MANAGEMENT OF BLACKBIRD POPULATIONS

IN WESTERN OKLAHOMA

By

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CHAPTER I

INTRODUCTION

Blackbirds create serious crop depredations in many localities, and in some instances over wide geographical areas. Many years ago, Warren (1890) quoted T. S. Wilkinson as saying:

> The rice crop in Louisiana, from the time the rice is in the milk till harvest time and during harvesting, is much damaged by birds, principally the Red-Shouldered Blackbird. -- I have known rice crops to be destroyed to the extent of over 50 percent, --

Blackbird damage to the Arkansas rice crop has been estimated at $5,500,000 annually (Williams, 1960). Powell (1960) reported that the loss of rice in one southeastern Arkansas county was more than $230,000 in one year. Gilfillan (1958) stated that blackbird damage to crops, chiefly corn in four Ohio counties, was about $200,000 a year. The annual loss to blackbirds of Maryland's sweet corn crop was said to be about $250,000 (Anon., 1963). In South Dakota, De Grazio (1964) reported corn losses to blackbirds of $41,000 in 1961, $20,000 in 1962, and $25,000 in 1963. Depredations are usually most severe in the vicinity of roosts, where they may result in near-total destruction of the crops of individual farmers (Neff and Meanley, 1957; Giltz, 1960).

Large aggregations of blackbirds create damage problems on national wildlife refuges. These areas serve as "natural" focal points for blackbirds because crops have been left in the field to provide food for migratory waterfowl. Refuges generally have large, undisturbed areas

which furnish roost sites for blackbirds. On the Tishomingo National Wildlife Refuge in Oklahoma, blackbird depredations were so severe that it became necessary to change the crop planting program (Cravens, 1964[1]). The problem was similar to the Washita National Wildlife Refuge in western Oklahoma during 1963-64, where most of the sorghum crop (Sorghum vulgare var.[2]) was lost to blackbirds according to Bennett (1964[3]). In addition, the birds had foraged over the adjacent countryside and had destroyed the grain sorghum crop of farmers near the refuge.

The Washita National Wildlife Refuge and its surroundings was selected as a study area for this type of problem. This area was selected because grain sorghum is left in the fields for wintering waterfowl and extensive stands of Johnson grass (Sorghum halepense) furnish roost sites. In addition, several large detention lakes in the area support growths of cattails (Typha sp.) which are used by thousands of blackbirds for roosting.

Information on blackbird populations on the refuge between 1961 and 1964 was available from narrative reports on file in the refuge office. Congregations of Brewer's blackbirds (Euphagus cyanocephalus[4]) and brown-headed cowbirds (Molothrus ater) began using the area shortly after the construction of Foss Reservoir and the establishment of the

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[1]Personal Communication with Earl Cravens.

[2]Botanical nomenclature taken from Fernald, 1950.

[3]Personal Communication with Merle Bennett.

[4]Bird Nomenclature taken from Peterson, 1963.

refuge on the northern one-third of this lake in 1961. The peak blackbird population that year was estimated at 100,000 individuals. The birds were reported to have consumed 50 percent of the sorghum crop in one of the refuge farming units (Washita National Wildlife Refuge, 1961, 1962 a).

The 1962 fall population was greater than that for the previous year. Flocks of yellow-headed blackbirds (Xanthocephalus xanthocephalus) visited the refuge during the early part of the fall. The wintering blackbird flock consisted of redwings (Angelaius phoeniceus), Brewer's and brown-headed cowbirds [Washita National Wildlife Refuge, 1962 b].

During 1963, upwards of 200,000 blackbirds caused serious damage to refuge sorghum fields. These birds left the area during the latter part of December (Washita National Wildlife Refuge, 1963).

With this background information, a study was conducted during the fall and early winter periods of 1964-65 and 1965-66 with the following objectives:

1. Study the ecology and general behavior of blackbirds;
2. Estimate damage on the refuge attributable to migrating and wintering blackbirds;
3. Test and evaluate the effectiveness of certain chemical repellents; and
4. Determine the most effective means of reducing or alleviating blackbird depredations.

My sincerest thanks and gratitude are extended to Dr. A. M. Stebler, Leader Oklahoma Cooperative Wildlife Research Unit and Dr. F. M. Baumgartner, who served as major advisers, for their encouragement,

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CHAPTER II

DESCRIPTION OF STUDY AREA

The 130-square-mile study area was located in the western third of Custer County, Oklahoma, and included most of the countryside surrounding Foss Reservoir (Figure 1). During the study, 13.3 and 12.4 inches of rainfall were recorded for the period September through December for 1964 and 1965, respectively. The minimum and maximum temperatures recorded during the period of study were 2°F and 98°F in 1964-65 and 16°F and 100°F for 1965.

The area's rolling topography was interlaced with gullies and ravines. The most abundant grasses in the area were sand bluestem (Andropogon hallii), little bluestem (Andropogon scoparius), Indian grass (Sorghastrum nutans), silver bluestem (Andropogon saccharoides) and Johnson grass. Much of the upland area had been overgrazed, and in these situations broomweed (Gutierrezia dracunculoides) had taken over.

The Washita River runs through the western edge of the area, while Barnitz Creek traverses the northeast section. Valleys formed by these streams are much more fertile than the uplands. Consequently, most of the farming activity is centered here and in the bottomlands of other smaller waterways. Some farming was conducted on the uplands. However, most of the uplands were used for cattle grazing. The major crops are cotton (Hibiscus herbaceum), grain sorghum, and wheat (Triticum aestivum).

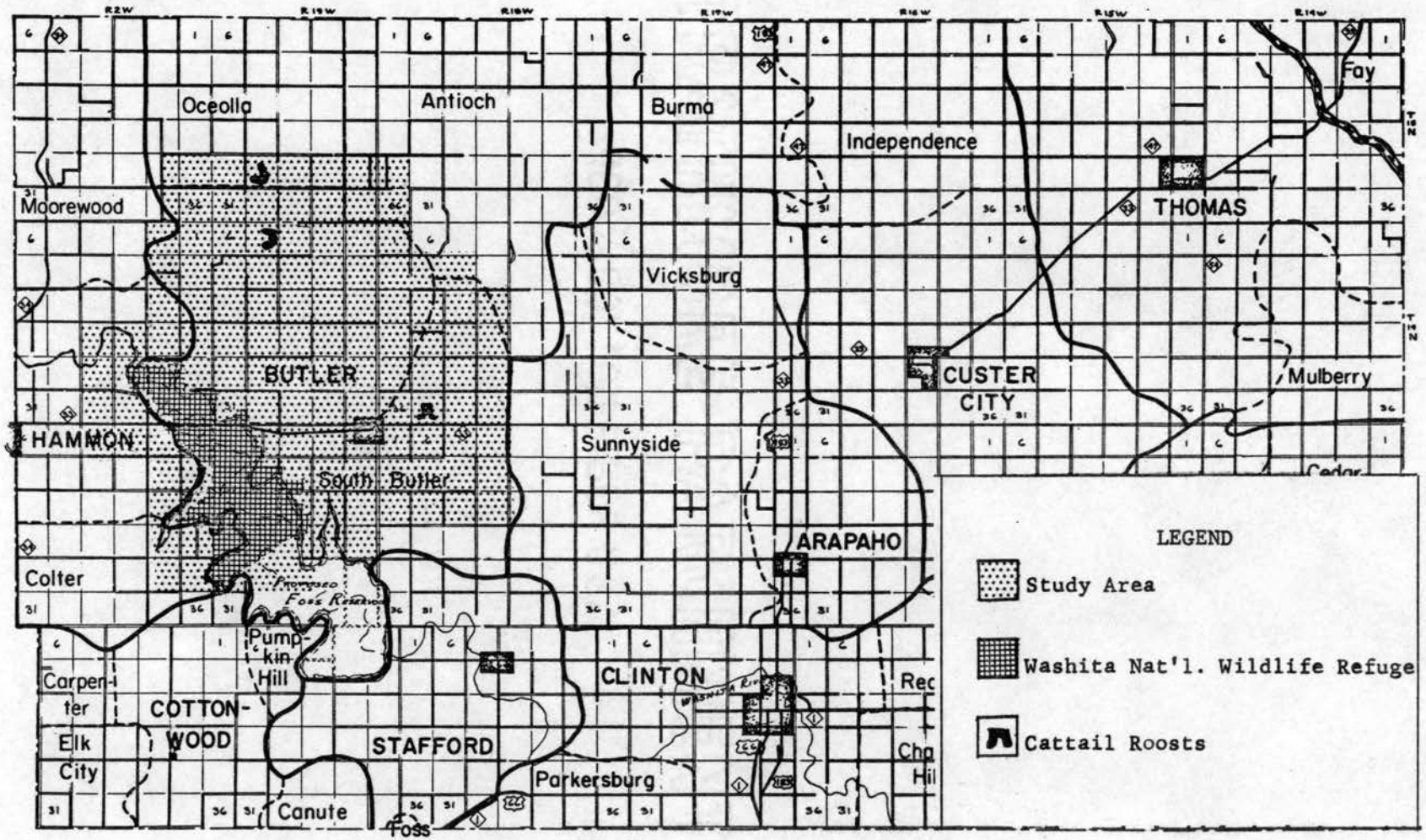

Figure 1. Map of Custer County Showing Location of Study Area, Washita National Wildlife Refuge, and Cattail Roosts

The large blackbird and starling roosts off the refuge were located on Ring's pond, Ray's pond, and Hughes' pond. These ponds had surface areas of 33, 26, and 20 acres, respectively. Cattails grew around the edges and occurred in thick stands in the shallow water portions. Willows (Salix spp.) grew around the borders and an occasional elm (Ulmus americana) and/or cottonwood (Populus deltoides) occurred a little farther from the water.

The Washita refuge (Figure 2) contains 8,200 acres, of which approximately 3,400 acres will be under water when the reservoir reaches maximum pool elevation. Gently rolling bottomlands make up another 2,600 acres and 2,200 acres are uplands.

Approximately 2,500 acres are being cultivated to provide feeding areas for wintering waterfowl. In 1965, 969 acres were planted in wheat, 659 acres in grain sorghum, 319 acres in corn (Zea mays) and 216 acres in barley (Hordeum vulgare). The remaining acreage was in alfalfa (Medicago sativa) or left fallow. Cattails and western salt cedar (Tamarix gallica) have become established along the shallow water portions and the lake shoreline and will probably be used for nesting by resident redwings.

Crops on the refuge are rotated to prevent Johnson grass from becoming established. This rotation program makes it difficult to increase sorghum acreage to provide additional feed for the rapidly increasing duck and blackbird populations.

