BLACKBIRDS

and the

SOUTHERN RICE CROP

U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

Resource Publication 100

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SOUTHERN RICE CROP

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Division of Wildlife Research

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UNITED STATES DEPARTMENT OF THE INTERIOR
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The Department of the Interior, created in 1849, is our Nation's Department of Natural Resources, concerned with management, conservation, and development of water, wildlife, fish, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

As America's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that park and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States, now and in the future.

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Cover drawing by John W. Taylor.
Except as noted, all photographs are by the author.

Introduction

Blackbirds have been a problem to the rice grower since colonial times. The problem has existed wherever rice is grown because man, by his culture of rice (*Oryza sativa*), creates food-rich rice-field marshes that apparently are more attractive to blackbirds than the natural marshes in which they have flourished for centuries.

In the 1700's and 1800's, rice was grown in the lowlands of South Carolina, Georgia, and North Carolina—on the major migratory route of the bobolink (*Dolichonyx oryzivorus*), the historic "rice-bird" of that area because of its consumption of ripening rice. By the late 1800's the rice-growing industry had largely shifted to the coastal prairies of Louisiana and Texas, which are bordered by some 5 million acres of marshland—breeding habitat for the red-winged blackbird (*Agelaius phoeniceus*) and the boat-tailed grackle (*Cassidix mexicanus*). By 1900, rice was being grown on the Grand Prairie of eastern Arkansas, which bestrides the largest blackbird flyway in the country. In recent decades, rice culture has spread to other sections of Arkansas and thence to contiguous areas in Louisiana, Mississippi, Tennessee, and Missouri. In effect, then, man has taken the rice to the blackbirds.

Although their depredations are serious during the rice season, blackbirds have certain redeeming qualities that should be recognized. During the year, they eat vast quantities of harmful insects and the seeds of many noxious weeds. Mankind appreciates esthetic values of blackbirds, especially in springtime—their colorful appearance, singing, flight habits, and breeding behavior. Blackbirds are protected under the Federal Migratory Bird Treaty Act, an amendment to which permits farmers to destroy blackbirds that are in the act of damaging or are about to damage crops. Because the Federal Government is concerned with agricultural production as well as wildlife resources, including migratory songbirds, it is the policy of the Bureau of Sport Fisheries and Wildlife to assist the rice farmer in developing efficient and practicable measures for reducing crop losses. These measures must be acceptable both to the general public and to the farmer—with the greatest possible safeguards for man and the total environment.

In 1919, the Bureau's first studies of the blackbird-rice problem in the South were conducted by Edwin R. Kalmbach in Vermilion

Parish, La. Kalmbach returned to the same area for further studies in 1925. His findings were reported in a 70-page manuscript (Kalmbach, 1937).

A 7-year research study of the problem on the Arkansas Grand Prairie was initiated by the Bureau in 1948. Johnson A. Neff and Brooke Meanley were the principal investigators; Neff supervised the work from Denver and made many extended field trips to Arkansas during the period, while Meanley was stationed on the Grand Prairie full time from 1950 through 1955. These investigations culminated in the 89-page Bulletin 584, "Blackbirds and the Arkansas Rice Crop" (Neff and Meanley, 1957), published by the University of Arkansas Agricultural Experiment Station in cooperation with the Bureau.

As new control techniques have been developed, they have been tested in various rice-growing areas. Since June 1963 the Patuxent Wildlife Research Center has maintained a substation in Arkansas. It is located at the Rice Branch Experiment Station near Stuttgart and is staffed by two Bureau biologists who concentrate their research on ways to alleviate blackbird depredations.

The present report replaces Bulletin 584, now out of print. The geographic coverage has been enlarged to include the entire Southern rice-producing area, and new information gathered during the past 12 years has been incorporated. The report is designed primarily to inform farmers, agriculturists, biologists, and others of the extent of the rice-blackbird problem in the South; of the habits, distribution, and movements of the blackbird populations involved; and of appropriate methods now available for reducing crop losses.

This publication is based on the studies, assistance, and courtesies of many people, though it is primarily the work of the author, who has been involved in blackbird-rice investigations in the South for the past 20 years. Through the years, several other biologists of the Bureau of Sport Fisheries and Wildlife have contributed substantially to the many-faceted blackbird research program in the rice-growing areas of the South, especially the following: Edwin R. Kalmbach, Johnson A. Neff, James S. Lindzey, John L. Seubert, Henry J. Spencer, Donald T. Harke, John S. Webb, Robert T. Mitchell, John T. Linehan, Don P. Fankhauser, Patrick L. O'Halloran, Charles P. Stone, James W. Caslick, Paul W. Lefebvre, and Albert E. Hester. I am especially indebted to John S. Webb for thorough review and editing of the manuscript. Many farmers, Experiment Station personnel, county agents, and other Federal and State employees have given valuable assistance to the rice-blackbird investigations by contributing time or facilities or land.

The University of Arkansas Agricultural Experiment Station

has granted permission to use several figures and text excerpts from Bulletin 584. Garner Allen of the *Stuttgart Daily Leader* has kindly permitted the use of his photograph showing a banding operation in an Arkansas blackbird roost. Al Godin made the drawings of grain-damaging blackbirds.

Southern Rice

THE RICELANDS

The ricelands of the South are found almost entirely on the Gulf Coastal Plain Province, where rice is grown on the coastal prairies and on the alluvial plain of the Mississippi River (fig. 1). Texas, Louisiana, Arkansas, and Mississippi are the principal rice-growing States of the South. Some rice is grown also in southeastern Missouri, and a small amount in western Tennessee. Very little rice

FIGURE 1.—Southern ricelands.

is now grown on the South Atlantic Coastal Plain, the original riceлands of the United States.

From the beginning, rice culture in the South Central States has been concentrated in the prairie soils, and more recently it has been extended to the bottomland alluvial soils of the Mississippi River. Vast areas of former natural tall-grass prairie in coastal southwestern Louisiana and southeastern Texas and in east-central Arkansas have been converted to riceland. Much former woodland and cottonland in the delta of northwestern Mississippi, eastern Arkansas, and northeastern Louisiana is now in rice production. The Missouri rice is produced in a small area in the southeastern part of the State, extending northward from the Arkansas boundary to the vicinity of Poplar Bluff.

The coastal rice prairies of Texas and Louisiana are virtually continuous, except where dissected by several rivers. In Texas, rice is grown from Victoria and Calhoun Counties northward to Liberty, Hardin, and Orange Counties and inland to Colorado, Austin, and Waller Counties. The Louisiana coastal rice belt extends eastward from the Texas boundary to Opelousas and northward from the coastal marshes to Mamou, Evangeline Parish. Small pockets of riceland are found southeast of Baton Rouge and along the Mississippi River a few miles southwest of Vidalia, Concordia Parish. The northeastern Louisiana rice-growing area is contiguous with the Arkansas rice belt, extending northward from the vicinity of Tallulah, Madison Parish.

