SIZE, MIGRATION PATTERN, AND STRUCTURE OF FALL AND EARLY WINTER BLACKBIRD AND STARLING POPULATIONS IN WESTERN OKLAHOMA

STEPHEN V. GODDARD

EVERY fall thousands of blackbirds and Starlings migrate into Oklahoma from their northern breeding areas. Populations of these birds have been increasing rapidly and reportedly are causing severe crop depredations in Custer County in western Oklahoma. Accurate records of the size of the population and its structure are not available. There are some records for the area around the Washita National Wildlife Refuge. Congregations of Brewer's Blackbirds (*Euphagus cyanocephalus*) and Brown-headed Cowbirds (*Molothrus ater*) began using the area shortly after the construction of Foss Reservoir and the establishment of the refuge on the northern one-third of the lake in 1961. The peak blackbird population that year was estimated at 100,000 individuals (Washita National Wildlife Refuge, Narrative Reports).

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 Red-winged Blackbirds (*Agelaius phoeniceus*), Brewer's Blackbirds, and Brown-headed Cowbirds.

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, Narrative Report).

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) Determine the size of the fall and winter blackbird and Starling population in the area; 2) ascertain the migration pattern of these birds; and 3) determine the species, age, and sex structure of the fall population; and 4) ascertain the relationship of the population buildup with actual crop depredations.

DESCRIPTION OF STUDY AREA

The 130 square-mile study area was located in the western third of Custer County, Oklahoma and included the Washita National Wildlife Refuge and the land adjacent to the Foss Reservoir.

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 more fertile than the uplands. Consequently, most of the farming activity is centered here and in the bottomlands of other smaller waterways. Usually the uplands were used for cattle grazing. The major crops are cotton (*Hibiscus herbaceum*), grain sorghum, and wheat (*Triticum aestivum*).

Three large blackbird and Starling (*Sturnus vulgaris*) roosts in cattails (*Typha* sp.) were located off the refuge in the northern part of the study area. These roosts were on ponds that had surface areas of 33 (Ring's Pond), 26 (Ray's Pond), and 20 (Hughes Pond) acres respectively. The cattails grew around the edges and occurred in thick stands in the shallow water portions.

Much of the work was conducted on the Washita Refuge which contains 8,200 acres, of which approximately 3,400 acres will be under water when the reservoir reaches maximum pool elevations. Gently rolling bottomlands make up another 2,600 acres and 2,200 acres are uplands. About 2,500 acres are being cultivated to provide feeding areas for migrating 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 was left fallow.

Cattails and western salt cedar (*Tamarix gallica*) have become established in the shallow water portions and along the lake shoreline. 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. Tall dense stands occurred along the banks of all the watercourses and in most of the low situations where water collected. These areas were used by roosting blackbirds.

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 Redwings, cowbirds, and Starlings. Data pertinent to Common Grackles (*Quiscalus quiscula*), Brewer's Blackbirds, and Rusty Blackbirds (*Euphagus carolinus*) were also included.

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 the 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 100-mile route was marked off on a map of the study area and a random starting point selected. The census was started at 10:00 and terminated 15:00. Only blackbirds and Starlings in odd mile segments and within 100 yards of the road were tabulated.

An attempt was made to determine the population of local blackbirds as contrasted to

TABLE 1

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

Month and week		1964–65	1965–66
August	4	10,000	2,000
September	1	10,000	3,100
	2	10,000	3,000
	3	10,000	6,400
	4	15,000	8,000
October	1	15,000	7,500
	2	500	17,000
	3	3,000	35,000
	4	40,000	40,000
November	1	140,000	50,000
	2	250,000	160,000
	3	200,000	270,000
	4	100,000	345,000
December	1	100,000	420,000
	2	80,000	862,000
	3	80,000	913,000
	4	80,000	621,000
January	1	15,000	591,000
	2	—	238,000
	3	—	161,000
	4	—	90,000
February	1	—	50,000
	2	—	50,000
	3	—	10,000
	4	—	5,000

migrants. Throughout the study periods, data were collected on the rate of population movement into and away from the area and on the age and sex structure of the population.