Dense stands of Johnson grass grew along the banks of the Washita River, which transected most of the refuge. These stands extended out for about 200 yards in some places. The grass was especially thick on the river's delta and occurred in tall dense stands along the banks of

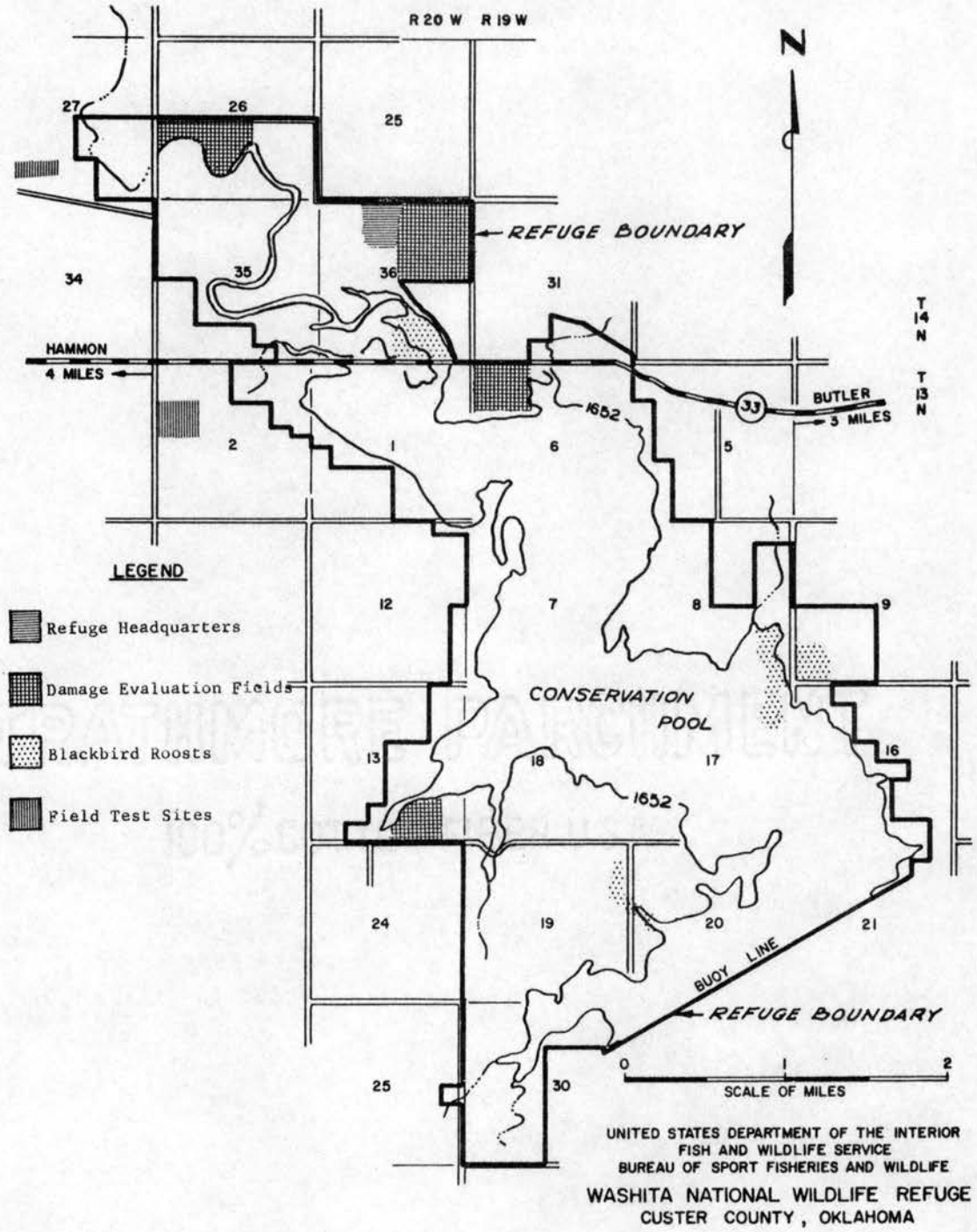

Figure 2. Map of Washita National Wildlife Refuge Region Showing Locations of Damage Evaluation Fields, Blackbird Roosts, and Field Test Sites

all the watercourses and in most of the low situations where water collected. Several types of trees grew along the banks of the larger and more permanent waterways. In addition, there were several scattered shelterbelt plantings and groves of trees around old homesites.

CHAPTER III

METHOD OF PROCEDURE

Field observations were conducted throughout two study periods, 24 August to 6 January in 1964-65 and from 1 September to 20 January in 1965-66. The information collected dealt primarily with red-winged blackbirds and brown-headed cowbirds. Starlings did not constitute a depredation problem in this area, but observations on the species were recorded whenever possible.

Blackbird populations were best estimated by counting birds flying to and from roosts. Roost counts were initiated two hours before sunset during the September through November period of 1964. For the remainder of the first study period, counts were begun one hour before sunset. This was due to birds coming in later in the day to the roost as days became shorter.

During the second year, evening counts were begun one and one-half hours before sunset from September through November and from one hour before sunset in late December and January. The observer remained in the area until about 30 minutes after sunset.

Morning counts extended from 45 minutes to one hour before sunrise until the last bird had left the roost.

Road censuses were made on 22 December, 1965, and on 4 January, 1966, to determine the relative density of blackbirds on the refuge and on adjacent lands. A one hundred-mile route was marked off on a study

area map and a random starting point selected. The census was started at 1000 hours and terminated at 1500 hours. Only blackbirds and starlings in the odd mile segments and within one hundred yards of the road were tabulated.

An attempt was made to determine the populations of local blackbirds as contrasted to migrants. Throughout the study periods, data were collected on the rate of population movement into and away from the area and on the sex composition of flocks.

A banding program was carried out in an endeavor to determine the major breeding and wintering grounds of the blackbirds. The modified Australian crow trap (U.S.F. and W.S., 1965) and mist nets (Low, 1957) were the means by which birds were captured.

All retrapped birds were recorded to study movement patterns. Redwings were sexed and aged in accordance with criteria presented by Packard (1936) and Mr. John De Grazio (1964[1]). Brown-headed cowbirds were aged by the method described by Selander and Giller (1960). Kessel's (1951) method was used to age and sex starlings.

During the first year, several birds were marked with plastic leg tags to aid in determining population movements (Campbell, 1960). A different color was used to represent each month of the study period in 1964-65. This method was not satisfactory due to difficulty of obtaining observations away from the site of banding. This phase of the study was discontinued.

A collection of blackbird and starling crops and gizzards was made randomly throughout the study periods. The extent of blackbird damage

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[1]Personal Communication with John W. DeGrazio.

to refuge sorghum fields was determined in the following manner. Each year, three refuge fields were selected for study. One field was chosen on the south side of the refuge, one in the middle, and one on the north side. In the first year, these were: Panther Creek, 50 acres; Fletcher's, 56 acres; and Headquarters, 135 acres. These were "cooperator" fields in which a local resident farmed the land and was allowed to harvest two-thirds of the crop.

A sample of sorghum heads in each study field was covered with paper bags in late September. In Fletcher's field, 200 heads were covered with the sampling conducted in a random manner. In the Headquarter's and Panther Creek fields, 396 and 180 heads, respectively, were covered in a stratified random manner (Hansen, Hurwitz, and Madow, 1953).

During the second year, the three fields used to obtain damage estimates were: Panther Creek, Fletcher's and Hines, (65 acres). In the middle of October, two hundred heads were covered in each field in a stratified random manner.

The number of birds feeding in each field was determined by field observations. In both years, the covered heads and a sample of unbagged grain sorghum heads were collected in January and compared to estimate the loss.

The chemical control work consisted of two field tests and four roost tests during the first year, and of four roost tests the second year. The sorghum field tests consisted of ground baiting a small portion of the fields with Avitrol 200. The procedure used in these tests has been reported by Goodhue and Baumgartner (1965, a, b).

In the study periods, five roosts were selected to evaluate the

effectiveness of Phillips' Chemical X in repelling roosting blackbirds. Phillips' Chemical Y was added to the mixture of Chemical X for the last test in January, 1966.

The selected test sites were: the cattail roost located in the west arm of Ring's pond and four roosts located in growths of Johnson grass; Subheadquarters, Twin Creeks, Washita River roost, and Duncan's roost (Figure 2). In 1964-65 one test was conducted using Ring's pond, Twin Creeks, and the Washita River roosts. Two tests were carried out on the Subheadquarters roost. The roost in the west arm of Ring's pond was a site for three tests in 1965-66 and Duncan's roost was used for one test.

These sites were chosen because large numbers of blackbirds had used them for roosting. Preliminary counts were taken to determine size and day-to-day variation of the roosting population. Counts were taken at other roosts to compare their trends in numbers with those observed in the treated sites.

The segments of the roost having the largest aggregations of birds were selected for the tests. A hand-held two-gallon garden sprayer was used to dispense the chemical.

Ring's roost, located one and one-half miles east of Butler, Oklahoma (Figure 1), consisted of approximately 2.1 acres of cattails and was used by 70 to 80 percent of the blackbirds roosting around the pond. The cattails were six to seven feet tall. Water depth varied from four inches to nine feet. On 20 November, an area of about 300 square yards near the center of the roosting concentration was sprayed with three gallons of 10 percent Phillips' Chemical X.

The Subheadquarters and Twin Creeks roosts were located in the

southeast portion of the refuge (Figure 2). Preliminary observations permitted an estimate that 50,000 to 70,000 blackbirds were using these roosts. Two of the largest roosting congregations where the grass grew tallest and thickest were marked off. A swath, 120 by 7 yards of the Twin Creek roost was sprayed with two gallons of 10 percent Phillips' Chemical X on the afternoon of 2 December. A strip 75 by 4 yards of the Subheadquarters roost was sprayed with three gallons of 10 percent Phillips' Chemical X on the same date. That night a rain and sleet storm coated the vegetation with ice. The original sprayed region plus another 920 square yards or a total of 1,220 square yards of the Subheadquarters roost were sprayed with five gallons of 10 percent Phillips' Chemical X on 8 December to increase the sprayed portion and to ascertain if the ice storm had reduced the effectiveness of the chemical. Twin Creeks roost was not sprayed again due to the difficulty of obtaining adequate observations of both roosts at the same time.

The Washita River roost was located in stands of Johnson grass along the Washita River north of the bridge where State Highway 33 crossed the river (Figure 2). A large number of trees in the roost served as a final rendezvous before the birds dropped into the grass to roost. There were other smaller roosts situated in growths of Johnson grass one-half mile west of the bridge.

Preliminary observations indicated that 28,000 blackbirds were using the Washita River roost. Another 22,000 blackbirds were using the west roosts. The major roost site, north of the bridge, was selected for testing the chemical. A test site was marked off. On the afternoon of 29 December, this portion was sprayed with five gallons of

10 percent Phillips' Chemical X. The sprayed segment was approximately 1,800 sqare yards.

In 1965-66, an attempt was made to conduct roost tests during the time when the blackbird population was rapidly building up. This was to see if it was possible to keep the population from reaching a high level and to discourage birds from remaining in the area.

Three tests were conducted at Ring's pond and one at Duncan's roost. The cattail growth on Ring's pond (west arm) had increased to about 2.5 acres. Approximately 65 to 80 percent of the blackbirds roosting around the pond used this location.

On 14 November a portion (200 square yards) of the roost where the greatest congregation of roosting birds occurred was sprayed with three gallons of 20 percent Phillips' Chemical X. Three days later a large segment of the south section of the roost was sprayed using three gallons of the same material.

A third test was undertaken on 11 December when approximately 500 square yards of the south section were sprayed with six gallons of 20 percent Chemical X. At this time, 146,000 blackbirds were roosting in the roost and another 104,000 on the rest of the pond.

The fourth and last test was conducted at Duncan's roost, which was a long narrow strip of Johnson grass 0.7 of a mile in length located in the southwest portion of the refuge (Figure 2). The north 0.3 of a mile consisted of Johnson grass growing in the bottom of an intermittent watercourse and along the gently sloping sides of the hill paralleling the watercourse. On the south and east end of the roost, water had eroded a gully that was 12 to 15 feet deep in some places. The roost vegetation varied in width from 10 to 80 yards with an average of 40

yards. The grass varied from six to eight feet in height and was the most dense in the bottom. There was little roosting in the north portion of the roost. The birds preferred locations that were down in the gully and more sheltered from the wind.

Two sections of the roost were sprayed on 12 January with 16 gallons of a mixture containing 20 percent Phillips' Chemical X, five percent Phillips' Chemical Y and 75 percent water. The sprayed portion contained 2,900 square yards.

Follow-up observations were made to determine: the trend in numbers of the roost populations, the time required before treatment became effective, and duration of effectiveness.

CHAPTER IV

RESULTS AND DISCUSSION

Habitat Preference and Daily Activities

The habitat situation preferred for feeding by redwings from the last of August until the last of October generally consisted of a mixed growth of sunflowers (Helianthus sp.) and Johnson grass with a nearby source of water.

In 1965, several inches of rain fell in late September and early October raising the level of Foss Lake. This resulted in the flooding of large stands of Johnson grass around the periphery of the lake. Redwings and yellowheads found this situation especially desirable and limited their daily activities for several weeks to a location comprising 320 acres just south of the Subheadquarters roost. There was a large stand of sunflowers on the hillside above the flooded Johnson grass. Refuge sorghum fields were nearby, which the birds used for feeding. Their feeding was sporadic and the damage was limited to the two closest fields.

