  
 TENNESSEE ROOST, NOVEMBER 1975 THROUGH FEBRUARY 1976

Month	Male Grackles	Female Grackles	Male Red-wings
November	126.1 $\pm$ 1.0 (75)*	100.0 $\pm$ 0.9 (54)	71.5 $\pm$ 0.6 (98)
December	126.0 $\pm$ 1.7 (41)	101.1 $\pm$ 0.9 (41)	73.6 $\pm$ 0.5 (68)
January	132.3 $\pm$ 1.0 (17)	103.8 $\pm$ 1.5 (14)	79.0 $\pm$ 1.3 (15)
February	126.4 $\pm$ 1.0 (64)	98.8 $\pm$ 1.2 (26)	72.8 $\pm$ 1.2 (24)

\* Sample sizes are in parentheses.

Starlings had the most cosmopolitan diet with plant seeds (29%), wheat seeds or sprouts (19%), corn (11%), and tree fruits (9%) commonly present (Table 4). Common plant seeds were sumac (*Rhus* sp.), wild grape (*Vitis* sp.), and pokeweed (*Phytolacca americana*). The tree fruits were predominantly hackberry (*Celtis* spp.). Starlings were the only species in which insects were consistently found.

Corn (54%) and weed seeds (34%) were the dominant foods in the small (15) sample of cowbirds collected (Table 4). Johnson grass, ragweed, and pigweed were the dominant weed seeds.

Monthly average body weights (November–February) were determined for male and female grackles and male Red-wings (Table 5). In all cases, weights were highest in January. The average weight ( $\pm 1$  S.E.) for 13 female Red-wings, 56 Starlings, and 9 male and 4 female cowbirds was 48.9  $\pm$  0.4, 86.2  $\pm$  0.9, 52.8  $\pm$  0.6, and 40.0  $\pm$  1.6 g, respectively.

#### IMPACT ON AGRICULTURE

*Winter wheat.*—A substantial part of our study was devoted to measuring the damage inflicted by Starlings and blackbirds on winter wheat in Gibson County. This study is the subject of a separate report (Stickley et al. 1977) and will be only briefly summarized here.

Forty-eight randomly selected wheatfields along the census routes were monitored during the period November through February. Two of the 33 fields planted before 13 November received bird damage (i.e., pulling up sprouting wheat). All 15 fields planted after 12 November received some damage. Seven of these 15 fields that could be assessed for damage averaged

TABLE 6

SUMMARY OF BLACKBIRD AND STARLING NUMBERS AT HOG AND CATTLE FEEDLOTS CENSUSED ON 9 DAYS FROM 29 JANUARY THROUGH 2 MARCH 1976 IN GIBSON COUNTY, TENNESSEE

Type of lot	Avg. no. lots censused/day	Avg. no. birds in lot/census	Avg. species composition (%)			
			Starlings	Grackles	Cowbirds	Red-wings
Hog	14	54.0 (1000) <sup>a</sup>	69	15	12	4
Cattle	8	223.0 (3000) <sup>a</sup>	17	20	62	1

<sup>a</sup> Values in parentheses represent maximum number of birds estimated in a lot during a census.

about 11% of their sprouts removed by birds. Frost damage to the 15 late-planted fields averaged 25% of the sprouts destroyed. Overall, the 48 fields suffered an estimated 3.5% sprout removal by birds and 13.5% sprout destruction by frost. Almost no fresh damage was noted after mid-January. A survey of some of these fields in May 1976, shortly before harvest, revealed no significant relationship between amount of bird damage in winter and number of mature heads of grain in May.

Almost all bird damage was done by Starlings (Table 4), a species that made up a minor (9%) part of the roosting population. Grackles commonly were observed feeding in wheatfields (Table 3); but they fed on items such as waste corn and weed seeds.

*Corn.*—Almost all corn was harvested in Gibson County by the time the roost developed in early November. Thus, the roosting population inflicted almost no damage to standing corn. However, both stomach contents (Table 4) and habitat-use censuses (Table 2) indicated that corn left in fields after harvest was an important food for blackbirds, particularly grackles. Most of this corn should be considered as waste corn, although in some fenced fields corn was used by livestock during the winter. About 17% of the cornfields along the census routes were fenced.

The estimated waste corn per ha of harvested cornfields declined significantly ( $P < 0.05$ ) from an average of 245 kg/ha (moisture content of 20–25%) for 12 fields sampled in November to <10 kg/ha for 20 fields sampled in January and February. Thus, far less corn was available to foraging blackbirds late in winter compared with November.