Banding was carried out in an endeavor to determine the major breeding and wintering areas of the birds and the age and sex composition of the flock. The modified Australian crow trap (U.S.F. & W.S., 1965) and mist nets (Low, 1957) were the means by which birds were captured. Redwings were sexed and aged in accordance with criteria presented by Packard (1936) and DeGrazio (1964). Cowbirds were aged by the method described by Selander and Giller (1960). Kessel's (1951) technique was used to determine the age and sex of Starlings.

TABLE 2

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

Month and week		1965	1966
February	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	—
August	1	500	—
	2	1,200	—
	3	1,500	—
	4	2,000	—

RESULTS

Population Size.—Blackbird population estimates for weekly periods during the fall and early winter for the two years are presented in Table 1. The population was approximately 10,000 birds when the study was initiated in 1964. The number increased to 15,000 by the end of September. By the middle of October, the blackbird population had declined to a low of 500 birds. The population increased after 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.

TABLE 3

SPECIES COMPOSITION OF THE BLACKBIRD AND STARLING POPULATION 1964–1965

Date	Red-winged Blackbirds		Brown-headed Cowbirds		Starlings		Other Blackbirds	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Aug. 4	4,000	40.0	4,500	45.0	—	—	1,500	15.0
Sept. 1	4,500	45.0	4,500	45.0	—	—	1,000	10.0
2	4,500	45.0	5,200	52.0	—	—	300	3.0
3	3,400	34.0	6,380	63.8	140	1.4	80	0.8
4	2,160	14.4	12,700	84.6	100	0.6	40	0.3
Oct. 1	2,400	16.0	12,450	83.0	100	0.6	50	0.4
2	100	20.0	380	78.0	—	—	20	4.0
3	660	22.0	2,250	75.0	—	—	90	3.0
4	3,000	7.5	36,800	92.0	—	—	200	0.5
Nov. 1	33,600	24.0	82,600	59.0	24,000	17.0	—	—
2	100,000	40.0	100,000	40.0	50,000	20.0	—	—
3	90,000	45.0	60,000	30.0	50,000	25.0	—	—
4	40,000	40.0	30,000	30.0	30,000	30.0	—	—
Dec. 1	40,000	40.0	30,000	30.0	30,000	30.0	—	—
2	32,000	40.0	20,000	25.0	28,400	35.0	—	—
3	32,000	40.0	20,000	25.0	28,400	35.0	—	—
4	32,000	40.0	20,000	25.0	28,400	35.0	—	—
Jan. 1	6,000	40.0	1,500	10.0	7,500	50.0	—	—
Total	430,320	37.1	449,260	38.7	277,040	23.9	3,580	0.3

In the second year, a population of 3,100 blackbirds was using the area by 1 September. The population steadily increased until it reached a peak of over 900,000 birds during the third week of December, then began to decrease the following week. On 20 January, 1966, the population was 160,000 birds. Follow-up observations indicated that the population had declined to 5,000 by the end of February.

Blackbird population estimates from road censuses were 301,000 and 315,000 for 22 December and 4 January, respectively. These figures were 48 and 53 per cent of the 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. The average density for the two days was 3.7 birds/acre for the entire study area. Tremendous concentrations took place at the various roosts where densities of 44,700 (Ring's Pond, 1964), 70,400 (Ring's Pond, 1965), and 99,700 birds/acre (Ray's Pond, 1965) were observed.