Redwings off the refuge fed in Johnson grass which grew in swales or along waterways intermittently carrying water. The birds also used growths of sunflowers, western ragweed (Ambrosia psilostachya), and giant ragweed (Ambrosia trifida) that grew along the roads. Other redwings confined their feeding activities to grass seeds and insects near

the marshy situations (flooded cattails) where they probably nested if adults, or were reared if immatures.

Brown-headed cowbirds preferred a different situation during this early period. They fed, usually in small flocks, in sorghum fields either alone or in association with yellow-headed blackbirds. They also fed on the seeds of grasses and forbs around the edges of fields. Other cowbirds fed in grassland pastures that were being grazed by cattle or in cattle pens and corrals. Generally, cowbird flocks that fed in pastures comprised fewer than 200 birds.

The favored feeding grounds of yellowheads differed from one year to the next. In 1964, only a few hundred yellowheads used the study area. They generally were associated with brown-headed cowbirds and fed in sorghum fields and on sunflower, grass, and forb seeds.

During the second year, yellowheads restricted almost all their activities to the same habitat situation as the redwings. The yellowheads remained in this location from the middle of September until they left the area in the middle of October.

Each year, cowbirds were responsible for some crop damage between late August and late October. This damage was not extensive due to the scattered nature and the small size of the feeding flocks. Redwing damage to commercial crops off the refuge was negligible.

Beginning the last few days of October, redwings and other blackbirds centered their feeding in sorghum fields. Grain sorghum was found in 100 percent of the redwing samples collected in November and 91 and 100 percent of the samples collected in December and January (Table I). Ragweed was found in 78, 81, and 69 percent of the stomachs collected in November, December, and January, respectively. The five

TABLE I

PERCENTAGE OCCURRENCE OF FOOD ITEMS DETERMINED FROM CROP AND GIZZARD ANALYSIS OF BLACKBIRDS COLLECTED 1964-65, 1965-66

	Percentage of collected samples containing food item															
	Redwing					Brown-headed Cowbirds						Brewer's Blackbirds				Grand
	Oct.	Nov.	Dec.	Jan.	Total	Sept.	Oct.	Nov.	Dec.	Jan.	Total	Oct.	Nov.	Dec.	Total	Total
Food Items																
Grain Sorghum	-	100	91	100	93	56	89	60	100	100	71	75	100	100	89	87
Grit	50	100	91	93	92	38	89	80	100	100	66	75	50	100	67	83
Ragweed	-	78	81	69	75	25	89	60	-	50	49	-	-	-	-	62
Insects	50	11	44	31	36	56	67	60	100	75	63	75	100	-	78	46
Sunflowers	100	67	35	24	36	38	56	60	-	75	49	25	-	-	11	38
Johnson Grass	50	44	23	17	24	44	44	40	100	50	46	25	-	-	11	29
Foxtail	-	11	19	-	10	62	67	80	100	25	63	-	25	-	11	25
Lamb's Quarter	-	11	7	14	10	6	33	20	100	75	26	-	-	100	11	14
Dove Weed	-	11	5	10	7	12	22	20	100	25	20	-	25	100	22	12
Pigweed	50	11	7	10	10	6	22	-	-	50	14	-	-	100	11	11
Sand Dropseed	-	11	-	3	2	-	44	-	100	-	14	-	-	100	11	6
Panic Grass	-	33	2	-	5	-	-	-	-	50	6	-	-	-	-	5
Paspalum	-	-	-	-	-	12	33	-	-	-	14	-	-	-	-	4
Smartweed	-	11	-	-	1	-	-	-	-	-	-	-	-	100	11	2
Grama Grass	-	22	-	-	2	-	-	-	-	-	-	-	-	-	-	2
Lespedeza	-	-	-	3	1	-	-	-	-	25	3	-	-	-	-	2
Bluestem	-	-	2	-	1	-	11	-	-	-	3	-	-	-	-	2
Wheat (green)	-	-	-	-	-	-	-	20	-	-	3	-	-	-	-	1
Empty	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	1
Miscellaneous	-	11	16	3	11	6	-	-	-	25	3	-	25	-	11	10
Number of Samples	2	9	43	29		16	9	5	1	4		4	4	1		127

most frequently found food items were grain sorghum (93 percent), ragweed (75 percent), sunflowers (36 percent), insects (36 percent) and Johnson grass (24 percent).

Grain sorghum occurred in 71 percent of the cowbird samples. This item was found in 56 percent of the September samples and in from 60 to 100 percent of the samples collected from October through January. There were six other food items that were found in over 25 percent of the samples. These were, in order of frequency; insects and foxtail (Setaria sp.) (63 percent), ragweed and sunflowers (49 percent), Johnson grass (46 percent) and dove weed (Chenopodium sp.) (26 percent).

Grain sorghum (89 percent) and insects (78 percent) were the only food items that were found in more than 25 percent of the samples taken from Brewer's blackbirds.

Grain sorghum was found in 87 percent of the blackbird stomach samples. This was followed by ragweed (62 percent), insects (46 percent), sunflowers (38 percent), Johnson grass (29 percent) and foxtail (25 percent).

Cowbirds and Brewer's blackbirds fed in mixed flocks beginning the first week of October and continuing into December. By that time, most of the Brewer's had left the area. Brewer's blackbirds and cowbirds were found in association with redwings to a larger degree from November through January. Only small flocks of starlings fed in the area, even though large numbers roosted there in the evenings.

The blackbirds followed a regular daily feeding pattern. After leaving the roost, most of the birds flew directly to the feeding grounds. Some birds stopped off a short distance from the roost, however, and fed before continuing their flight. This flight was usually

interrupted by several stops for food. This type of behavior was observed more often with cowbirds and Brewer's than it was for redwings. The redwing flight was more direct.

The birds started to feed almost immediately upon arriving at the feeding site. After 10 to 15 minutes, a portion of the flock flew to nearby trees, telephone wires or barbed wire fences where they rested, preened, and performed other general body maintenance before returning to feed. Generally, feeding redwing flocks had a preponderance of one sex. This suggested a sex segregation of feeding redwings to some extent in the fall.

While feeding there was a continual shuffle of blackbirds from nearby "loafing cover" to the field, with occasional side trips to roadways or other sources of grit. If water was not close by, the birds flew to the nearest water which sometimes was one-half to one mile away.

During late summer and early fall, the favored loafing situations for redwings were in sunflowers and Johnson grass near water. Cowbirds preferred telephone wires, trees and the vegetation surrounding sorghum fields or pastures. As described earlier, yellowheads associated with cowbirds in 1964 and with redwings in 1965. The loafing situations favored by blackbirds from the last of October through January were dense stands of Johnson grass along waterways. These locations had a permanent water supply and an interspersion of trees. Other loafing sites were in tree rows making up shelterbelts, especially if there was a good stand of Johnson grass under the trees. Loafing aggregations in shelterbelts and along the waterways sometimes exceeded 80,000 birds. On other occasions, congregations in the grassy creek bottoms reached

30,000 to 40,000 birds along 200 yards of the creek. During the hot months of summer and early fall, hundreds of blackbirds watered, bathed, and preened near water sites associated with loafing cover.

The favored roosting situations were cattail stands around the shorelines of flood detention lakes and dense Johnson grass growths in stream bottoms and swales. Cattails were preferred from late August until late November. Later, blackbirds used Johnson grass. This cover was used for roosting earlier. Occasionally, Johnson grass roosts were used for only a week or so before they were abandoned. Some of these locations, for example, Twin Creeks and Subheadquarters, were used in the latter part of the study periods.

The cattail roosts were used both years. In 1965, blackbirds continued to roost on Ray's and Hughes' ponds, located 6 and 8 miles north and 3 miles west of Butler, Oklahoma (Figure 1), after the roost on Ring's pond had been abandoned. Cattail roosts were small (2.1 to 3.5 acres), but they had high densities of roosting blackbirds and starlings. Ring's pond had a maximum density of 44,700 birds per acre on 16 November, 1964, (Table II) and 70,400 birds per acre on 14 December, 1965, (Table III). The maximum density attained on Ray's pond was 99,700 birds per acre on 16 December, 1965, (Table IV).

Blackbirds were not evenly distributed in the larger Johnson grass roosts where lower densities also prevailed. The largest aggregations occurred along ditch banks, creek banks, or low places where the vegetation was taller and denser. These different locations varied in size. Since they were from 200 yards to several miles apart, they were considered as separate roosts. However, considerable shifting back and

TABLE II

POPULATIONS OF BLACKBIRDS AND STARLINGS
AT RING'S POND ROOST
FALL-WINTER 1964-65

Date	Count	Remarks
Sept. 14	8,885	
15	6,300	
16	7,581	
17	7,971	
27	2,758	
29*	10,477	
30	5,960	
Oct. 1*	4,995	
7	156	
14	1,065	
24	9,699	
26	24,118	
Nov. 7*	86,320	
10*	72,250	35,000 on main pond
14*	70,800	22,000 on main pond
16	93,850	West arm sprayed with 10 percent Phillips' Chemical X on 20 November
21	65,000	
22	35,000	
24	27,538	19,190 starlings
29	500	
Dec. 1	25	
8*	17	
16	500	
28	285	
Jan. 5	15	

*Morning Counts

TABLE III

POPULATIONS OF BLACKBIRDS AND STARLINGS
AT RING'S POND ROOST
FALL-WINTER 1965-66

Date	Count	Remarks
Sept. 9	6	
24	468	
27	1,866	14 yellow-headed blackbirds also present
Oct. 7*	3,853	
10*	6,123	
12*	12,760	
14*	9,420	
14	9,677	
20	18,200	
21*	14,500	21 Oct., 2,600 on main pond 22* Oct., 3,100 on main pond
25	12,300	
27	10,000	28 Oct., 2,520 on main pond
29*	9,150	
31	5,300	
Nov. 3	3,200	
9*	11,100	Several thousand Brewer's blackbirds
12	24,490	
14	28,600	West arm sprayed with two gallons 20 percent Chemical X, 1,100 in sprayed site
16	37,300	16 Nov., 20,600 on main pond; west arm sprayed with three gallons 20 percent Chemical X on 17 Nov.
21	41,500	22 Nov., 17,600 on main pond
25*	28,500	
28*	27,200	
29	40,300	
Dec. 7	75,800	32,000 starlings
8	89,200	25,200 starlings
9	95,500	16,000 starlings
10	122,800	18,000 starlings
11	146,000	15,000 starlings; sprayed southwest arm with six gallons of 20 percent Chemical X. 2,500 in sprayed site.

TABLE III (Continued)

Date		Count	Remarks
Dec.	12	104,100	15,000 starlings, 700 in sprayed site
	13	126,700	37,000 starlings, 1,200 in sprayed site
	14**	162,000	700 in sprayed site
	15	102,600	1,200 in sprayed site
	17	94,000	44,800 starlings, 1,100 in sprayed site
	21	102,800	77,500 starlings, 600 in sprayed site
	23	52,000	19,000 starlings
	29	10,000	
Jan.	3	107	

*Morning counts

**Peak population on entire pond 240,000

TABLE IV

POPULATIONS OF BLACKBIRDS AND STARLINGS
AT RAY'S POND ROOST
FALL-WINTER 1965-66

Date	Count
Oct. 24	1,000
30*	2,000
Nov. 10	18,000
12*	20,000
19*	38,350
23*	64,700
Dec. 1*	79,000
8	103,000
11*	107,600
12*	125,000
14*	317,000
16*	351,000
22*	212,800
Jan. 3*	174,000
5*	162,000
11*	7,250
13*	1,235

*Morning counts

forth occurred between locations before the birds settled down for the night.

The evening roost flight was initiated by small flocks of birds leaving their feeding grounds late in the afternoon. Shortly after the initial departure, most of the birds rose en masse and departed for the roost. The flight was not always direct. Usually, the birds made one or more stops to feed. Certain locations served as rendezvous sites where birds congregated before leaving for the roost. There was a continuous movement of birds in and out of these locations until 5,000 to 25,000 birds were present. Shortly after this time, virtually all the birds departed for the roost. A few stragglers remained in the feeding grounds until sunset, then flew directly to the roost.