The Arkansas rice belt extends from Louisiana to Missouri in the eastern third of the State. The major rice-producing districts in Arkansas are (1) the central, principally the Grand Prairie (Arkansas, Prairie, and Lonoke Counties), (2) the northeastern (especially Poinsett, Cross, Jackson, Woodruff, St. Francis, and Craighead Counties), and (3) the southeastern, a strip two counties wide along the Mississippi River from the Arkansas River to Louisiana. In the central district, rice production extends eastward discontinuously from near Little Rock to the Mississippi River; a little rice is grown south of Helena along the Mississippi River in Phillips County. North of the Grand Prairie, most of the rice is produced in the area between the Ozark Uplift and Crowley's Ridge; this section of the rice belt closely follows along the Cotton Belt Railroad. Some rice also is grown east of Crowley's Ridge on the Mississippi River delta, chiefly in Crittenden County.

In Mississippi, rice has been an important crop for the last 20 years. The Mississippi rice belt lies on the delta lands in the western part of the State, on the alluvial plain of the Mississippi River. Rice is grown in an area extending southward for more than 100 miles from near Memphis, Tenn., to near Vicksburg. Bolivar and

Washington Counties account for more than half of the Mississippi rice production.

PRODUCTION IN 1968 BY STATES

The total production of rice in the United States in 1968 (table 1) was distributed as follows: Texas 26.1 percent, Louisiana 25.2 percent, Arkansas 23.7 percent, California 22.1 percent, Mississippi 2.6 percent, and Missouri 0.3 percent.

TABLE 1.—*Estimated rice acreage and production by States, 1968*
[Consumer and Marketing Service, Grain Division, 1968, table 20, p. 15]

State	Acreage	Production	
		Pounds	Percent
Arkansas	568,000	2,556,000,000	23.7
California	432,000	2,376,000,000	22.1
Louisiana	678,000	2,712,000,000	25.2
Mississippi	66,000	283,800,000	2.6
Missouri	6,100	29,280,000	0.3
Texas	610,000	2,806,000,000	26.1
Total	2,360,100	10,763,080,000	100.0

Rice yields have doubled throughout the ricelands in the past 18 years. The average yield per acre in 1968 was estimated at 4,560 pounds—over 100 bushels per acre. Rice production has become increasingly efficient since Federal acreage allotments were effected in 1954.

RICE CULTURE

Rice is grown in warm climates characterized by relatively high mean temperatures during the growing season, and abundant fresh water is required. In the southern ricelands, the summers are warm and sultry, and the daily maximum temperature usually ranges from 90° to 100° F; the mean summer temperature is near 82° F. The average annual precipitation ranges from 50 to 57 inches, and is well distributed during the growing season (Jones et al., 1952).

About 35 to 45 acre-inches of water are required annually to grow a crop of rice, depending upon the water-holding capacity of the soil. Water is maintained in a ricefield at a depth of from 4 to 8 inches during the growing season. This is necessary to control weeds and to meet the high moisture requirements of the crop. Irrigation water for rice production is obtained mostly from wells, reservoirs, and bayous, and is supplemented by 10 to 15 inches of rainfall during the growing season (fig. 2).

Land on which rice is grown is comparatively level. Levees are constructed on the contour to maintain an even distribution of water in the field during the growing season (fig. 3). Rice culture in the South Central States is mainly associated with prairie soils and alluvial or "buckshot" river soil types. These soils are of medium to heavy texture and rest on impervious subsoils that retard loss of

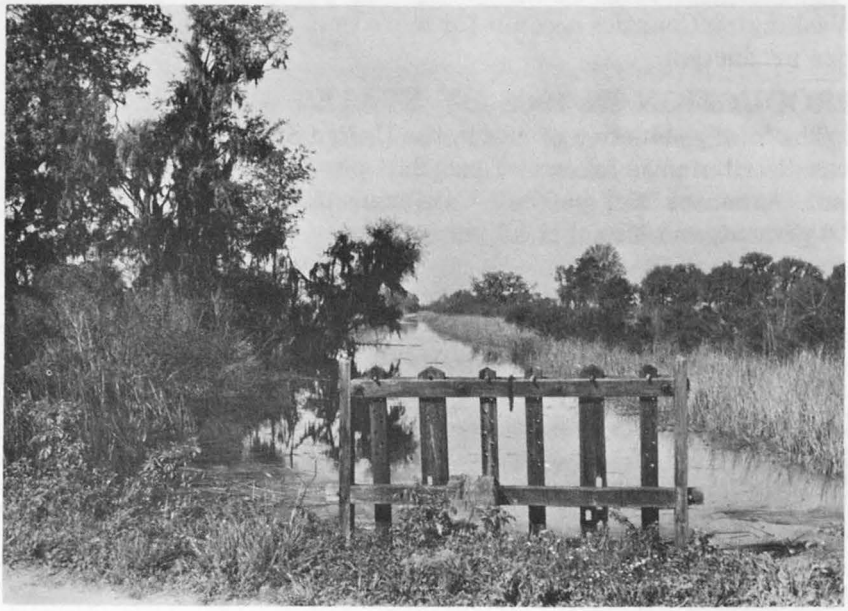


FIGURE 2.—Floodgate and ricefield canal built by slaves and still in use, April 1960. This irrigation system is used for flooding ricefields on the Savannah National Wildlife Refuge in South Carolina. Rice grown for commercial use a century ago was irrigated by such a system of canals as the tide rose from the Savannah River.

FIGURE 3.—Sprouting rice in field near Stuttgart, Ark., June 1950. Damage to sprouting rice is relatively minor compared with damage during the ripening period.

irrigation water; lighter soils also may be used for growing rice if underlain by subsoils through which water penetrates slowly. Important rice soil types are: Lake Charles Clay and Beaumont Clay in Texas; Crowley Silt Loam, Midland Silt Loam, and Acadia Silt Loam in Louisiana; and Crowley Silt Loam, Calhoun Silt Loam, and Sharkey Clay in Arkansas (Agricultural Research Service, 1966).

Rice is usually sown in dry seedbeds by a grain drill or endgate seeder. Sometimes it is broadcast by airplane over flooded seedbeds. The rate of seeding is about 100 to 125 pounds per acre.

The rice growing season is 100 to 170 days, depending upon the variety and location. Rice is planted in Texas and Louisiana from March 15 to July 1. In Arkansas and Mississippi, where the growing season is shorter, the planting season is from mid-April until early June. Some 15 varieties of rice are grown in the South; but five varieties, Bluebelle, Saturn, Starbonnet, Nato, and Belle Patna, accounted for about 85 percent of the acreage sown to rice in 1968 (R. Adair, personal communication). Bluebelle and Belle Patna are long-grain varieties with growing periods of only 100 to 115 days. Saturn and Nato are medium-grain early-season varieties with growing periods of 115 to 130 days. Starbonnet is a long-grain mid-season variety with a growing period of 130 to 140 days.

Crop rotation is practiced in rice culture. Usually soybeans and oats, and occasionally cotton, corn, or lespedeza, are rotated with rice in Arkansas and Mississippi. Grazing beef cattle on vegetation volunteering between rice crops is common practice in Texas and Louisiana.

Since about 1960, all rice has been harvested by combine (fig. 4).