*Feedlots.*—There were major differences in blackbird and Starling populations in cattle and hog feedlots (Table 6). Cattle lots had an average of 223 birds per census compared to 54 birds for hog lots. Cowbirds, making up 62% of the birds observed, were by far the predominant species at cattle lots, followed by grackles (20%) and Starlings (17%). In hog lots, Starlings, constituting 69% of the birds seen, were by far the predominant species, fol-

lowed by grackles (15%) and cowbirds (12%). Red-wings made up <5% of the birds at either cattle or hog lots. Although they were not enumerated during feedlot censuses, House Sparrows (*Passer domesticus*) were often as numerous as Starlings or blackbirds. Blackbirds and/or Starlings were present in about 75% of cattle and hog lots during the censuses.

The extended observations suggested that during midday, when the feedlot census was normally run, there was little exchange in the populations of blackbirds and Starlings associated with the feedlots. In the early morning and evening, however, there appeared to be a transfer of birds at feedlots (i.e., new flocks coming in to feed as other flocks left).

The actual loss of feed to birds was not measured; however, some behavioral information on feeding and qualitative information on feed loss was obtained. In hog lots, almost no feed was lost to birds directly from feeders because feeders were covered. Hogs commonly spilled grain out of feeders and this was a source of food for the birds. Starlings, the predominant species at hog lots, were the only birds seen perching on the hogs' backs. The major concern of hog farmers was the suspected role of the birds in the spread of disease among hog lots.

In cattle lots, the predominant feeding activities of birds were: (1) feeding on corn and other food items in cattle droppings, and (2) feeding in pastures associated with cattle-feeding operations. Cowbirds, grackles, Starlings, and House Sparrows were observed in feeding troughs (covered feeders are not used with cattle). Farmers expressed as much concern over feed contamination from bird droppings as they did over feed consumption by birds. Disease complaints were minor.

#### DISCUSSION

##### Niche Differentiation of the Bird Species

Grackles, Red-wings, cowbirds, and Starlings, although using a common roost at night, had strikingly different niches in their daily existence.

*Grackles.*—Grackles were not only the most numerous species at the roost, constituting about 64% of the birds and peaking at a population of over 6 million in January and early February; but, they also had the greatest body weight per bird. Thus, if we assume a 1:1 sex ratio, grackles, from the viewpoint of numbers, biomass, and energy consumed, had a greater impact than the other species combined on the ecosystem within the foraging range of the roosting population.

Food-habits analyses and the habitat-use censuses showed that waste corn was of primary importance to grackles. Overall, the negative impact that grackles had on agriculture appeared rather minor. Areas of conflict were: (1) use of feedlots in late winter, perhaps as a result of depleted supplies of

corn in fields; and (2) competition with livestock feeding in harvested cornfields. Grackles were the most common species observed in wheatfields; however, our food-habits data and observations indicated they fed on other foods (often corn) and not wheat. Thus, their presence in wheatfields can only be considered as beneficial. Thirty-one percent of the wheatfields had previously been in corn and many had considerable amounts of corn at the soil surface.

*Red-wings*.—Red-wings were the only species commonly associated with harvested soybean fields (Table 3). A primary food source for Red-wings in these fields appeared to be cocklebur, a common weed in soybeans. Corn was also an important food source for Red-wings; they were often observed with grackles feeding in corn stubble or wheatfields. Red-wings probably had the least impact on agriculture of all roosting species. They, along with grackles, increased their use of feedlots in late winter (Fig. 2), but were still a minor species at feedlots (Table 6).

*Cowbirds*.—Cowbirds were the least common species in the roosting population (with the exception of Rusty Blackbirds). They also had the lowest body weight per bird and, thus, the lowest total biomass. They were primarily associated with cattle, either in pastures or feedlots. Corn, both from feedlots and harvested fields, was an important food source.

*Starlings*.—Starlings made up 9% of the roosting population and about 8% of the biomass; they appeared to have the greatest negative impact on agriculture of all species. They inflicted almost all the damage to sprouting wheat and were by far the dominant species associated with hog lots. In addition, they were the only species commonly associated with buildings and urban areas. Starlings also used pastures and grassy areas much more than did the other species.

Of considerable interest also is the fact that many of the Starlings roosting in the mid-southern United States in winter (such as in Gibson County) are year-round residents of the region. For example, B. L. Monroe (pers. comm.) has estimated that 47% of the Starlings roosting in Kentucky in the winter remain in the state year-round. This contrasts with the vast majority of winter-roosting grackles, Red-wings, and cowbirds that are migrants from the northern United States and Canada (Fankhauser 1968, Meanley 1971, Meanley and Dolbeer 1977, Dolbeer 1978).