The roosts were essentially deserted after the departure of the morning flight. A few birds, 25 or less, might remain in the vicinity during the day. About two hours befofe sunset, a few redwings returned to the roost. These birds came in high and spiralled down, chirping as they descended. Once down, the males began to sing. Several small flocks of redwings flew in during the next hour. The flight increased and the majority of redwings arrived during the next 45 minutes. Later arrivals flew in at a lower height.

The first brown-headed cowbirds and starlings arrived about 30 minutes after the first redwings. The remainder of the cowbird and starling flight lagged behind the redwings by about 30 minutes. The peak cowbird and starling flight occurred the last 30 minutes before sunset. The total time of the starling flight was shorter than that for redwings or cowbirds. Starlings flew in at the greatest height and cowbirds at the lowest. This stratification in the roost flight already

has been reported by Meanley (1965). On windy days, birds flew just above the ground. Generally, cowbirds were the only birds that arrived after sunset, but occasionally, redwings and starlings were among the latecomers. The evening roost flight began closer to sunset with the advance of colder weather.

Redwings landed in trees adjacent to the roost where they preened and fluffed their feathers before dropping into the lower vegetation. Some redwings landed and immediately dropped out of sight.

Cowbirds and starlings gathered in nearby trees until the trees were teeming with thousands of birds. As more birds flew in, many dropped into the vegetation. It was not possible to determine whether these were recent arrivals or not. On several occasions, thousands of birds landed on adjacent hillside grasslands and fed before going to roost. Most of the birds used the time before dark to bathe, water, and preen their feathers.

A behavior pattern that was most often exhibited by cowbirds was their restlessness in the roost. For no obvious reason, thousands of them flew up and "swirled" over the roost. These "swirls" would sometimes carry them 200 feet above the roost. The birds flew back and forth to other parts of the pond or to a Johnson grass patch, only to return and land; then they swirled up again. These flights continued until the birds settled down for the night. Starlings participated in these flights, but to a lesser degree than cowbirds. Redwings in most instances did not take part. The frequency and number of birds involved varied, but the flights occurred every night observations were conducted.

Just before sundown, most of the birds were singing or flying back and forth looking for a suitable roost site. A few minutes later, most

of the birds were down in the vegetation and out of sight.

The birds continued to sing for several minutes. Redwings ceased singing first, but cowbirds continued to sing for 30 to 40 minutes after sunset.

The birds were quick to react to the presence of predators. They flew up immediately whenever a marsh hawk (Circus cyaneus) flew over. On 27 October, 1965, several hundred blackbirds engaged in mobbing a male marsh hawk. The hawk circled higher and higher attempting to elude the blackbirds. The higher he flew the fewer the number of blackbirds that pursued him. About 50 blackbirds were harassing him when they flew out of sight. On other days, blackbirds were observed mobbing great horned owls (Bubo virginianus) and one day a Cooper's hawk (Accipiter cooperii). The blackbirds also reacted in a similar manner to an American bittern (Botaurus lentiginosus) that flew over a roost. The presence of red-tailed hawks (Buteo jamaicensis) did not disturb them. On several occasions, blackbirds were seen sitting in a tree occupied by a red-tailed hawk.

However, some sex segregation was noted among redwings on Ring's pond. Observations conducted on several evenings in late November and December of 1965 showed that sex ratios varied for different sections of the roost. The observed sex ratios were: 11.63 males per female in the east section, 0.81 males per female in the middle section, and 0.26 males per female in the west section. The redwing sex ratio for the entire roost was 1:1. There was no recognizable segregation by species, sex or age in the cowbirds and starlings. Redwings, cowbirds, and starlings roosted alongside each other with no apparent conflict.

Blackbirds followed a regular pattern from the time they awakened

in the morning until they left the roost. This pattern was initiated when the first redwing sang approximately 35 minutes before sunrise. This song was cut off sharply. After a minute or two, this redwing or another sang again. This was followed by a pause and then another song. The sequence was repeated with the songs coming closer and closer together. Within 10 to 20 minutes after the first song, many birds had joined in chorus and the roost was alive with sound. On a quiet morning, it was possible to hear the birds singing for at least one-quarter of a mile. During this time, the blackbirds were out of sight in the vegetation. Soon, small groups followed by flocks of several hundred flew up, "swirled" around several times, then returned to the roost. The intensity of the singing reached a peak at this time. The "swirling" and singing appeared to function as stimuli for preparing the birds to leave. The first birds left the roost between 26 and 47 minutes after the first song was heard. The peak of the flight occurred from two to 17 minutes after the first birds departed. The duration of the flight varied from 12 to 20 minutes, after which, the roost was completely deserted. The entire sequence required an average of 56 minutes to complete. The initiation, subsequent events, and time of departure were delayed 10 to 20 minutes if the sky was heavily overcast or if it was foggy. Cowbirds and starlings were the first to leave, with redwings departing minutes later. This sequence of departure by species agrees with that reported by Arthur (1957). The flight usually began a few minutes before and terminated several minutes after sunrise in the period from September to the middle of December. From the middle of December through January, the flight commenced from 15 to 27 minutes and terminated from zero to 14 minutes before sunrise.

Discussion

The large increase in the fall and winter blackbird population using the study area was related to the change in the habitat brought about by the grain sorghum left unharvested on the refuge. In earlier years, there was not an abundant supply of food available to the birds after October. The refuge's sorghum crops solved this problem. Large numbers of blackbirds did not start feeding in sorghum fields until the latter part of October. By this time, resident farmers have usually harvested their sorghum crops. Road censuses indicated that the refuge was a congregation point for feeding blackbirds. Stands of cattails furnished excellent roosting sites for thousands of blackbirds. Large growths of Johnson grass provided other roosting sites. These factors combined with a reliable food supply during the months of November, December, and January (the second year) greatly increased the number of blackbirds which could and did use the area.

The major purpose of the refuge is to stop and hold migratory waterflowl by furnishing them a protected feeding and resting site. It is not surprising then that a large flock of blackbirds built up in the area. The refuge and surrounding environs furnished the basic requirements of the blackbirds' fall and winter habitat; food, water, and shelter.

The primary components of redwing habitat have been discussed earlier. In early fall, they utilized tall, stiff-stemmed vegetation, such as sunflowers and Johnson grass, which furnished both food and cover. A nearby source of water was important. Cowbirds and Brewer's

blackbirds preferred a more open situation such as cattle pastures or pens.

Yellow-headed blackbirds were early migrants. They did not create much of a depredation problem due to their low numbers and the short time they remained in the area.

The heavy use of grain sorghum by these blackbirds indicated it was the most important food item. Other important items, in order of frequency in the birds' diets, were ragweed, insects, and the seeds of sunflowers, Johnson grass and foxtail. The destruction of insects and seeds of abundant "weeds" classed as harmful by man definitely are an indication that the birds are not entirely detrimental to man's interest at this time.

On several occasions, thousands of blackbirds were observed feeding in a field of green wheat. However, wheat occurred in only one stomach sample. The birds were there evidently for some purpose other than eating wheat.

Beal (1900) examined 1,008 redwing stomachs collected during a 12-month period over most of the birds' range [except the rice growing regions]. The most frequently occurring food items were: weed seeds (55 percent), insects (27 percent), oats (six percent), and corn (five percent). Insects made up 22.3 percent of the food in 544 cowbird stomachs from 20 states collected during all 12 months. The plant foods that occurred most frequently were: barnyard grass (48.7 percent), ragweed (32.4 percent) panic grass (24.4 percent), oats (18.8 percent), and corn (10.3 percent).

The analysis of 92 blackbird stomachs collected in Okfuskee County, Oklahoma, on 30 January, 1950, showed that the eight food items

which occurred most frequently had no commercial value. Grain sorghum ranked ninth and oats eleventh (Stebler, 1952).

There was an abundance of maintenance or loafing cover in the study area. The refuge fields were adjacent to shelterbelts, tree-lined creekbanks or dense stands of Johnson grass. In most cases, a source of water was nearby. This cover may have been used by some birds for feeding, resting or protection from weather and predators.

Cattails and Johnson grass were the favored roosting cover types. Blackbirds can, if necessary, use a variety of situations for roosting. Meanley (1965) reported the largest winter concentrations of redwings found in the United States were in Arkansas, Mississippi, and Louisiana, where deciduous thickets were the main roosting cover. Other roosts were found in canebrakes (Arundinaria) and willow bars along the Mississippi, Arkansas and other rivers; and cattail and giant cut grass (Zizaniopsis miliacea) marshes bordering old riverbed lakes or oxbows. Bamboo (Phyllostachys sp.) was used for roosting in the southern Piedmont. Sugarcane and rice fields were used for fall roosts. Meanley and Webb (1961) reported that the three principal cover types for roosts along the Atlantic coast were reed cane (Phragmites communis), cattail, and big cordgrass (Spartina cynosuroides) in the Delaware Valley-Chesapeake Bay area; swamps and pocosins in southeastern Virginia and eastern North Carolina; and giant cutgrass and big cordgrass in coastal South Carolina and Georgia. Pocosin swamps contain the most impenetrable thickets in eastern North America. The jungle-like aspect results from a dense undergrowth of shrubby broad leaved evergreens mixed with cat briers (Smilax laurifolia) bays (Persia borbonia) and (Gordonia lasilanthus), titi (Cyrilla racemiflora), and

gallberry (Ilex glabra). Solid stands of pond pine (Pinus serotina) form the overstory. Spencer and De Grazio (1962) reported capturing blackbirds and starlings that had been roosting in a frozen cattail marsh in Colorado.

In general, the roosting behavior of blackbirds agreed with that reported by Meanley (1965). However, there were some exceptions. He reported that the first birds arrived one hour before sunset in late July and one-half hour before sunset in November and December. In this study, blackbirds using the study area usually started arriving about 90 to 110 minutes before sunset in September, 60 to 90 minutes in December, and from 45 to 60 minutes before sunset in January. In this regard, Miskimen (1960) concluded that pre-roosting activity is initiated and terminated by variations in intensity of light from the overhead sky. Meanley stated that in late winter, just before the large roosts begin to break up and diminish in size, birds are sometimes quite unsettled when they arrive. With no apparent provocation, they fly up and circle about the roosts many times. In Oklahoma, it appeared that increased restlessness occurred when birds were moving into unfamiliar surroundings. It may have been largely due to their moving about seeking a place to roost. The "swirling" type of behavior was more characteristic of cowbirds than redwings or starlings.

Meanley also noted that some segments of the population were segregated in about every roost. According to him,

> Segregation is the result of (a) birds feeding in segregated flocks during the day and returning to the roost in the same manner; (b) flocks of birds of one species or one sex returning to a favorite section of the roost each evening; and (c) stratification in the roost.

There was some sex segregation among redwings in Oklahoma. No

apparent sex segregation was noted in cowbirds or in starlings. There was no observed segregation by species. No stratification was observed among roosting birds. This may have been due to the low height of the roost vegetation.

As the days became shorter and the average daily temperature colder, blackbirds left the roost earlier in the morning and returned later in the evening. A probable explanation for this behavior may have been the greater metabolic needs of the birds under these conditions. The birds needed to spend as much time as possible foraging during the day to effectively meet this need.

Population Size, Migration Patterns, and Composition

Population Size

The blackbird populations estimated for weekly periods in the two years are presented in Table V. The area population was approximately 10,000 birds when the study was initiated in August of 1964. The number increased to 15,000 by the end of September. In the first half of October, the blackbird population declined to a low of 500 birds. The population started to build up on 15 October and reached 40,000 by the end of the month. A peak population of 250,000 birds occurred during the second week of November. The population started to decline the next week and had dropped to 15,000 birds by 6 January, 1965.