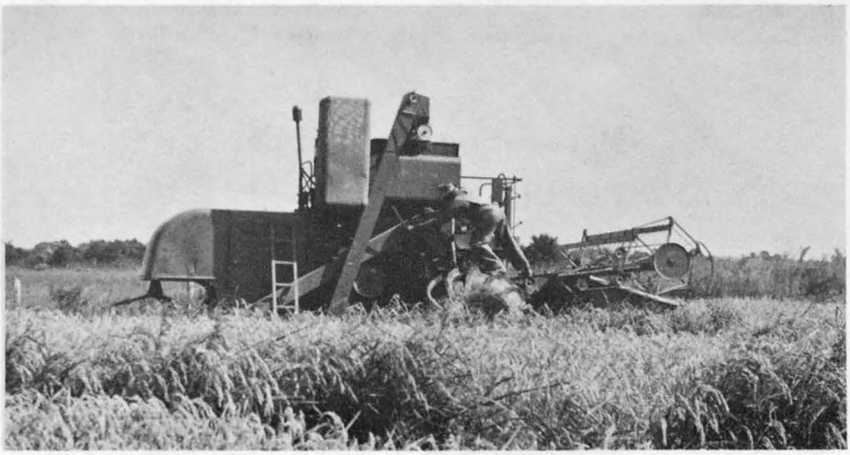


FIGURE 4.—Combine harvesting rice on Vern Tindall farm, Stuttgart, Ark. Rice production is now a highly mechanized agricultural industry.

Before the advent of the combine in the 1940's, rice was cut with a binder, shocked by hand, allowed to dry for from 2 to 6 weeks in the shock (fig. 5), and then threshed and carted to the mill. Rice now is cut and threshed in the field in one operation, then trucked to an artificial drier where its moisture content is gradually reduced within a few days. The dried or rough rice is stored in bulk at an elevator or warehouse, and then is delivered to a mill for final market processing (Jones et al., 1952, p. 26–31).

FIGURE 5.—A picture of the past: shocked rice on the Arkansas Grand Prairie, October 1951. Changing methods of drying and harvesting result in removal of most of the crop from the field before migrating blackbirds arrive from the north.

Rice-eating Blackbirds

SPECIES AND POPULATIONS

Species

Four blackbird species cause the major damage to southern rice: the red-winged blackbird, the brown-headed cowbird (*Molothrus ater*), the common grackle (*Quiscalus quiscula*), and the boat-tailed grackle (fig. 6). The boat-tailed grackle and one race of redwings (*littoralis*) occur in the ricelands only along the Gulf Coast; together they are responsible for most of the rice damage in Texas and southern Louisiana. Eastern redwings (*A. p. phoeniceus*), cowbirds, and common grackles are the principal rice-depredating blackbirds in the remainder of the southern ricelands.

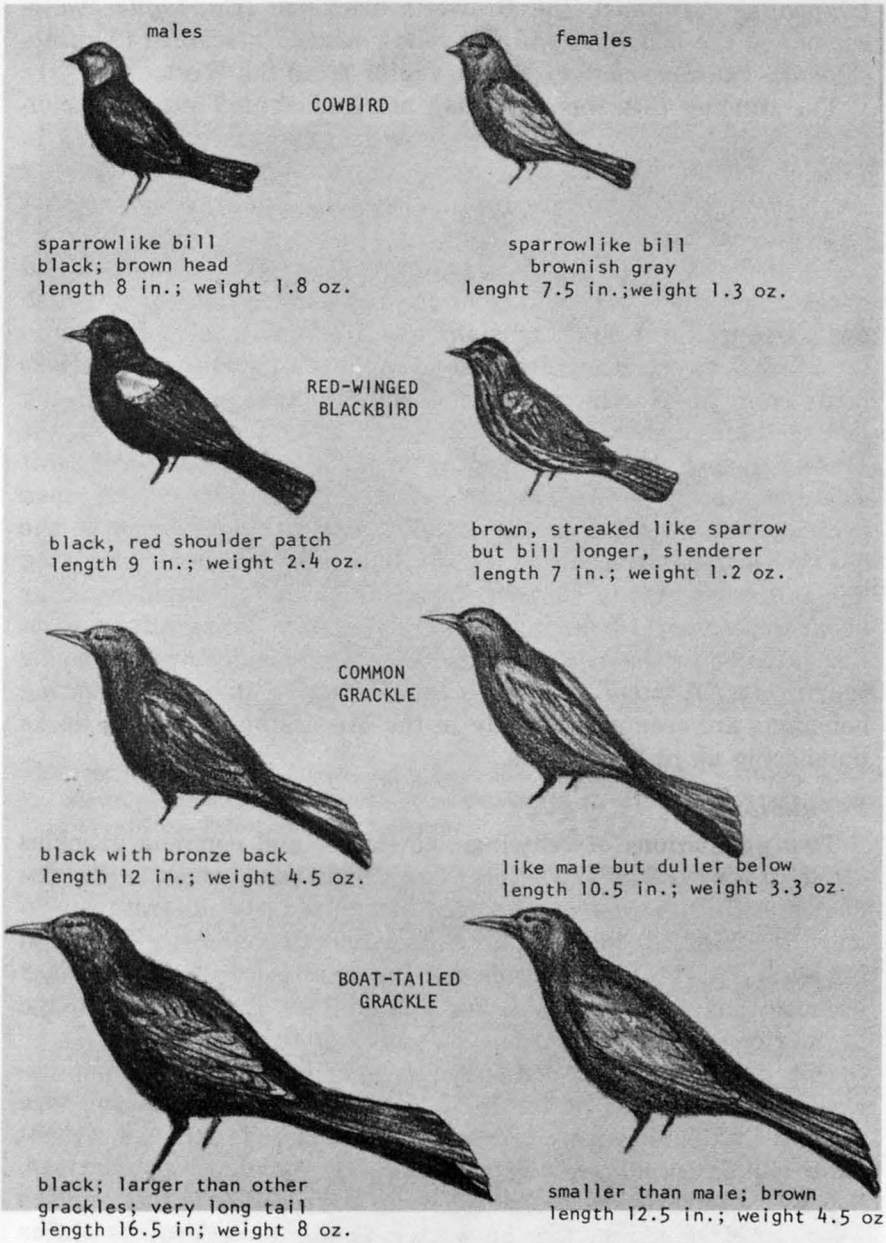


FIGURE 6.—Major rice-damaging blackbirds. (Drawings by Al Godin).

Other members of the blackbird family, though found regularly in the southern rice belts, do little or no damage to growing rice, either because they are absent during the depredation time or because they occur in numbers too small to cause appreciable damage. These species of minor importance include the rusty blackbird

(*Euphagus carolinus*), the Brewer's blackbird (*Euphagus cyanocephalus*), the bobolink, and the yellow-headed blackbird (*Xanthocephalus xanthocephalus*), a rare visitor from the West.

The starling (*Sturnus vulgaris*), not a blackbird but often confused with American blackbirds, was introduced from Europe in 1890. It is now abundant as a winter resident and increasingly more common as a breeder in the ricelands. But starlings are not known to eat growing rice.