TABLE 4

SPECIES COMPOSITION OF THE BLACKBIRD AND STARLING POPULATION 1965–1966

Month and Week	Red-winged Blackbirds		Brown-headed Cowbirds		Starlings		Other Blackbirds	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Aug. 4	1,100	55.0	300	15.0	—	—	600	30.0
Sept. 1	1,705	55.0	465	15.0	—	—	930	30.0
2	1,710	57.0	300	10.0	—	—	1,000	33.0
3	3,900	61.0	500	8.0	—	—	2,000	31.0
4	3,600	45.0	2,000	25.0	—	—	2,400	30.0
Oct. 1	3,800	51.0	2,200	29.0	—	—	1,500	20.0
2	6,400	38.0	9,300	55.0	600	3.0	700	4.0
3	3,850	11.0	30,800	85.0	350	1.0	800	2.0
4	7,200	18.0	32,000	80.0	—	—	1,200	7.0
Nov. 1	13,500	27.0	31,000	62.0	1,500	3.0	4,000	8.0
2	105,000	66.0	39,000	24.0	3,200	2.0	12,800	8.0
3	210,000	78.0	44,000	16.0	8,000	3.0	8,000	3.0
4	241,000	70.0	44,850	13.0	58,650	17.0	—	—
Dec. 1	273,000	65.0	46,200	11.0	100,000	24.0	—	—
2	578,000	67.0	113,000	12.0	171,000	21.0	—	—
3	547,000	60.0	92,000	10.0	274,000	30.0	—	—
4	323,000	52.0	25,000	4.0	273,000	44.0	—	—
Jan. 1	284,000	48.0	23,000	4.0	284,000	48.0	—	—
2	189,000	80.0	28,000	12.0	21,000	8.0	—	—
3	128,000	80.0	20,000	12.0	13,000	8.0	—	—
4	72,000	80.0	10,800	12.0	7,200	8.0	—	—
Total	2,996,765	61.9	594,715	12.3	1,215,500	25.1	35,930	0.7

Migration Patterns.—The summer pattern is not known for 1964, but a population of 10,000 birds was present on 1 September of that year. The population remained relatively stable for five weeks and then most of the birds left. They could not be located during the day or at any of the roosts. Blackbirds began moving into the area during the third week of October and the migration peak occurred during the second week of November. Large numbers of the birds migrated through during the next two weeks. From the last week of November until the end of December, the population was relatively stable. A large movement of birds from the area took place during the first week of January in 1965. Additional small movements out of the area occurred until only 2,000 birds were present by the end of February.

The numbers in the spring migration, which took place during the first part of April, were considerably less than in the fall (Table 2). After this move-

TABLE 5

REDWING SEX RATIOS AND PERCENTAGE OF MALES OBTAINED FROM FIELD COUNTS 1964–65, 1965–1966

	Males		Males/Female	
Month	1964	1965	1964	1965
September	220	569	2.3	0.6
October	128	224	0.7	0.2
November	1,230	1,298	4.5	0.8
December	1,510	3,254	4.1	1.0
January	—	1,712	—	1.5
Total	3,088	7,057	3.4	0.9

ment, the population dwindled to about 100 resident birds. The population had increased to 300 by the second week of July. This increase was probably due to young birds and to post-nesting flocking. Another increase took place the first week of August which was attributed to birds raised in the immediate area moving onto the refuge. Blackbirds continued to move in and population increased slowly to 8,000 by the end of September. By the second week of October, large numbers of birds were migrating into the area and 40,000 birds were present by the end of the month. The migration tempo picked up tremendously from the second week of November until the third week of December as about 860,000 birds were added to the population. This build-up was only transitory and birds began moving out the next week (190,000). Large movements out of the area continued until the first of February. There was no definite spring migration in 1966. It appeared the population simply declined until the first week of May when 200 birds or local nesters were present. A small movement of birds did take place during the third week of April.

Population Structure.—Cowbirds made up 38.7 per cent of the population the first year (Table 3). Redwings and Starlings made up 37.1 and 23.9 per cent respectively of the total population. Cowbirds were the earliest migrants but peak numbers of all three species occurred during the second week of November. Cowbirds were the first to leave followed by Redwings and Starlings. The latter two species made up 90 per cent of the total population the first week of January.