A population of 3,100 blackbirds was using the area on 1 September of the second year. The population steadily increased until it reached a peak of more than 900,000 birds in the third week of December. The population declined the next week. When the field work was terminated

TABLE V

BLACKBIRD AND STARLING POPULATION ESTIMATES
BY WEEKLY PERIODS
1964-65, 1965-66

Month and Week	1964-65	1965-66
Aug. 4	10,000	2,000
Sept. 1	10,000	3,100
2	10,000	3,000
3	10,000	6,400
4	15,000	8,000
Oct. 1	15,000	7,500
2	500	17,000
3	3,000	35,000
4	40,000	40,000
Nov. 1	140,000	50,000
2	250,000	160,000
3	200,000	270,000
4	100,000	345,000
Dec. 1	100,000	420,000
2	80,000	862,000
3	80,000	913,000
4	80,000	621,000
Jan. 1	15,000	591,000
2	--	238,000
3	--	161,000
4	--	90,000
Feb. 1	--	50,000
2	--	50,000
3	--	10,000
4	--	5,000

on 20 January, 1966, the area population was 160,000 birds. Follow-up observations by the refuge manager indicated that the population had decreased to 5,000 birds by the end of February.

Using the data from Table V, and beginning on 1 September and ending the first week in January, the calculated blackbird and starling use days on the study area were 8,004,500 and 30,464,000, respectively, for the first and second years of the study. Observations of blackbirds feeding in refuge fields were evidence that the 1965 population was more than three times that recorded in 1964 (Table VI).

The blackbird population estimates from road censuses were 301,000 and 315,000 for 22 December and 4 January, respectively. These figures were 48.4 percent and 53.2 percent of the area population estimated from roost counts. The density of blackbirds on the refuge obtained from the census data was 28.5 and 93.5 times as great as the density of blackbirds off the refuge for the two days.

Migration Patterns

The refuge nesting population in 1965 was about 100 birds (Table VII). The population remained at this level until the second week of July when it increased to 300 birds. This increment was probably due to young birds and to post nesting flocking which began about the middle of July. Another increase took place the first week of August which was attributed to birds raised in the immediate area moving on to the refuge.

A definite increase occurred the second and third weeks of August which brought the refuge population to 1,500 birds. This increase continued until 3,000 blackbirds were present in the study area by the end

TABLE VI

NUMBERS OF BLACKBIRDS FEEDING IN DAMAGE EVALUATION FIELDS
1964-65, 1965-66

Month and Week	Panther Creek 1964	Panther Creek 1965	Fletcher's 1964	Fletcher's 1965	Headquarters 1964	Hines' 1965	Total 1964	Total 1965
October								
4	--	12,500	--	--	--	--	--	12,500
November								
1	8,000	12,000	--	2,500	--	20	8,000	14,520
2	20,000	40,000	--	--	--	2,200	20,000	40,200
3	27,000	40,000	--	--	--	5,000	27,000	45,000
4	--	8,000	23,000	--	22,000	17,000	45,000	25,000
December								
1	--	--	10,000	--	45,000	40,000	55,000	40,000
2	--	--	10,000	50	7,500	80,000	17,500	80,050
3	--	--	3,000	100,000	300	70,000	3,300	170,000
4	--	--	200	60,000	20	2,000	220	62,000
January								
1	--	10,000	100	20,000	10	15,000	110	45,000
2	--	--	--	35,000	--	50,000	--	85,000
3	--	--	--	50,000	--	--	--	50,000

TABLE VII

BLACKBIRD POPULATIONS ONLY ON THE WASHITA NATIONAL WILDLIFE REFUGE
FEB.-AUG. 1965, FEB.-APRIL, 1966

Month and Week	1965	1966
Feb. 3	--	10,000
4	2,000	5,000
March 1	3,000	5,000
2	3,000	3,000
3	2,000	2,000
4	2,000	100
April 1	5,000	50
2	--	200
3	--	1,000
4	--	200
May 1	200	--
2	100	--
3	75	--
4	100	--
June 1	120	--
2	100	--
3	75	--
4	80	--
July 1	85	--
2	200	--
3	275	--
4	300	--
Aug. 1	500	--
2	1,200	--
3	1,500	--
4	2,000	--

of August. The summer pattern is not known for 1964, but the population was 10,000 birds by 1 September of that year.

The 1965 late summer population decreased to 8,000 by the end of September. The first yellowheads (1,600 birds) were observed on 17 September feeding with redwings on the refuge. They reached a peak population of 2,400 on 24 September. By the end of September, 1,500 yellowheads were still in the area. Their numbers had declined to 40 birds by 14 October.

The 1964 population peaked during the second week of November. Beginning the next week, the numbers of blackbirds declined. The population level was nearly stable from the last week of November until January, when a large movement of blackbirds out of the area took place.

The 1965 population continued to increase through November and early December, with the peak occurring during the third week of December. Then it declined at a rapid rate and continued to decline until the end of the third week in January.

There were five recoveries from the 1964 bandings. One starling was recovered in Minnesota in January, 1966; another starling was recovered in South Dakota in February, 1966. Three cowbirds were recovered in late winter (January through March of 1965) in the vicinity of Lake Overholser near Oklahoma City, Oklahoma.

Population estimates by refuge personnel suggested that the early spring population in 1965 was about 2,000 birds (Table VII). There was a small movement of birds through the refuge during the first and second weeks of March. The peak spring population of 5,000 birds occurred during the first week of April. After this movement, the

population dwindled to the resident nesting birds.

In 1966, there were 5,000 blackbirds on the refuge during the first week of March. This population declined to 200 by the end of April. A small movement of birds through the refuge took place during the third week of April.

Population Composition

Sex ratio (males/female) counts of redwings at various places in the study area generally followed the same trend both years, but not to the same degree. September sex ratios were 2.34 and 0.60 males/female for 1964 and 1965, respectively (Table VIII). The sex ratio declined to 0.74 and 0.18 males/female during October. In November, the proportion increased both years to 4.52 and 0.83 males/female. The December sex ratio decreased to 4.07 in 1964 and the population remained about constant. The sex ratio in December of 1965 increased to 1.03. The January sex ratio of 1.48 in 1966 indicated that the population was composed of about 60 percent males.

A sex ratio count of yellow-headed blackbirds in September of the second year indicated there were 1.8 males/female. A count of brown-headed cowbirds in October gave a sex ratio of 1.08 males/female.

During 1964, males to female ratios of the banded birds increased from November to January for all three species (Table IX). The greatest change occurred in those for redwings. The field counts suggested that male redwings were trapped in a larger proportion than they occurred in the population.

The number of redwings banded the second year was too small to justify drawing any conclusions concerning the population. The

TABLE VIII

REDWING SEX RATIOS AND PERCENTAGE OF MALES
OBTAINED FROM FIELD COUNTS
1964-65, 1965-66

Month	Males		Males/Female		Percent Males	
	1964	1965	1964	1965	1964	1965
Sept.	220	569	2.34	0.60	70.1	37.3
Oct.	128	224	0.74	0.18	42.4	15.3
Nov.	1,230	1,298	4.52	0.83	81.9	45.4
Dec.	1,510	3,254	4.07	1.03	80.3	50.8
Jan.	---	1,712	--	1.48	--	59.7
TOTAL	3,088	7,057	3.39	0.91	77.2	47.6

TABLE IX

SEX RATIOS OF BLACKBIRDS AND STARLINGS BANDED ON THE WASHITA NATIONAL WILDLIFE REFUGE
1964-65, 1965-66

	Redwings				Brown-headed Cowbirds				Starlings	
	Sample Size		Males/Female		Sample Size		Males/Female		Sample Size	Males/Female
	1964	1965	1964	1965	1964	1965	1964	1965	1964	1964
Oct.	--	--	--	--	--	36	--	0.28	--	--
Nov.	37	8	8.25	0.00	203	49	0.92	0.75	--	--
Dec.	221	11	43.20	10.00	717	314	1.91	1.78	197	1.94
Jan.	30	11	--	4.50	69	202	2.63	3.21	26	4.20
TOTAL	288	30	31.1	1.73	989	601	1.65	1.77	223	2.10

proportion of male banded cowbirds increased from October through January. The October sex ratio of 0.28 males/female was evidence that female cowbirds made up most of the birds in the first movement into the area. The proportion increased to 0.75 in November and increased further to 1.78 and 3.21 in December and January, respectively.

Age ratios (immatures/adult) of birds banded the first year declined for all three species from November to January (Table X). Adult males steadily increased in the population from November to January. This was verified by an examination of the various sex and age classes. Adult males made up 86.7 percent of the redwings, 47.8 percent of the cowbirds, and 57.7 percent of the starlings banded in January, compared with 8.1 percent of the redwings, and 15.8 percent of the cowbirds banded in November and 32 percent of the starlings banded in December (Table XI). The percentages of adult males for the combined samples were 14.6 in November and 59.2 in January. The proportions of adult females, immature males and females in the sample decreased from November to January. The lone exception was adult female cowbirds, which increased slightly.

The age ratio for cowbirds banded in October 1965 was 1.77. This ratio remained about the same during November and then increased to 2.74 during December. The ratio decreased to 1.24 in January.

Referring again to the age and sex class data, it can be seen that even for the small sample of banded redwings the percentage of adult males increased from November through January. The percentages of adult and immature females declined from their November levels. The percentage of immature males increased from November to December and then declined in January.

TABLE X

AGE RATIOS OF BLACKBIRDS AND STARLINGS BANDED ON THE
WASHITA NATIONAL WILDLIFE REFUGE
1964-65, 1965-66

	Redwings				Brown-headed Cowbirds				Starlings	
	Sample Size		Immatures/Adult		Sample Size		Immatures/Adult		Sample Size	Immatures/Adult
	1964	1965	1964	1965	1964	1965	1964	1965	1964	1964
Oct.	--	--	--	--	--	36	--	1.77	--	--
Nov.	37	8	8.25	0.60	203	49	3.23	1.72	--	--
Dec.	221	11	1.08	1.75	717	314	1.15	2.74	197	1.77
Jan.	30	11	0.15	1.20	69	202	0.57	1.24	26	0.73
TOTAL	288	30	1.12	1.14	989	601	1.33	1.93	223	1.59

TABLE XI

PERCENTAGE OF BLACKBIRDS AND STARLINGS BANDED ON THE WASHITA NATIONAL WILDLIFE REFUGE IN DIFFERENT AGE AND SEX CLASSES 1964-65, 1965-66

1964-65

	Redwings					Brown-headed Cowbirds					Starlings				
	Sample Size	Adults		Immatures		Sample Size	Adults		Immatures		Sample Size	Adults		Immatures	
		Males	Females	Males	Females		Males	Females	Males	Females		Males	Females	Males	Females
Nov.	37	8.1	2.7	81.1	8.1	203	15.8	7.9	32.1	44.3	-	-	-	-	-
Dec.	221	46.2	1.8	51.6	0.4	717	32.7	13.7	32.9	20.6	197	32.0	4.1	34.0	29.9
Jan.	30	86.7	0.0	13.3	0.0	69	47.8	15.9	24.6	11.6	26	57.7	0.0	23.1	19.2
TOTAL	288	45.5	1.7	51.4	1.4	989	30.3	12.6	32.2	24.9	223	35.0	3.6	32.7	28.7

1965-66

Oct.	-	-	-	-	-	36	13.9	22.2	8.3	55.6
Nov.	8	0.0	62.5	0.0	37.5	49	12.2	24.5	30.6	32.6
Dec.	11	27.3	9.1	63.6	0.0	314	16.2	10.5	47.8	25.5
Jan.	11	36.4	9.1	45.4	9.1	202	31.2	13.4	45.0	10.4
TOTAL	30	23.3	23.3	40.0	13.3	601	20.8	13.3	43.1	22.8

The sample of banded cowbirds was large enough to present an accurate picture of the age and sex class structure of the population. Adult males increased from October (13.9 percent) to January (31.2 percent). The percentage of adult females was higher in October (22.2 percent) than it was in January (13.4 percent). The percent of immature males was lowest in October (8.3 percent), but increased through November (30.6 percent) to a peak in December (47.8 percent), and then declined during January (45.0 percent). Immature females made up 55.6 percent of the banded birds in October, but they composed only 10.4 percent of the January population.