All the above birds are migratory except for the boat-tailed grackle and the *littoralis* race of the red-winged blackbird, which are found in the coastal Louisiana and Texas rice belts. Each winter a few Brewer's blackbirds from the West and many rusty blackbirds from the North are found in the ricelands, seldom arriving before the middle of October; however, they feed mostly on the ground rather than on standing rice. Rusties mainly inhabit swampy woods, while Brewer's blackbirds occur on the open prairie; both species inflicted some damage to the rice crop in the days when rice was shocked (fig. 5). Bobolinks are common spring and fall migrants; in eastern Arkansas, peak fall numbers occur about September 15, during the season of rice depredations. Similar in color to the ripening rice, they are usually overlooked by the farmer. Although they are few in total numbers, migrating bobolinks are seen occasionally in the Mississippi Valley in flocks numbering up to 1,500 birds.

Populations

Two populations of redwings, cowbirds, and common grackles occur in the ricelands: (1) local blackbirds that breed in the rice States, and (2) hordes of northern blackbirds that migrate southward in the fall from their breeding areas to the north. The local populations are of great economic importance to the rice farmer because they are responsible for virtually all of the bird damage to the rice crop.

Only about half of 1 percent of the northern blackbird populations reach the rice States in time to feed on the ripening rice grains; this is shown by Meanley, Webb, and Fankhauser (1966) from banding and recovery evidence. The northern populations, however, comprise the vast majority of the blackbirds found in the southern ricelands during the winter. Some of the local Arkansas blackbirds remain in Arkansas in winter, but the majority move southward.

MIGRATION AND MOVEMENTS

Knowledge of the seasonal distribution of migratory blackbird populations that damage rice is based on recoveries of blackbirds

that have been banded. Thus, banding activities are important (figs. 7, 8, and 9), and large numbers of blackbirds must be banded if

FIGURE 7.—Banding a female red-winged blackbird. The male redwing is well known to the rice farmer, who often thinks the female is a separate species and calls it a "ricebird" or a "sparrow."

FIGURE 8.—This male red-winged blackbird is tagged with both a numbered aluminum band and a colored plastic leg marker for use in studies of migration and local movements.

FIGURE 9.—At this Arkansas roost near Stuttgart, 925 male red-winged blackbirds were captured by hand and banded in one night between 7 p.m. and 1:30 a.m., February 1954. (Photo by Garner Allen).

many are eventually to be recovered. Blackbird recovery rates are estimated to be near 1.5 percent, whereas rates are near 13 percent for many kinds of waterfowl.

All records of blackbird band recoveries from the eastern half of North America (the Mississippi and Atlantic Flyways) were analyzed by biologists at the Patuxent Wildlife Research Center to

determine the relation between various geographic populations and rice damage (Meanley, Webb, and Fankhauser, 1966). During a 42-year period (1920 to July 1962), this mass of 25,325 blackbird recovery records had accumulated in the files of the Bird Banding Laboratory of the U.S. Fish and Wildlife Service. Most of the banding in the lower Mississippi Valley was done in or near the rice belts of Arkansas and Louisiana. Principal banding localities in Arkansas were near Stuttgart, De Witt, Jonesboro, Forrest City, and Eudora. The main Louisiana localities were Avery Island, Alexandria, and Baton Rouge. Memphis, Tenn., also was an important banding locality.

The banding analyses (1966) show that most of the blackbirds associated with the rice problem are Mississippi Flyway birds. Their main routes of travel are through the lower Mississippi Valley from various points between Canada and the Gulf Coast.

Another important conclusion based on band recoveries is that nearly all blackbird damage to rice is done by local breeding populations. Only about 1 percent (25 of 2,031 recoveries) of the northern population move into southern States before the end of the rice harvest, and only about 0.5 percent (11 of 2,031) reach rice States during the depredation period (Meanley et al., 1966, p. 18).

Blackbirds do not travel far during the summer and early fall, the preripening and ripening periods for rice. Table 2 shows examples of young red-winged blackbirds that were banded in June and July on the Arkansas Grand Prairie and recovered a few weeks later in ripening ricefields within a few miles of their banding place.

TABLE 2.—*Young redwings produced near Stuttgart, Ark., and found in nearby ricefields during the next damage season*

Date banded	Date recovered	Miles from banding to recovery site
June 21, 1951	September 12, 1951	3
June 28, 1951	October 14, 1951	4
July 3, 1951	August 12, 1951	4
July 24, 1950	October 27, 1950	10

Similarly, two brown-headed cowbirds were banded in summer on the Grand Prairie, where they were recovered late in the damage period—one banded July 30 and recovered October 13, 1951, and one banded August 22 and recovered October 6, 1950. Also, 51 of 53 cowbirds color-marked on a 25-square-mile Arkansas study area in August 1965 were observed within 2 miles of the place of tagging during the following month (Stone and O'Halloran, 1966b, p. 20). From the evidence, then, fall migration of the local depredating blackbird populations in Arkansas does not begin until harvest of the rice crop is completed.

Fall recovery records from Louisiana attest that some blackbirds linger in the Arkansas ricelands for a month or more after harvest, while others move southward soon after all the rice is cut. Some examples of Arkansas blackbirds arriving in Louisiana shortly after harvest are as follows: a redwing banded at Stuttgart on September 29, 1950, had moved to Franklin Parish, La., by November 12; a cowbird banded at Stuttgart on September 20, 1963, was recovered at Opelousas, La., on November 18; and two cowbirds banded at Jonesboro (northeastern Arkansas) on October 10, 1964, were recovered—one at Eudora (in Arkansas only 8 miles from the Louisiana line) on November 11, and one at Innis, La., on November 17.

Some local Arkansas blackbirds do not leave the State until early winter, as shown in table 3 for 12 of 20 cowbirds that were banded in northeastern Arkansas during September and October and recovered nearby in December. The other eight cowbirds were recovered southward, in Mississippi or Louisiana, in December.

TABLE 3.—*Cowbirds banded in northeast Arkansas (September–October) and recovered (December) either nearby or southward*

Banded in northeast Arkansas on ——	Recovered	
	Time	Place
September 9, 1963	December 1963	Northeast Arkansas.
Do	Do	Do.
September 14, 1963	Do	Do.
September 16, 1963	Do	Do.
September 17, 1963	Do	Do.
September 18, 1963	Do	Do.
October 3, 1963	Do	Do.
October 9, 1963	Do	Do.
Do	Do	Do.
October 10, 1963	Do	Do.
October 16, 1963	Do	Do.
October 16, 1964	December 1964	Do.
September 9,1963	December 21, 1963	Louisiana.
September 10, 1963	December 30, 1963	Mississippi.
September 16, 1963	Do	Louisiana.
October 2, 1963	Do	Do.
October 3, 1963	Do	Mississippi.
Do	December 5, 1963	Louisiana.
October 21, 1964	December 26, 1964	Do.
Do	Do	Do.

Southward migration of most blackbirds, both rice-State summer populations and northern ones, follows their molting (Meanley, 1964, p. 35–37). The molt takes place on the breeding grounds and is usually complete by late September or early October. Weeks then pass before northern birds reach the ricelands.

Thus, blackbird populations migrate southward principally in November and early December. Nearly half (427 of 865 band recoveries) of the northern blackbirds that winter in the South migrate during the fall period of November 1–December 14 (Meanley et al., 1966, p. 20). The remainder of the South-wintering northern blackbirds arrive in the South during the December 15–January 31

period, when nearly half (481 of 995) of the recovered blackbirds in eastern North America are in the rice States (Meanley et al., 1966, p. 23).