#### IMPACT OF BIRDS ON AGRICULTURE

*Winter wheat*.—The 48 wheatfields surveyed received an estimated 3.5% sprout removal (range 0–34%) by Starlings during the winter and 13.5% sprout destruction (range 0–50%) by frost. There was no apparent relationship between amount of bird damage in winter and number of mature heads

of grain in May. Thus, overall, bird damage to sprouting wheat appeared to be a minor problem in the winter of 1975–76. Most bird damage and all freeze-thaw damage occurred to fields planted after 12 November; therefore, a preliminary management recommendation for areas in western Tennessee, where bird damage is a problem, is that wheat should be planted before early November when possible. (Of course, additional data are needed to determine year-to-year and geographical variability before final management recommendations are made.) For reasons other than bird damage, the Tennessee Agricultural Extension Service recommends that wheat be planted before 1 November (Cobble 1974).

*Feedlots.*—This study documented that blackbirds and Starlings commonly used feedlots, and that the feeding behavior and species composition of the birds were different for hog and cattle lots. In both types of lots, the predominant species (Starlings or cowbirds) were species that made up a minor part of the bird population at the Milan roost. House Sparrows, which do not roost with blackbirds and Starlings and are present year round, were also commonly found at the feedlots.

Additional quantitative studies are needed to document: (1) the proportion of feed consumed by birds that represents a real loss to the farmer (Besser et al. 1968, Feare 1975), (2) the loss of feed in cattle lots due to contamination by birds, and (3) the role that birds at feedlots play in the spread of diseases. Also, more work, both extension and research, needs to be done in the area of feedlot design and in the use of toxicants and mechanical scare devices to reduce bird populations at feedlots (e.g., West 1968, Besser et al. 1967, Wright 1973).

*Corn.*—Standing corn received insignificant damage from the roosting population because almost all was harvested by the time the roost formed in early November. Nevertheless, waste corn was a dominant and perhaps critical food item, particularly for grackles and Red-wings. Further studies should be undertaken on the relationship of roosting populations to corn. The abundance of waste corn in fields may be the major factor allowing many of these large roosting populations to exist in their present locations throughout the winter.

#### CONCLUSIONS

The 4 bird species that composed the roost near Milan, Tennessee, varied considerably in their numbers, biomass, foraging behavior, food habits, and impact on agriculture. Because of this overall diversity and the complexity of the various problems the birds create, simplistic management schemes are likely to fail in solving the conflicts—they may even exacerbate them. For example, much of the nuisance, feedlot problem, and wheat damage in Gibson

County was caused by Starlings, a minor species in the roosting population. Attempts to exterminate or greatly reduce the roosting population by spraying with a wetting agent may selectively favor the Starling, a highly adaptable and prolific species that perhaps survives wetting-agent applications and low-temperature stressing better than native blackbird species (Odum and Pitelka 1939, Lustick and Joseph 1977).

Long-term relief from the various conflicts most likely will require an integrated management program with a sound ecological basis. The use of bird-control chemicals at feedlots, roost dispersal and roosting habitat manipulation techniques, lethal control at certain roosts, changes in certain cultural practices in agriculture, chemical repellents, and public tolerance may all be a part of such an integrated approach. We hope that this preliminary study has contributed information that will help make such a management program a reality.

#### SUMMARY

Habitat preferences and use, food habits, and impact on agriculture were studied for 11 million blackbirds and Starlings roosting in Gibson County, Tennessee, in the winter of 1975-76. The roost was composed of Common Grackles (64%), Red-winged Blackbirds and Brown-headed Cowbirds (27%), Starlings (9%), and Rusty Blackbirds (<1%). The various species had strikingly different niches in their daily existence and impact on agriculture. Waste corn was of primary importance to grackles and Red-wings, which spent most of their time feeding in corn and soybean stubble and woodlots. Red-wings fed commonly on cocklebur seeds in soybean stubble. Cowbirds and Starlings commonly used pastures and feedlots. Starlings did almost all the bird damage to sprouting wheat. Starlings, a minor species in the roost, had the greatest negative impact on agriculture. Simplistic management schemes are likely to fail in solving bird-man conflicts caused by multi-species roosting populations—they may even exacerbate them. Long-term relief most likely will require an integrated management program with a sound ecological basis.

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