Banding Information

During the first year, 1,555 birds were banded. The species composition was 291 redwings, 1,003 cowbirds, 253 starlings, and eight common grackles (Quiscalus quiscula). The banded sample of 636 birds the second year consisted of: 30 redwings, 601 cowbirds, four Brewer's blackbirds and one starling.

Recapture data were used to obtain an estimate of the relative vulnerability of birds to trapping due to species, sex and/or age. Ninety-six birds recaptured 247 times in 1964-65 indicated cowbirds were more readily trapped the first time and retrapped later (Table XII). There was considerable movement between trap sites. The percentages of second and third recaptures made away from the original banding location were 24.1 and 28.6, respectively.

Recapture information provided an indication of the length of time blackbirds were in the area. Three intervals were set up; one to 10 days, 11 to 20 days, and 21-plus days. The time interval was the period

TABLE XII

DECLINING TRAP RESPONSES FOR THREE BIRD SPECIES BANDED ON THE WASHITA NATIONAL WILDLIFE REFUGE 1964-65

Species	Banded Sample	1st Retrap	Per-cent	2nd Retrap	Per-cent	3rd Retrap	Per-cent	4th Retrap	Per-cent	5th Retrap	Per-cent	6th Retrap	Per-cent	7th Retrap	Per-cent	8th Retrap	Per-cent	9th Retrap	Per-cent	Total Retraps	Percent of Total Retraps
Cowbird	1003	84	8.4	49	4.9	28	2.8	22	2.2	16	1.6	11	1.1	7	0.7	4	0.4	2	0.2	223	90.3
Redwing	291	8	2.7	4	1.4	2	0.7	2	0.7	1	0.4	1	0.4	-	-	-	-	-	-	18	7.3
Starling	253	4	1.6	1	0.4	1	0.4	-	-	-	-	-	-	-	-	-	-	-		6	2.4
TOTAL	1547	96	6.2	54	3.5	31	2.0	24	1.6	17	1.1	12	0.8	7	0.5	4	0.3	2	0.1	247	100.0

from banding date to date of final recapture. The percentages of birds in these categories were 64.6, 17.7, and 17.7, respectively.

Cowbirds were the only species retrapped in 1965. There were 16 recaptured once (2.7 percent); six recaptured twice (1.0 percent); and five birds recaptured three times (0.8 percent). There was some movement between trap sites. Of birds retrapped once, 18.8 percent were away from the original banding location. One out of the five birds recaptured three times was taken away from the original site of banding. The percentages of recaptures in the three time intervals were 50, 31.2, and 18.8, respectively, for the one to 10, 11 to 20, and 21-plus days periods.

Recapture rates of the age and sex classes of the birds retrapped are presented in Table XIII. Retrap data for the two years were combined, because of the small number of birds retrapped the second year. Immature male cowbirds were retaken more readily than adult males. Female cowbirds were recaptured about twice as often as males. No redwing females were retrapped. Immature redwing males were recaptured more readily than adult males. Four immature starlings were recaptured, whereas no adults were taken more than once. Immature male and female starlings were taken in about equal proportions.

Discussion

The population peak the second year was more than three and one-half times that observed the first year. The 1965-66 population maintained a level for seven weeks that was greater than the peak 1964 population. A comparison of the data for Ring's pond (Tables II and III) indicated that the 1965 population peak was about twice that for

TABLE XIII

BLACKBIRD AND STARLING RECAPTURE RATES
IN DIFFERENT AGE AND SEX CLASSES
1964-66

Species	Adults				Immatures			
	Males Banded	Recap. Rate	Females Banded	Recap. Rate	Males Banded	Recap. Rate	Females Banded	Recap. Rate
Cowbirds	425	3.8	208	10.6	579	5.2	384	8.3
Redwings	142	2.1	12	0.0	161	3.1	8	0.0
Starlings	78	0.0	8	0.0	73	2.7	65	3.1

1964. The peak blackbird population feeding on the refuge in 1965 was more than three times the 1964 population (Table VI).

The increased population in 1965 may have been due to several factors. The weather was extremely mild during late summer and fall. The warm weather slowed down the migration (evidenced by population peak occurring five weeks later). The increased numbers may have been due to greater survival, recruitment, or simply to more birds using the area. Redwings made up about 75 percent of the peak population the second year. The first year redwings comprised about 30 percent of the area population indicating a large influx of redwings was responsible for much of the increase. The refuge narrative reports indicated that the blackbird population has increased every year since the establishment of the refuge.

The two road census samples obtained about the same percentage (one-half) of the population. This indicated that it may have application as a means for obtaining a population index. Roost count estimates included birds feeding outside the area (especially starlings) which flew in at night to roost. These birds were not included in the road census.

Road census data showed the density of blackbirds was much greater on the refuge. This was evidence that the refuge was a congregation point for feeding, even though most of the blackbirds roosted off the refuge. The higher density obtained in January suggested that more birds had moved on to the refuge to feed.

Some blackbird movement into the study area must have taken place by 1 September in both years. The September population was larger than could reasonably be attributed to reproduction by resident birds.

Goddard and Board (in press) reported that the average redwing production in a study conducted in North Central Oklahoma was 2.5 young per pair. It would have taken 4,000 and 1,200 pairs of nesting redwings in 1964 and 1965, respectively, to produce the late August populations. This was unlikely due to the low nesting population observed on the study area in the spring of 1965. A reasonable estimate of the resident breeding population and young would be about 1,000 to 1,500 birds.

Sex ratio (males/female) data obtained from field counts and banding demonstrated a similar movement pattern. In both years, a decline in the percentage of males in October coincided with a blackbird movement into the area. This suggested the early build-up was largely composed of females.

The greater proportion of male redwings and cowbirds in November both years implied that most birds moving into the area during this month were males. In 1964, many females were in the large movement out of the area the last two weeks of November. During 1965, the population was still increasing in November resulting largely from males moving into the area.

The November 1965 age ratio (immatures/adult) remained almost constant with that obtained in October which suggested that flocks moving into the area during this time had about the same age and sex composition as the population already present. The similarity may have been due to the small sample size and thus, an investigational artifact, or perhaps to the greater trapping vulnerability of immatures. Generally, the proportion of males in the area's population increased from November to January.

The 1964 peak population occurred during the second week of

November. The higher redwing sex ratios obtained for November indicated that many males had moved into the area. Since the population was composed largely of immatures at this time, the largest proportion of the birds were presumed to be immature males. The sex ratio of banded redwings and cowbirds increased during December, and the proportion of immatures in the population declined. This information suggests that the large segment of the population which left during November was composed of immatures and adult females.

No female redwings were banded in January of 1964. A higher proportion of male cowbirds and starlings was present. This information, combined with age ratios that declined for all three species, suggests again that immatures and adult females made up most of the birds which left during December and the first part of January. Further demonstration of this trend was the percentage increase of banded adult males from November to January for redwings and cowbirds. For starlings, the percentage of adult males increased from December to January. The proportions of adult females, immature males and females decreased from November to January. The only exception was adult female cowbirds which increased slightly from November to December.

A movement of blackbirds into the study area occurred in October of 1965. These birds were largely females as evidenced by a decrease in the proportion of males from September to October.

The proportion of males increased in December and January for both redwings and cowbirds. The December age ratio indicated that the population peak which occurred during the third week of December contained a large proportion of immatures. A substantial movement of blackbirds out of the area took place over the next three weeks. The birds leaving the

area were largely adult females and immature males and females. Indicative of this was the increased number of adult males from December to January and the decreased proportions of the remaining age and sex classes. Immature males still composed about 45 percent of the January population. Adult and immature females made up only 20 percent of the January population.

The number of birds banded was considerably lower the second year. Based on recapture data, cowbirds were the most easily captured, (Table XII) followed by redwings and starlings. Movement between trap sites was indicated by 19 to 29 percent of the birds retrapped once or twice being taken away from the original site of banding in 1964 and 1965, respectively. From time of banding until final capture, 64.6 and 50.0 percent of the birds were individuals which were not again recaptured after 10 days in 1964 and 1965, respectively. There were 17.7 and 18.8 percent of the birds in the 21-plus day interval. Cessation of trapping in January eliminated the possibility of birds banded in late December and early January being included in the longer time intervals.

Grain Sorghum Loss

The estimated grain sorghum loss on the refuge to blackbirds is presented in Table XIV. Grain sorghum acreage was increased from 613 acres in 1964 to 800 acres in 1965. The average yield increased the second year from 34.9 to 41.8 bushels/acre. Total unharvested grain (that available to wildlife) increased from 10,011 to 15,059 bushels. Estimated losses were 64.9 and 71.3 percent respectively in 1964 and 1965, or 6,500 and 10,733 bushels. Calculated cash values of these losses (at $1.80 a hundred pounds) were about $7,000 and $10,600

TABLE XIV

SUMMARY OF GRAIN SORGHUM LOSSES TO BLACKBIRDS
ON THE WASHITA NATIONAL WILDLIFE REFUGE
FALL-WINTER 1964-65, 1965-66

Fields	Acreage		Average Yield (Bushels/acre)		Unharvested Yield (Bushels)		Loss (Bushels)		Percent Loss	
	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965
Damage Evaluation	206	219	36.3	39.7	2,648	2,900	1,719	2,462	64.9	84.9
Other Cooperators	270	394	36.3	47.8	3,263	6,279	2,118	5,331	64.9	84.9
Refuge	137	147	30.3	40.0	4,100	5,880	2,661	2,940	64.9	50.0
TOTAL	613	800	34.9	41.8	10,011	15,059	6,498	10,733	64.9	71.3

respectively in 1964 and 1965. These figures do not include grain estimated to have been consumed by waterfowl. The first year little grain sorghum was left when the large blackbird movement out of the area occurred the first week of January.

In 1964, blackbirds began feeding first in Panther Creek field (Table VI). They fed from 3 to 20 November and attained a maximum feeding population of 27,000 birds. Blackbirds began feeding in Fletcher's field on 24 November, and continued until 6 January. The maximum number of feeding birds (23,000) occurred on 24 November. Blackbirds fed in the Headquarters field from 26 November to 5 January and attained a maximum feeding population of 45,000 the first two days of December. The maximum number of blackbirds feeding in the evaluation fields at one time was 50,000 to 60,000.

A flock of 13,000 blackbirds was first observed feeding in the Panther Creek field on 18 October, 1965. Blackbirds fed off and on in this field for the next 76 days, at which time 10,000 birds were using the field. The maximum feeding population was 40,000 on 10 and 13 November. The first blackbirds fed in Fletcher's field on 3 November when 2,500 were observed. Few birds fed in the field until December. A peak feeding flock of 100,000 birds was reached on 21 December, and 60,000 were in the field on 24 December. Use declined until 19 January when another 60,000 blackbirds moved into the field to feed.

Only 20 blackbirds were feeding in Hines' field on 3 November. This number had increased to 5,000 on 17 November. Blackbirds continued to feed in this field for another 57 days. Flocks of 80,000 and 70,000 were observed on 12 and 15 December. The maximum number of blackbirds

feeding in the evaluation fields at one time was estimated to be 170,000.

Discussion

The peak number of blackbirds feeding on the refuge in 1965 was more than three times the number observed in 1964. However, the calculated loss in 1965 was less than twice that obtained the preceding year. This disproportionately lower loss may have resulted from birds feeding in other refuge fields before using the damage evaluation fields. Generally, blackbirds fed in one field until they had eaten all the grain before moving to another field. In 1965, blackbirds began feeding in Fletcher's field about a week after the sample of bagged and unbagged grain heads was collected. The loss undoubtedly would have been greater if the sample had been collected later.

The pattern of blackbird feeding was identical the two years. The birds started feeding in the evaluation field closest to the lake. They moved next to the field in the middle of the refuge, and finally they fed in the northern evaluation field.