Breeding bird populations from the Prairie Provinces and North Central States that migrate down the Mississippi Valley winter mainly from the latitude of the upper part of the ricelands (southeastern Missouri) to the southern limit of rice culture in coastal Louisiana and Texas. Breeding birds of the ricelands north of central Louisiana winter mainly south of their nesting grounds. Most of the breeding and depredating birds from Arkansas winter in Louisiana (fig. 10) and Texas; a few winter in Mississippi and Arkansas.

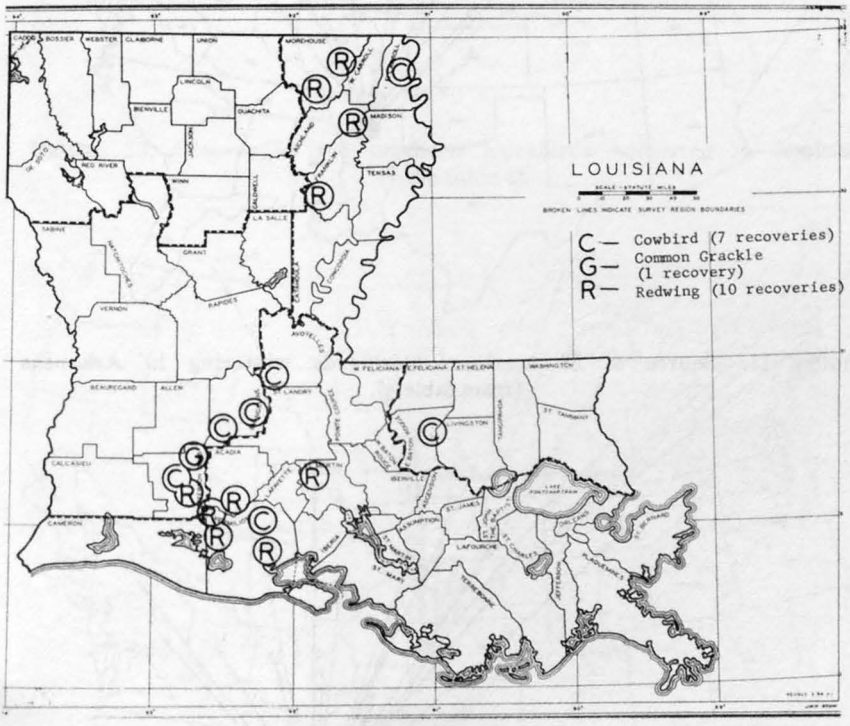


FIGURE 10.—Recovery stations on Louisiana wintering ground of blackbirds banded in the Arkansas rice belt during the breeding and depredations periods.

During the entire winter season (mid-December to March), 84 percent (1,418 of 1,681 recoveries) of the blackbirds in the rice States are from the North (Meanley et al., 1966, p. 40). Over 94 percent (1,339 of 1,418) come from 12 North Central States extending from Ohio westward to the Dakotas and Kansas. Most of the remainder come from five bordering Provinces of Canada, and the

others are scattered between the Northeast and the Rockies. Figures 11, 12, 13, and 14 show which States and Provinces supply the northern blackbird populations that winter in the four principal rice States, and table 4 is a summary of the 350 recovery records from which these figures were constructed. Figure 15 is a diagram-

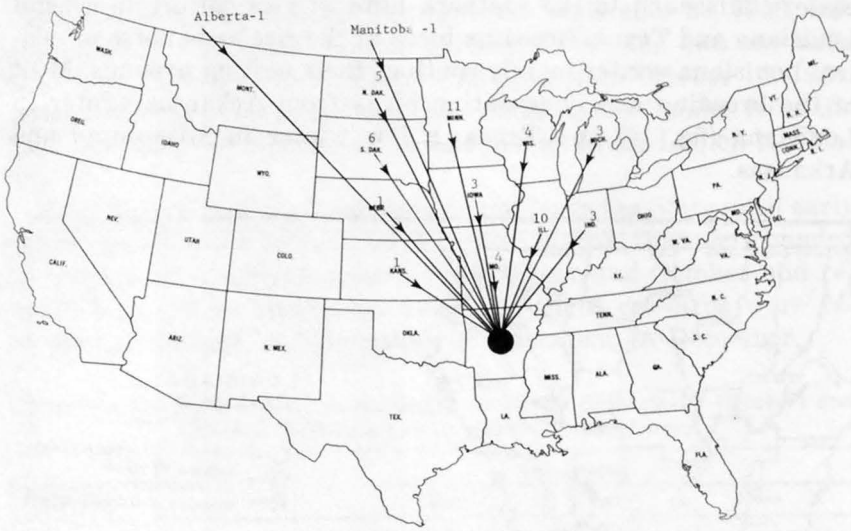


FIGURE 11.—Source of 53 northern blackbirds wintering in Arkansas (from table 4).

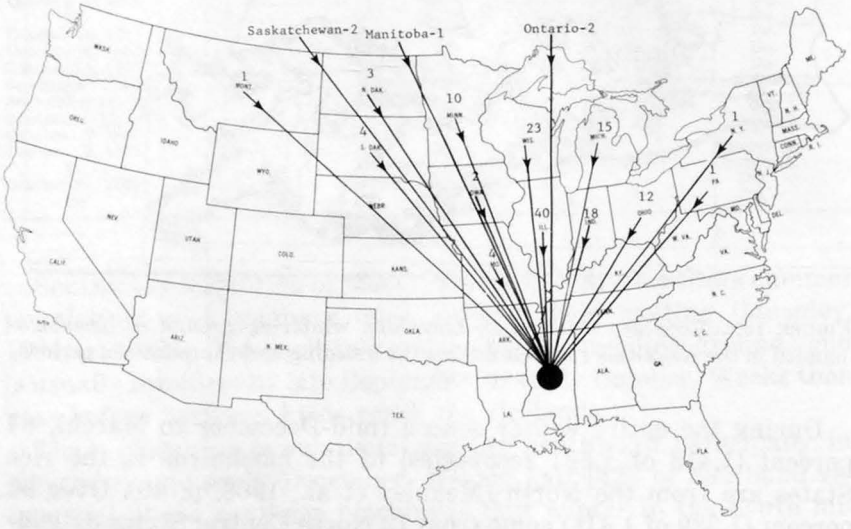


FIGURE 12.—Source of 139 northern blackbirds wintering in Mississippi (from table 4).

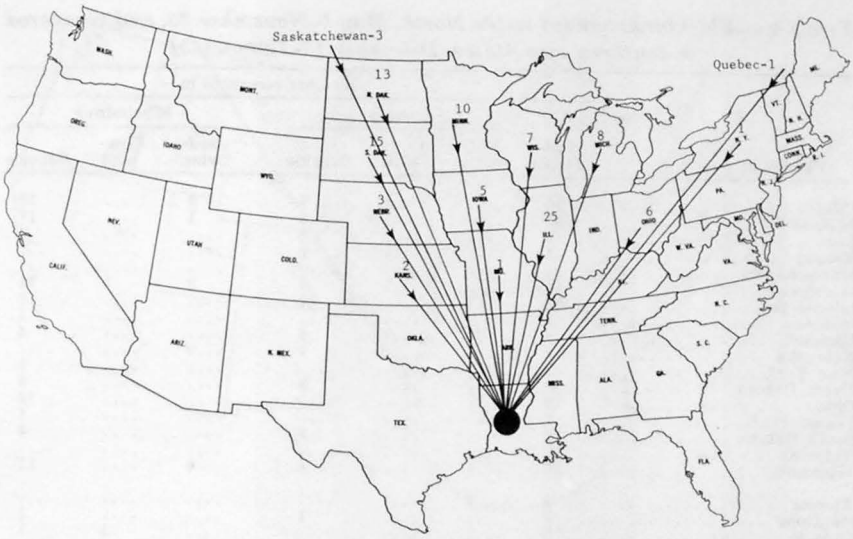


FIGURE 13.—Source of 100 northern blackbirds wintering in Louisiana (from table 4).