The large population increase the second year was primarily due to the tremendous increase in the numbers of Redwings and Starlings (Table 4). There was also a smaller increase in the cowbird population. Redwings made up 61.9 per cent of the total population. Starlings and cowbirds com-

TABLE 6

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

	Oct.	Nov.	Dec.	Jan.	Total
Redwings					
Sample Size					
1964	—	37	221	30	288
1965	—	8	11	11	30
Males/Females					
1964	—	8.2	43.2	—	31.1
1965	—	0.0	10.0	4.5	1.7
Cowbirds					
Sample Size					
1964	—	203	717	69	989
1965	36	49	314	202	601
Males/Females					
1964	—	0.9	1.9	2.6	1.6
1965	0.3	0.8	1.8	3.2	1.8
Starlings					
Sample Size					
1964	—	—	197	26	223
1965	—	—	—	—	—
Males/Females					
1964	—	—	1.9	4.2	2.1
1965	—	—	—	—	—

prised 25.1 and 12.3 per cent respectively of the total. Cowbirds again were the earliest migrants followed by Redwings. However, peak populations for both species occurred the second week of December. The Starling population did not peak until a month later. Again Starlings and Redwings made up about 90 per cent of the population the first week of January. More Starlings and cowbirds moved out during the next three weeks so that the population consisted of 80 per cent Redwings by the end of the month.

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. During the first year, September sex ratios were 2.3 (Table 5). The number of females increased and the ratio declined to 0.7 in October. The November sex ratio increased to 4.5 and then declined slightly in December to 4.1 while the population remained relatively constant.

During 1965, the September sex ratio was 0.6. The number of females again

TABLE 7

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

	Oct.	Nov.	Dec.	Jan.	Total
Redwings					
Sample Size					
1964	—	37	221	30	288
1965	—	8	11	11	30
Immatures/Adult					
1964	—	8.2	1.1	0.2	1.1
1965	—	0.6	1.8	1.2	1.1
Cowbirds					
Sample Size					
1964	—	203	717	69	989
1965	36	49	314	202	601
Immatures/Adult					
1964	—	3.2	1.2	0.6	1.3
1965	1.8	1.7	2.7	1.2	1.9
Starlings					
Sample Size					
1964	—	—	197	26	223
1965	—	—	—	—	—
Immatures/Adult					
1964	—	—	1.8	0.7	1.6
1965	—	—	—	—	—

increased in October and the sex ratio declined to 0.2. With a larger influx of males in November, it increased to 0.8. The sex ratio continued to increase in December to 1.0 and increased again in January to 1.5.

During the first year, 1,555 birds were banded. The species composition was 291 Redwings, 1,003 cowbirds, 253 Starlings, and eight grackles (Table 6).

Sex ratios for the three major species of banded birds increased from November to January. The greatest change occurred in the sex ratio for Redwings. Field counts indicated that male Redwings were trapped in a larger proportion than they occurred in the population.

The banded sample in 1965 of 636 birds consisted of 30 Redwings, 601 cowbirds, four Brewer's Blackbirds, and one Starling. The number of Redwings banded the second year was too small to justify any conclusions con-

cerning the population. The proportion of male cowbirds increased from October through January. The October sex ratio of 0.3 was evidence that female cowbirds predominated. The proportion of males increased in November to 0.8 and increased further to 1.8 and 3.2 in December and January respectively.

Age ratios (immatures/adult) of birds banded in 1964 declined for all three species from November to January (Table 7). The pattern was slightly different the second year. The highest age ratios were obtained from birds banded in November. After this it appeared the age ratio declined as birds moved out of the area.

DISCUSSION

The population peak of 900,000 birds in 1965 was more than three and one-half times that observed the first year. For seven weeks, the 1965 population was equal to or greater than the peak population observed in 1964. Several factors may have accounted for the much larger numbers in 1965. The weather was extremely mild during late summer and fall. This milder weather may have slowed migration and allowed birds to build-up and not migrate through the area. Evidence for this was that the population peak occurred five weeks later. There was a tremendous increase in the numbers of Redwings (about seven times) and Starlings (approximately five times). Also, the larger population coincided with the trend of increased blackbird populations every year since the refuge was established.