Evaluation of Chemical Repellents

Some of the 2,000 blackbirds feeding in a sorghum field two miles west of refuge headquarters (Figure 2) fed on grain treated with Avitrol 200 within three minutes after baiting was completed. The first affected bird was observed 15 minutes later. Six additional affected birds were seen in the next 20 minutes. During this time, most of the birds flew from the field. A flock of 150 redwings flew over the field approximately 30 minutes after treatment. They circled overhead

chattering excitedly. About 100 of the birds alighted for about 30 seconds before flying away. Two other flocks of about 150 birds flew over the field, circled it several times chattering incessantly before flying off. The field was completely abandoned 40 minutes after the birds first began feeding on the treated grain.

The field was canvassed and two dead redwings were picked up. A south wind drifted most affected birds away from the field. Follow-up observations over the next two weeks indicated that the treatment was effective. The maximum number of birds observed during this time was five.

A flock of 3,000 to 4,000 blackbirds flew into the second field which was located one mile south and one and one-half miles west of refuge headquarters (Figure 2) and began feeding on the treated grain about three minutes after baiting was completed. During the next three minutes, a flock of 2,000 blackbirds landed on an adjacent road and began to feed on the bait and pick up gravel. The first affected bird was observed nine minutes later. In the next eight minutes, 13 affected birds were observed. Several thousand blackbirds left during this time. The entire location was deserted within 30 minutes. During this time, 30 affected birds were observed. The field and nearby pasture were walked out and 12 dead birds (six redwings and six cowbirds) were picked up. Again, a strong south wind drifted many affected birds away from the test site. The affected redwings screamed vociferously and could be heard above the wind at a distance of 70 to 80 yards. The next day, a small flock of 40 cowbirds fed in the field. No birds were seen in the field during the next eleven days. The field was completely harvested seven days after the treatment.

In 1964, there was a sharp reduction in the number of birds using Ring's pond roost following the application of Phillips' Chemical X on 20 November with practically complete abandonment by 29 November (Table II). This decline was spread over several days. The roost population was estimated at 65,000 on 21 November and at 35,000 birds on 22 November. A count on the evening of 24 November indicated that about 28,000 birds were using the roost. An interesting observation was that starlings made up 7.4 percent of the maximum population of 94,000 on 16 November, whereas on 24 November, they made up 69.4 percent (19,200 birds) of the population.

The Twin Creeks roost population declined for six days following treatment on 2 December (Table XV). The Subheadquarters roost population was about one-third of the pre-treatment population on 8 December. However, only 300 to 400 birds roosted in the sprayed portion. The other birds used the periphery of the roost, where the vegetation was not as dense and offered less protection. During this time, the population in the Twin Creeks region had increased from 59,000 to 70,000 (18.6 percent). After the second treatment on 8 December, the roost population dropped to zero within four days even though 47,000 blackbirds were roosting in the region. This is significant because the Subheadquarters roost was a favored site. The roost contained 29 percent of the 70,000 birds using the region on 9 November; 61 percent of 28,900 on 13 November; and 20 percent of 59,000 on 30 November. Initially, the chemical appeared to cause the birds to shift to nearby roosts. Later, the birds left and by 5 January the population in the Twin Creeks region had declined to 4,000 birds.

The North Washita River roost population was estimated at 28,000

TABLE XV

POPULATIONS OF BLACKBIRDS AND STARLINGS AT
TWIN CREEKS AND SUBHEADQUARTERS ROOSTS
FALL-WINTER 1964-65

	Count	Remarks
Twin Creeks Roost		
Aug. 25	4,500	
26	5,420	
27	32	
Sept. 5	0	
Nov. 9	20,000	
13	10,200	28,900 in region
14	15,000	
30	20,000	
Dec. 2	7,500	Portion of roost sprayed with 10 percent Phillips' Chemical X. Ice storm during night.
3	6,000	
4	2,000	
5	1,500	
8	5,000	
Subheadquarters Roost		
Sept. 29	3,578	
Oct. 1	300	
Nov. 9	20,000	70,000 in region
13	17,700	28,900 in region
14	200	59,000 in region
30	12,000	Portion of roost sprayed with 10 percent Phillips' Chemical X on 2 Dec.
Dec. 4	200	
5	2,000	60,000 in region
7	350	75,000 in region
8	4,000	65,000 in region; 350 in sprayed site
9	2,500	45,000 in region; 100 in sprayed site Roost sprayed again
10	500	
11	300	42,000 in region
12	0	47,000 in region
16	0	50,000 in region
26	0	5,000 in region
Jan. 5	5	4,000 in region

prior to spraying (Table XVI). Including adjacent roosts, the total population was 50,000 birds. The roost population declined steadily and reached zero eight days after treatment on 29 December. Again it appeared the birds shifted to other roosts before leaving the area. On 1 January, the roost population was estimated at 8,600 and the Washita River region population at 47,000 to 50,000 which equaled the total population prior to the treatment. The total population was only 3,000 birds on 6 January.

An incident similar to the one described earlier at Ring's pond occurred at the Washita River roost. Starlings composed five to 10 percent of the roost population on 29 December. On 4 January, five days after spraying, starlings made up 50 percent of the population.

In 1965, there was an increase in the Ring's pond roost population during the first test of Phillips' Chemical X initiated on 14 November (Table III). The roost population increased for five days following the second application of the chemical on 17 November. This was followed by a decline in the population for five to six days, and then a large increase took place.

On the first evening of the tests, the birds appeared agitated and hovered over the sprayed location chattering excitedly. Some of the birds that alighted in the sprayed sites were excited. In general, very little distress was exhibited. Redwings, cowbirds, and starlings used the cattails, which had been broken down by the passage of a boat during spraying, as perches above the water while bathing and drinking. All the birds were extremely restless and constantly shifted back and forth so that it was impossible to see if the birds remained in the sprayed site for any length of time. This restless behavior was characteristic

TABLE XVII

POPULATIONS OF BLACKBIRDS AND STARLINGS AT THREE ROOSTS
IN THE WASHITA RIVER REGION
WINTER 1964-65

		Count	Remarks
North Washita River Bridge			
Dec.	27	28,000	50,000 in region
	28	26,000	50,000 in region
	29	31,390	Sprayed area with Phillips' Chemical X. 39,000 in sprayed site
	30	29,000	1,300 in sprayed site
	31	17,200	2,800 in sprayed site
Jan.	1	8,600	2,100 in sprayed site
	4	7,160	360 in sprayed site. Estimate 34,000 birds in region.
	6	0	Estimate 3,000 in region
South Washita River			
Dec.	27	6,000	
	28	9,000	
Jan.	1	6,800	Estimate 47,000-50,000 in region
	6	1,016	
West Washita			
Dec.	27	15,000	
Jan.	4	10,000	
	6	1,000	

of birds new to a roost. Redwings composed about 90 percent of the roost population on 18 November. There was an increase in the populations using the control roosts on Ray's pond (Table IV) and Twin Creeks (Table XVII).

A significant decline in the roost population took place for three days following the third application of Phillips' Chemical X on 11 December. This was suggestive of some repellency because the counts increased at the control roosts. The population peaked on 14 December at 162,000 (240,000 for entire pond) and then declined over the next eight days to 52,000 of which 19,000 were starlings. The roost on Ray's pond had a peak population of 351,000 on 16 December. This population had declined to 212,000 by 22 December. The Twin Creeks roost reached 38,500 birds on 15 December, but declined to 4,900 by 24 December. The Ring's pond population had decreased to 107 birds by 3 January, whereas the roost on Ray's pond was used by 174,000 birds. The Twin Creeks roost population was 13,000 on 6 January.

No distress reactions or abnormal behavior were displayed during the test. The birds again used the bent over cattails for perches while bathing, even though the cattails had been saturated with the chemical. However, on 12 December, many birds moved out of the sprayed site about 30 minutes after sunset.

The chemical turned the cattails a darker brown and gave them a lustrous appearance. There were 2,500 birds in the sprayed site the first night (Table III). This number decreased to 700 the second night, but increased to 750 and 1,500 on the fourth and fifth nights, respectively. This number declined to 600 by 21 December. There was a drastic change in the species composition. On 11 December, starlings

TABLE XVII

POPULATIONS OF BLACKBIRDS AND STARLINGS
AT TWIN CREEKS ROOST
FALL-WINTER 1965-66

Date	Count
Sept. 3*	2,900
8	1,913
13	1,200
15	700
22	450
30	2,325
Oct. 8	300
Nov. 1	3,630
3	1,600
9	4,000
15*	11,000
19	15,000
22*	8,000
26*	16,900
30	80,000
Dec. 9*	25,200
10*	25,000
13*	34,800
15*	39,500
24*	4,900
30*	2,500
Jan. 6	13,000
14*	25,200
16*	33,600
18*	98,000
19	92,000

*Morning counts

composed only 10 percent of the roost population (15,000 birds). The percentage of starlings increased to 20 percent (37,000 birds) by 13 December. Their numbers increased until they made up 48 (44,800 birds) and 75 percent (77,500 birds) of the roosting population on 17 and 21 December, respectively.

On 29 December, approximately 70,000 birds flew into the roost. They remained a short time and then most of them flew off in the direction of Ray's pond. Starlings made up 36.5 percent of the 10,600 birds which remained in the roost.

Duncan's roost population declined from 59,633 on 12 January to 26,535 the next night (Table XVIII). The population decreased gradually over the next four days to 17,200 and dwindled to 1,830 birds by the fifth night.

The population in the Twin Creeks roost increased during this time from 13,000 on 6 January to 98,000 on 18 January (Table XVII). Ninety-two thousand birds were still using this location on the evening of 19 January.

The blackbirds using Duncan's roost appeared to be more nervous than usual the first evening. They flew up, circled over the roost and shifted back and forth. Later, the birds settled down. No distress behavior was exhibited by the 3,000 birds roosting in sprayed site one or the 2,500 in sprayed site two. The blackbirds appeared to be nervous the second evening, but no distress behavior was noted. Only 700 birds roosted in sprayed site one. A group of 2,000 settled in sprayed site one the third night. They flew up and moved to another part of the roost. Only 110 birds roosted in the sprayed site. On the seventh

TABLE XVIII

POPULATIONS OF BLACKBIRDS AND STARLINGS
AT DUNCAN'S ROOST
WINTER 1966

Date	Count	Remarks
Jan. 7*	39,800	
10	50,600	
11	44,735	Another 30,000 roosting in east end
12	59,633	Sprayed area with 16 gallons Phillip's Chemical X and Y**
13	26,535	
14	22,953	
17	17,200	
18	1,830	

*Morning count
**Mixture contained 20 percent Phillip's Chemical X and 5 percent Phillips' Chemical Y

night, 550 birds landed in sprayed site one for a short time before leaving. Only 70 birds roosted there that evening.

Discussion

The results of the two field tests suggest that blackbird damage in sorghum fields can be greatly reduced. These results may have been biased because the birds had been feeding in the treated locations for days. They readily accepted the treated material, which resulted in several birds being almost immediately affected. Affected redwings uttered loud screams, which could be heard for a considerable distance. These distress calls undoubtedly aided in frightening birds from the baited fields. A good feature of the tests was that good control resulted with only a small segment of the population being killed.

The 1964 roost test results indicated that Phillips' Chemical X had promise of being an effective repellent for blackbirds and starlings roosting in vegetation. It appeared to cause the birds to shift to nearby roosts, and they had practically abandoned the region. The movement from treated roosts did not occur at once. Instead, it took place over a four to eight day period.

Changes in blackbird behavior patterns indicated that the chemical affected the birds in an adverse manner. On 2 December, in the Sub-headquarters roost, blackbirds hovered over the sprayed grass, circled a few times and then flew off. A few landed, but they only remained about 30 seconds before leaving. The trees just west of the roost were a rendezvous site where several thousand birds gathered before going to roost. After the roost was sprayed, several thousand birds gathered in the trees, but only a few used the roost. A small number of birds

roosted in the sprayed portion. Most of them roosted near the periphery where the vegetation was sparse and offered considerably less protection.