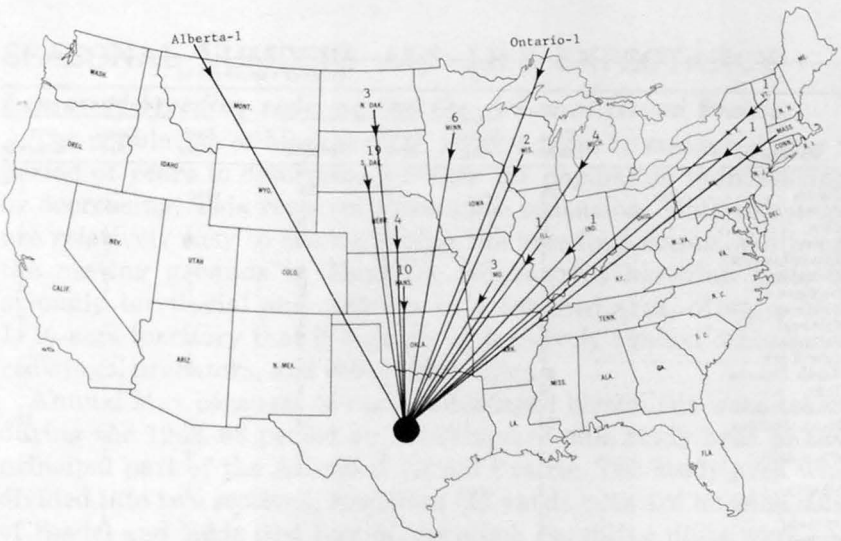


FIGURE 14.—Source of 58 northern blackbirds wintering in Texas (from table 4).

matic illustration of the northern areas from which blackbirds come to winter in the southern ricelands..

Banding records indicate that a large majority of the Arkansas blackbird breeding populations spend the first part of the winter (December 15 to January 31) in Louisiana, Texas, and Mississippi, but by late February much of the Arkansas breeding population is

TABLE 4.—*Blackbirds banded in the North, May 1–November 30, and recovered in southern rice States, December 15–January 31*

Banded in —	Number recovered in —						
		Arkansas			Mississippi		
	Two States	Red-wing	Cow-bird	Grackle	Red-wing	Cow-bird	Grackle
Illinois	50	....	1	9	2	....	38
Indiana	21	....	....	3	1	....	17
Iowa	5	....	....	3	....	....	2
Kansas	1	....	....	1	....	....	....
Massachusetts	..	....	....	....	....	....	....
Michigan	18	....	....	3	2	1	12
Minnesota	21	....	....	11	....	....	10
Montana	1	....	....	....	....	....	1
Missouri	8	....	....	4	....	....	4
Nebraska	1	....	....	1	....	....	....
New York	1	....	....	....	....	....	1
North Dakota	8	....	....	5	....	....	3
Ohio	12	....	....	....	....	....	12
Pennsylvania	1	....	....	....	....	....	1
South Dakota	10	....	....	6	....	....	4
Vermont	..	....	....	....	....	....	....
Wisconsin	27	....	....	4	6	....	17
Alberta	1	1	....	....	....	....	....
Manitoba	2	....	....	1	....	....	1
Ontario	2	....	....	....	....	1	1
Quebec	..	....	....	....	....	....	....
Saskatchewan	2	....	....	....	....	....	2
Total	192	1	1	51	11	2	126
			53			139	

Banded in —	Number recovered in —						
		Texas			Louisiana		
	Two States	Red-wing	Cow-bird	Grackle	Red-wing	Cow-bird	Grackle
Illinois	26	....	3	22	....	....	1
Indiana	1	....	....	....	....	1	....
Iowa	5	....	....	5	....	....	....
Kansas	12	....	....	2	4	2	4
Massachusetts	1	....	....	....	....	1	....
Michigan	12	2	4	2	....	4	....
Minnesota	16	1	1	8	3	1	2
Montana	..	....	....	....	....	....	....
Missouri	4	....	....	1	....	....	3
Nebraska	7	....	....	3	....	....	4
New York	2	1	....	....	1	....	....
North Dakota	61	....	....	13	3	....	....
Ohio	6	....	5	1	....	....	....
Pennsylvania	..	....	....	....	....	....	....
South Dakota	34	1	....	14	6	....	13
Vermont	1	....	....	....	....	1	....
Wisconsin	9	....	2	5	1	1	....
Alberta	1	....	....	....	1	....	....
Monitoba	..	....	....	....	....	....	....
Ontario	1	....	....	....	....	1	....
Quebec	1	....	1	....	....	....	....
Saskatchewan	3	....	....	3	....	....	....
Total	158	5	16	79	19	12	27
			100			58	

back in Arkansas. In contrast, about 78 percent of the northern breeding blackbirds are still on southern wintering grounds through February, only 18 percent during March, and only about 1 percent in April (Meanley, Webb, and Fankhauser, 1966, p. 32).

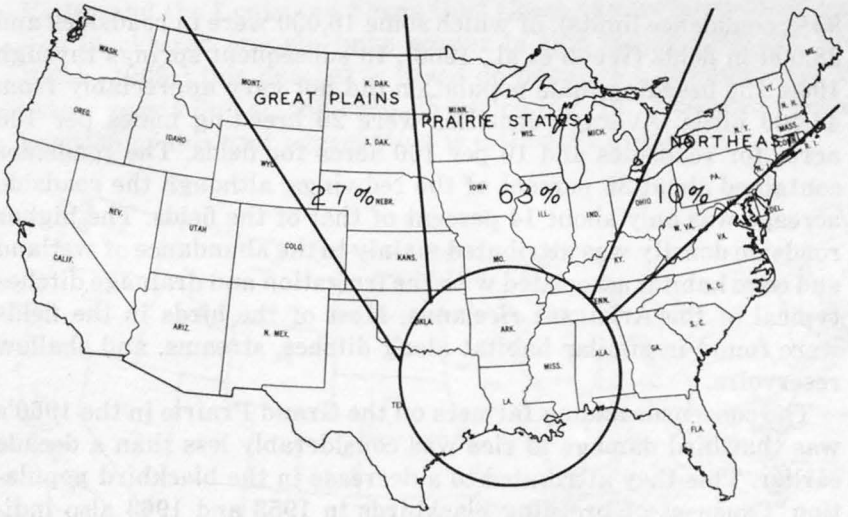


FIGURE 15.—Source of northern blackbirds wintering in the rice States (Arkansas, Mississippi, Louisiana, and Texas).