Populations based on two road-census samples both gave about the same percentage (one-half) of the population estimates based on roost counts, indicating that road censuses may be useful for obtaining a population index. A road census has already been developed for censusing breeding Redwings (Hewitt, 1967). Population estimates based on roost counts included birds feeding outside the area (especially Starlings) which flew in at night to roost. These birds would not be included in the road census and thus resulted in a lower population estimate.

The road-census data indicated a greater density of blackbirds on the refuge than on the rest of the study area. The refuge appeared to be a congregation point for feeding (due to grain sorghum planted for waterfowl) even though most of the blackbirds roosted off the refuge. Greater densities of birds occurred on the refuge in January as food became less available off the refuge.

Some blackbird movement into the study area had taken place by 1 September both years. The early September population was larger than could reasonably be attributed to reproduction by resident birds. Goddard and Board (1967) reported that the average Redwing reproduction in north

central Oklahoma was 2.5 young per pair. It would have taken 1,800 and 680 nesting Redwings in 1964 and 1965 respectively to produce the late August populations. It was unlikely that this many birds were present due to the low nesting populations observed on the area in the springs of 1965 and 1966. A reasonable estimate of the resident breeding population and their young would be about 1,000 birds.

Sex-ratio data obtained from field counts and banding demonstrated similar movement patterns. In both years, a decline in the proportion 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 of 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. Since the population was composed primarily 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 age ratio declined. This suggested that the large segment of the population which left during November was composed of immatures and adult females.

A higher proportion of male cowbirds and Starlings was present in January. These data combined with age ratios that declined for all three species, indicated again that immatures and adult females made up most of the birds which left during December and the first part of January.

During the second year, the age ratio of cowbirds in November remained almost constant with that for October which suggested that flocks moving into the area during this time had about the same age composition as the population already present. The similarity may have been due to small sample size or perhaps to greater trapping vulnerability of immatures. Generally, the proportion of males increased from November to January. The population peak in November seemed to be due to a large number of males moving into the area.

The proportion of males increased again in December and January. The December age ratio indicated that the population peak which occurred during the third week of December contained large numbers of immatures. A substantial movement out of the area took place over the next three weeks. The movement consisted largely of adult females and immature males and females. Evidence of this was the increased number of adult males in the December and January samples and the decreased proportions of the other age and sex classes.

Approximately 65 and 71 per cent of the grain sorghum in the damage-evaluation fields was eaten by blackbirds and Starlings in 1964 and 1965

respectively. Using these data, and expanding it for the entire refuge, the losses were $6,500 and $10,700 in the two years. Loss of a large amount of the refuge's sorghum crop to the blackbirds and Starlings was presumed to have been responsible for the daily feeding flights of waterfowl off the refuge in late 1964 and early 1965. These flights exposed the ducks to additional hunting pressure. At least four farmers are known to have lost most of their 1964 sorghum crop. This was due to late rains which delayed the harvest until large numbers of blackbirds were present. Normally the harvest is completed by the end of October before the large build-up of blackbirds. Warmer weather delayed the migration the second year and little damage off the refuge was reported. The loss of sorghum and subsequent reduction in waterfowl use of the refuge were related to the size and duration of use by the blackbird and Starling populations.

SUMMARY

A study of the population size, migration pattern, and structure of blackbird and Starling populations was carried out during the fall and early winter of 1964 and 1965 in western Oklahoma. In 1964, the peak population of 250,000 birds was observed in the second week of November. The peak the second year was 900,000 and occurred during the third week of December. Greater densities of birds were observed in January on the refuge portion of the study area. Possible reasons for the increased population the second year and greater densities on the refuge are discussed.

The relationship between migration patterns the two years and the species, age, and sex composition of the populations are also discussed.

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