Unusual behavioral reactions were noted in the North Washita River roost. The blackbirds dropped into the grass as usual. However, about dark, a large number of them left and flew south to a smaller roost. Usually, once the birds drop into the roost vegetation, they are settled for the night. About sunset on 30 December, 4,500 birds were in the treated site. By dark, this number had declined to 1,300. This occurred the next two nights when 4,700 and 3,200 blackbirds were in the treated sites after sunset. The numbers had decreased to 2,800 and 2,100 respectively by nightfall.

Another curious incident occurred on 4 January. The blackbird population in the treated location was 360 birds, of which 260 were roosting in trees at nightfall. During the entire study, these were the only birds observed roosting in trees.

The chemical did not appear to affect starlings as markedly as it did redwings and cowbirds. Starlings composed from five to ten percent of the Ring's pond and North Washita roosts' populations prior to spraying. Four to five days later, starlings made up from 50 to 70 percent of the populations.

In 1964, many of the birds which left Ring's pond shifted their feeding to sorghum fields and weedy pastures in the vicinity of the refuge. These birds roosted in the Twin Creeks region, which was only a ten-minute flight from Ring's pond. However, blackbirds were observed on many occasions to move greater distances from roosting to feeding sites. Large flocks of blackbirds flew over the pond in the evening and early morning flying toward and away from the Twin Creeks roosts. They

bypassed the pond to roost on the refuge which indicated that the roost was not abandoned simply because of a shift in feeding grounds.

The results from the 1965 repellent tests were not as favorable as those from the preceding year. It was difficult to draw any definite conclusions. First, because the area population was increasing rapidly during the tests. The population increased on Ring's pond and on the control roosts during the first two tests. Second, due to nervousness of the birds in the roosts, it was impossible to ascertain if any of the birds which first entered the sites roosted there for the evening. It is possible the birds that roosted there were the last ones which moved into the site. Third, on Ring's pond, the number of starlings increased during the test which tended to mask the effectiveness of the chemical. The use of Chemical X did not appear to delay or hinder the blackbird population build-up.

There was a large movement into the area on 14 December. The Ring's pond peak occurred on this date. However, the roost population declined by about 37 percent the next evening, indicating that Chemical X was effective. The peak population on Ray's pond occurred on the evening of 15 December. This population was about equal to the 14 December population plus the decline in the number of birds using Ring's pond. This suggested that birds shifted to Ray's pond. The chemical may have been the reason for the nearly complete abandonment of Ring's pond by 3 January. On this date, 174,000 birds were using the roost on Ray's pond.

The number of birds using Ray's pond had declined to 7,200 by 11 January. The number of birds roosting in Duncan's and Twin Creeks had increased from 65,000 on 6 and 7 January to 135,000 on 12 January. This

suggested that some of the birds from Ray's pond moved on to the refuge to roost, whereas others left the area.

The treatment of Duncan's roost with the mixture of Phillips' Chemicals X and Y on 11 December appeared to be successful in repelling blackbirds. The number of birds using the roost had decreased by over 50 percent the next evening. By the fifth night, the population had diminished by 97 percent. The increase in the Twin Creeks population implied that many of the birds shifted to that roost. Other birds using Duncan's roost may have departed in the movement from the area which occurred at this time.

The better repellency exhibited in the last test may have been due to the addition of Phillips' Chemical Y. This chemical had shown a high degree of repellency in laboratory tests. Also, a much larger segment of the roost was sprayed. This resulted in more birds being exposed to the chemical, which may have caused a higher degree of repellency. In other tests, greater repellency might have been obtained if more of the roost had been sprayed. Unfortunately, this required equipment and manpower that were not available.

The results from the 1964 and 1965 tests were not conclusive. There are certainly indications that Chemical X or the combination of Chemical X and Y may be effective in repelling blackbirds and starlings roosting in vegetation.

CHAPTER V

CONCLUSIONS AND MANAGEMENT IMPLICATIONS

Conclusions

The numbers of blackbirds using the study area during the fall and winter has steadily increased since 1961. The peak population the second year was about three times that observed in 1964. The peak occurred the second week of November in 1964 and during the third week of December the second year. Blackbird use-days were over three and one-half times greater in 1965.

The steady increase apparently was related to changes in the area which improved the situation for blackbirds. Most important was the development of a reliable food supply during late fall and winter, which was provided by grain sorghum left unharvested in refuge fields. This large food supply centered in a restricted location induced congregations of blackbirds for feeding. Densities of feeding blackbirds were much higher on the refuge than on adjacent land during the last part of December and through January. Cattail stands around some nearby dentention lakes furnished roosting cover for thousands of birds. Large growths of Johnson grass were also used as roost sites. Foss Lake and the numerous farm ponds provided an abundance of watering and bathing places.

Redwings preferred feeding in stands of sunflowers and Johnson

grass from late August through October. Brown-headed cowbirds favored more open situations where cattle were being pastured or in cattle pens. During this period, they also fed in and around sorghum fields.

Yellow-headed blackbirds associated with cowbirds the first year. For some reason, they preferred the company of redwings in 1965. Brewer's blackbirds fed in small discrete flocks or in association with cowbirds. Only small numbers of starlings fed in the area even though thousands roosted there in the evening during December and January.

There was a shift of feeding activity to refuge sorghum fields beginning the latter part of October. At this time, the feeding flocks contained several species of blackbirds. Grain sorghum was the food item most frequently eaten by blackbirds. Other favored food items in order of occurrence were: ragweed seeds, insects, sunflower, Johnson grass, and foxtail seeds. Favored loafing cover situations were dense Johnson grass stands along creek banks and trees along waterways and in shelterbelts.

Cattail roosts were used both years. These locations were more permanent, smaller, and had larger densities of roosting birds than Johnson grass roosts. Some Johnson grass roosts were used both years. Generally, Johnson grass roosts were more temporary than cattail roosts.

Evening roost flights were initiated late in the afternoon. The birds generally made several stops to feed. Certain rendezvous sites were selected where blackbirds congregated before going onto the roosts. A few redwings started to come in about two hours before sunset early in the fall. The first cowbirds and starlings arrived about 30 minutes later. In late December and in January, the first birds flew into the roost about 50 minutes before sunset. Starlings flew in at the greatest

height and cowbirds at the lowest. Once in the roost, many birds with no apparent provocation flew up and "swirled" around before landing. These flights continued until the birds settled down for the night. This type of behavior was more characteristic of cowbirds. Starlings participated in these flights, but few redwings took part. On many evenings, the birds fed along nearby hillsides or in pastures before going to roost.

Blackbirds and starlings reacted quickly to predators. A flock would "boil up" into the air whenever a predator appeared. On several occasions, blackbirds were observed mobbing an avian predator.

Some sex segregation was observed among roosting redwings. It was not determined whether there was any segregation by age. No apparent segregation by species or sex was noted in cowbirds and starlings.

Blackbirds followed a regular pattern in the morning. The time required for the sequence of events averaged 56 minutes from the time the first bird sang until the roost was abandoned. Cowbirds and starlings were the first to depart, with redwings following a few minutes later. The flight terminated several minutes after sunrise from September until the middle of December. The flight was completed from 14 to zero minutes before sunrise during the interval from mid-December through January.

At the end of the breeding season, the area resident population of blackbirds was estimated to be 1,000 to 1,500 birds. The first movement into the area occurred during the last part of August. The peak yellow-headed blackbird population took place on 24 September, 1965. Few yellowheads were in the area by 14 October. The population influx which occurred in October of both years was largely composed of females. A

large gain in the population took place in the first two weeks of November in 1964 and throughout the month in 1965. There was a large influx of males both years with the proportion of males being greater the first year. The second year, this influx contained immatures and adults in the same proportion as the population already present in the area.

In 1964, the large blackbird movement out of the area the last two weeks of November was largely composed of immatures and adult females. The movement out in December and January also consisted primarily of immatures and adult females. Adult males made up about half or more of the birds in the area during January.

In 1965, the large influx in December was composed largely of immatures and adult males. The immatures had a preponderance of males. A large outward emigration of blackbirds consisting mostly of females took place during the last week of December and the first part of January.

The spring population peak was only a fraction of that observed in the preceding fall and winter. This peak occurred the first week of April in 1965 and during the first week of March in 1966.

Cowbirds were most easily captured and recaptured, followed by redwings and starlings. Immature male cowbirds were retaken more readily than adult males. Female cowbirds were recaptured about twice as often as males. Male redwings were trapped more easily than females. Immature redwings and starlings were captured at about twice the rate of adults.

Approximately 65 and 71 percent of the grain sorghum in the damage evaluation fields was lost to blackbirds in 1964 and 1965, respectively.

Using these figures, the estimated losses on the refuge were 6,500 and 10,700 bushels in the two years. Both years, blackbirds fed first in the evaluation field closest to the lake. They moved next to the field in the middle and then to the one on the north edge of the refuge.

Field tests using Avitrol 200 demonstrated that damage to grain sorghum can be reduced with little mortality to blackbirds. Roost tests in 1964 indicated that Phillips' Chemical X had promise of being an effective repellent for blackbirds and starlings roosting in vegetation. Unusual behavior was exhibited which was additional evidence of the chemical's repellency. Phillips' Chemical X appeared to be more effective in repelling redwings and cowbirds than starlings.

Roost test results the second year were not conclusive. Some repellency occurred, but many factors contributed to make interpretations of the results difficult. A mixture of Phillips' Chemicals X and Y achieved good repellency in the one test conducted. Unfortunately, there was not sufficient time to make additional tests. However, other tests are warranted to determine the effectiveness of the chemical as a repellent.

Management Implications

The loss of a large amount of the refuge's sorghum crop to blackbirds was presumed to have been responsible for the daily feeding flight of ducks from and back to the refuge in late 1964 and early 1965. This feeding flight exposed the ducks to additional hunting pressure. A diminished food supply could result in a lessened duck use during the spring migration. At least four farmers are known to have lost most of their sorghum crop in 1964. Warmer weather delayed the blackbird

migration the second year and little damage off the refuge was reported. It appears the numbers of blackbirds using the area will continue to increase. If this takes place, the depredation problem can be expected to increase. A program to manage blackbird numbers and/or distribution is certainly justified to alleviate the present situation. Its purpose should not be to eliminate the blackbirds. These birds are beneficial to man throughout most of the year and are not entirely detrimental during the fall and winter. It is essential that the management program be initiated as soon as blackbirds begin feeding on the refuge. If delayed, the birds become established and effective regulation may be more difficult to achieve. A suggested management program for the refuge consists of three parts. First, before the birds arrive, mow all large stands of Johnson grass that have been used as roosts. The grass should not be cut at ground level because this would destroy its value as cover for other wildlife species. If the grass was cut about two feet above the ground, it would be undesirable as a roost site, but it would still provide valuable cover. Much of the Johnson grass is not accessible to a mower. Therefore, the second part would make use of chemicals that have a repellent effect on blackbirds roosting in the vegetation. The third and certainly most difficult would take advantage of "flock-frightening" chemicals such as Avitrol 200. Field tests using Avitrol 200 showed that damage to grain sorghum can be reduced with little mortality (five percent or less) to blackbirds. This has also been demonstrated by De Grazio (1964) at Sand Lake National Wildlife Refuge where Avitrol 200 (DRC-1327) was successfully used to reduce blackbird damage. This method can result in effective regulation with low mortality to the birds creating the problem and with little or no

mortality to other species. Enough emphasis cannot be placed on the fact that this work should be placed in the hands of qualified individuals. If handled correctly, these three steps should result in reduced grain sorghum losses. However, the extent to which any of the chemical compounds may affect the environment on a long term basis is not known.

The possibility exists that this program may not be economically feasible. It is possible that the cost of prevention could exceed the loss. However, grain sorghum lost as waterfowl food may be more valuable than its actual monetary value.

It is apparent from this study that blackbirds are responsible for serious crop depredations during the fall and winter when they congregate in large flocks. These depredations and large numbers can be reduced and regulated to some extent by physical and chemical means. The effect of any of the chemical compounds on the environment has not been determined. Therefore, a management program using chemicals should be viewed as a temporary solution. It is urgent that an extended effort be made at exploring ecological means of managing the numbers and distribution of blackbird populations. This is the approach which, in the long run, poses the least threat to man and to the environment in which he lives.

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