SEASONAL NUMBERS AND LIFE EXPECTANCY

Census of breeding redwings on the Arkansas Grand Prairie

The population of blackbirds in an area must be measured over a period of years to determine whether the population is increasing or decreasing. This requires systematic censusing. Male redwings are relatively easy to census during the breeding season. While on the nesting grounds in May, the conspicuous breeding male is strongly territorial and remains in a confined area, often only a 1/10-acre territory that it defends aggressively against other male redwings, predators, and other interlopers.

Annual May censuses of male red-winged blackbirds were taken during the 1962–68 period on a 900-square-mile study area of the principal part of the Arkansas Grand Prairie. The study area was divided into two sections, roadsides (75 yards outward on each side of roads) and fields (the rest of the area). Sampling units were selected at random within each section; roadside stretches for census were 5 miles long and 150 yards wide (272.7 acres), and field units were 10-acre circular plots. Thus, all major land-use types that are found in the study area were covered by the census. The roadsides were censused from a moving automobile by the technique developed by Hewitt (1967), and the field-plot counts were made by the method developed by Patuxent biologists Meanley and Webb (1960).

The territorial male population of 900 square miles of Grand Prairie was estimated in 1963 to be near 44,000 (43,700 ± 5,400,

95% confidence limits), of which some 16,000 were in roadsides and 28,000 in fields (Webb et al., 1968). In subsequent springs through 1968, the breeding male population did not vary appreciably from 44,000 birds. Average densities were 20 breeding males per 100 acres for roadsides and 10 per 100 acres for fields. The roadsides contained about 36 percent of the redwings, although the roadside acreage was only about 14 percent of that of the fields. The higher roadside density was attributed mainly to the abundance of wetland and edge habitat associated with the irrigation and drainage ditches typical of the Arkansas ricelands. Most of the birds in the fields were found in similar habitat along ditches, streams, and shallow reservoirs.

The consensus among farmers on the Grand Prairie in the 1960's was that bird damage to rice was considerably less than a decade earlier. This they attributed to a decrease in the blackbird population. Censuses of breeding blackbirds in 1953 and 1963 also indicated a decline in the population during the 10-year period. The 1953 census was limited to a total count of territorial male redwings in a single block of land (8,320 acres) in the center of the Grand Prairie, while the 1963 census covered a much larger portion of the Prairie (900 square miles). In 1953 the average breeding male population was 101 per section (Neff and Meanley, 1957, p. 11). The 1963 census showed an estimated population of 78 breeding male redwings per section in the inner part of the Grand Prairie, including the 8,320 acres covered in 1953.

Relative abundance of species during the damage season

For 4 years (1950–53) during the late summer and early fall periods, the relative abundance of the three species of blackbirds that feed on ripening rice in Arkansas was determined. Biweekly roadside counts were made each year along the same 150-mile route through the Grand Prairie from mid-August through October. Cowbirds were much more commonly seen than were redwings or grackles (table 5).

TABLE 5.—*Relative abundance of blackbird species during damage season on Arkansas Grand Prairie ricelands, 1950 to 1953*

Species	Percentage during damage season			
	August 15–October 31	August 15–31	September 1–30	October 1–31
Cowbird	69.0	59.4	57.9	84.9
Redwing	23.3	28.6	32.6	11.3
Grackle	7.7	12.0	9.5	3.8

Winter populations in rice States

The largest winter concentration of blackbirds in North America is in the ricelands and associated areas of the Lower Mississippi

Valley and the Louisiana-Texas Gulf Coast. An estimated 200 million blackbirds and starlings winter in this region (Meanley and Webb, 1965); this number is based on population estimates for 63 major roosts during the 1960–65 period (fig. 16). The species composition of this vast aggregation is estimated in table 6.

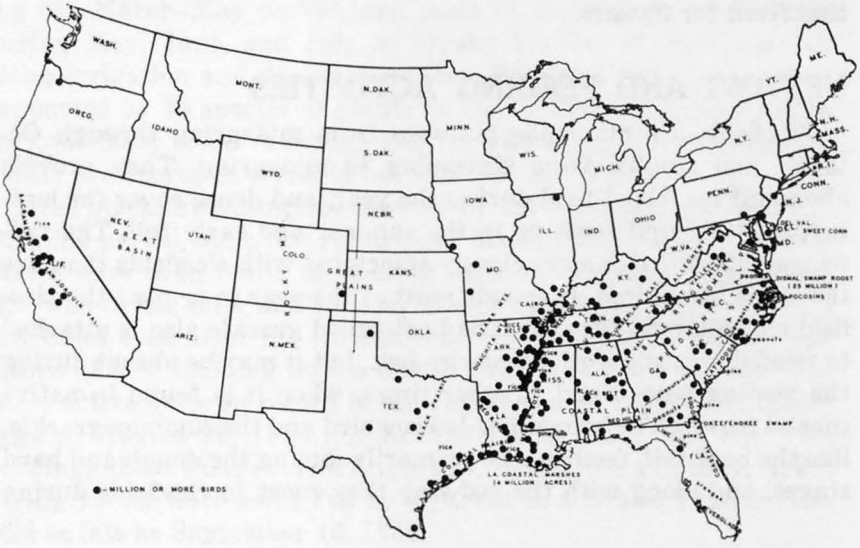


FIGURE 16.—Major winter blackbird-starling roosts, 1960–65.

TABLE 6.—*Relative abundance of species in major blackbird-starling winter roosts in rice States, 1960–65*

Species	Percentage in major winter roosts in —				
	Four States	Arkansas	Mississippi	Louisiana	Texas
Red-winged blackbird	43	50	39	48	33
Common grackle	22	22	29	20	17
Brown-headed cowbird	20	20	11	14	36
Starling	11	7	20	8	9
Boat-tailed grackle	3	0	0	9	4
Rusty blackbird	(1)	(1)	(1)	(1)	(1)
Brewer's blackbird	(1)	(1)	(1)	(1)	(1)

[1] Trace.

Survival and life expectancy

Blackbirds are relatively short lived. Many young birds die in the nest or during the first few weeks after they leave the nest. The average life span of blackbirds that survive the critical first half year after hatching is approximately 2 years, but some live for 10 years or more.

Research biologists have determined, from analysis of banding and recovery records, that the annual survival rate of adult redwings is about 52 percent (Fankhauser, 1967). They found two

records of redwings living to the age of 10 years, one to 11½ years, and one to 14½ years.

The annual adult survival rates for the other blackbirds have been calculated in similar studies to be near 52 percent for grackles and 45 percent for cowbirds. One record was found of a banded grackle that lived for 17 years, and several of banded cowbirds that lived for 9 years.

NESTING AND FEEDING ACTIVITIES

Ricefields are manmade marshes from midspring through October, and stubble from November to midspring. They provide abundant blackbird food during the year, and dense cover for loafing, molting, and roosting in the summer and early fall. The red-winged blackbird is more closely associated with ricefields than are the other blackbirds. It spends most of the year in or near the ricefield environment (fig. 17). The boat-tailed grackle also is attached to ricefields in the Gulf Coast rice belt, but it may be absent during the nesting season and at other times, when it is found in native coastal marsh. The brown-headed cowbird and the common grackle, like the boat-tail, feed on rice primarily during the dough and hard stages, and along with the redwing they roost in ricefields during

FIGURE 17.—Typical redwing feeding and loafing habitat in edge of ricefield near Scott, Miss. The mixture of plants (rice, panicgrass, and nodding smartweed shown in photograph) in this environment provides the variety of foods characteristic of the redwing's diet.

summer and fall. All of the blackbirds, including the Brewer's and rusty, feed in the rice stubble during the winter half of the year.

Red-winged blackbird

The local populations of redwings are found on breeding areas from early spring through October. Territories are established during the March–May period, and most of the nesting takes place during May, June, and July in brushy borders of ricefields and along irrigation and drainage ditches. Redwing nests were found supported by 70 species of plants on the Arkansas Grand Prairie. In Louisiana, some redwings nest in ricefields when supporting plants are scarce in ricefield borders and ditches.

Most blackbirds complete nesting by the beginning of the rice-ripening period, but a few red-winged blackbirds in each of the rice States have been found incubating eggs and feeding young when rice was in the milk and in later stages of development, and in a few cases even after the earliest field was harvested. The earliest record of nest building on the Grand Prairie is April 7, 1952. The latest active nests on record in the rice area are one that contained eggs on August 19, 1956 (Evangeline Parish, La.), and one with nestlings about 6 days old on August 23, 1961 (Chicot County, Ark.). Flying young were being fed by a parent in a Grand Prairie ricefield as late as September 16, 1968.

Nero (1956) and Meanley and Webb (1963) have shown that some red-winged blackbirds in more northern latitudes have two broods in a season. Many more redwings are believed to be double-brooded in the rice States, where the nesting season is longer than in the North (Beer and Tibbetts, 1950).

The height of a nest above the ground has much to do with nesting success. In one study on the Grand Prairie where all 100 nests were 2 feet or more above the ground, the average clutch size was 3.2 eggs, and an average of two young birds per nest survived; in 70 of these 100 nests, one or more young survived. By contrast, in another study where nests were less than 2 feet above the ground, one or more young survived in only 10 of 100 nests. Snakes, especially the blacksnake (*Coluber constrictor)* and the king snake (*Lampropeltis getulus*), are responsible for most of the predation in Arkansas redwing nests.

Rice seed is available to the red-winged blackbird as soon as sown, whether a field is sown dry (drilled or broadcast) and then flooded, or flooded and then seeded from an airplane. More seed is available in a dry-seeding operation, but some seeds that are sown from the air miss the water and lie exposed on the levees. When areas between levees become exposed because of evaporation or poor leveling of the land, blackbirds often go in and "mud out" the

seeds. Sometimes sprouting seeds are exposed when the field is drained to control weeds or root maggot (*Lissorhoptrus oryzophilus*). On May 7, 1951, a male was observed to pull out 23 sprouts of rice in 3 minutes, and in June 1952 a female was seen pulling out 26 sprouts in 5 minutes. During April and May on the Grand Prairie, however, red-winged blackbirds spend more time feeding on ("milking") ripening oats than on any other food, including newly seeded rice. They also feed on armyworms (*Spodoptera frugiperda*) in oatfields at that time.

Following the nesting season, the local breeding blackbirds and their offspring congregate in flooded ricefields, particularly those heavily infested with weeds. By the time the earliest fields reach the milk stage, in late July, some of the flocks contain many thousand redwings. From this time on, until the next nesting season, blackbirds usually feed in flocks composed mostly of one sex. They also separate, to some extent, into adult and young groups.

Redwings and other blackbirds usually confine their feeding activity to particular sections of ricefields, returning for several days to continue their depredations. During the milk stage, these spots stand out as a conspicuous white patchwork on a green background. This is the result of the red-winged blackbird milking the rice—pinching one kernel after another, forcing out the milky starch interior, some of which hardens into the white residue that characterizes the damage sections.

Evidence that some blackbirds return daily to feed in the same part of a ripening ricefield was obtained in mid-September 1968. About 500 redwings were seen feeding each day from September 6 to 16 in the same corner of an Arkansas ricefield in the dough stage. On the 12th, 20 of these birds were captured at the site, tagged with conspicuous colored leg-markers (fig. 8), and released. From four to seven of the marked blackbirds were noted at the same ricefield corner on each of the following 4 days.

Often the favorite rice-feeding area is a strip close to a brushy fence row or woods. Blackbirds apparently like to have a "jumping off" place as well as a place for retreat when alarmed during the feeding period. The wooded border is also a favorite resting spot during the early afternoon, when there is a lull in feeding activity.

Blackbirds are partial to certain ripening fields even though other ricefields in the same stage of development may be near the one where they are feeding. Many of these nearby fields may go untouched throughout the ripening period. Along a 150-mile route on the Arkansas Grand Prairie, on September 10, 1952, Neff and Meanley observed blackbirds (mostly redwings) feeding in only 8 of 56 ripening ricefields.

While rice is a prime food, the red-winged blackbird has a varied

seed diet; it feeds considerably on seeds of barnyardgrass (*Echinochloa* spp.), and other grasses and sedges found in ricefields. For example, I recall one occasion when several thousand redwings were concentrated on ricefield levees where the growth of barnyardgrass was especially dense. Although the adjacent rice was in the milk and dough stages—optimum conditions for feeding—blackbirds continued to concentrate on the levees and to feed on the barnyardgrass for the next 3 days.

During the ripening period, redwings are often found in young ricefields in which the grainheads have not formed. They also frequent soybean fields, pastures, oat stubblefields, and even woodlands near ricefields (where they obtain insects in much the same manner as vireos or warblers).

By the end of October, when most of the rice has been harvested, the few remaining unharvested fields are usually subject to devastating bird damage. I have seen a million blackbirds feeding and roosting in the last unharvested field on the Grand Prairie.

From the end of harvest until the advent of spring seeding, red-winged blackbirds spend most of their time gleaning the rice stubble. Much waste grain is left from the combine operation. Also, undesirable "red rice" remains to contaminate some fields the following year. When redwings and other blackbirds are gleaning the stubble, they perform one of their greatest services to the farmer by cleaning up the red rice and other noxious seeds (fig. 18).

Common grackle

Like the red-winged blackbird, the common grackle (or bronzed grackle) is found near ricefields during much of the year. However, it frequents woodlands more than the redwing does; much of its time is spent in oak woods, where it feeds substantially on acorn mast in fall and winter. Thus, most of its depredations on rice are in fields close to the woods. In several areas, grackles were observed to inflict considerable damage to rice in fields bordering woods: in Arkansas along the White and Arkansas River woodland bottoms, and in Chicot County, Ark., and East Carroll Parish, La., along the Mississippi River and Bayou Macon.

Shortly after the first frost, usually in November, immense flocks of grackles from the North Central States and Prairie Provinces appear in the Arkansas and Mississippi rice country. Many of these, with some of the summer resident birds, then drift southward into Louisiana and adjacent Gulf Coast States. By January, the wintering population is relatively stabilized.

In late March, native grackles disperse from communal winter roosts to the prairies and delta lands to nest. For some days after the first local birds begin to move to their nesting grounds, north-

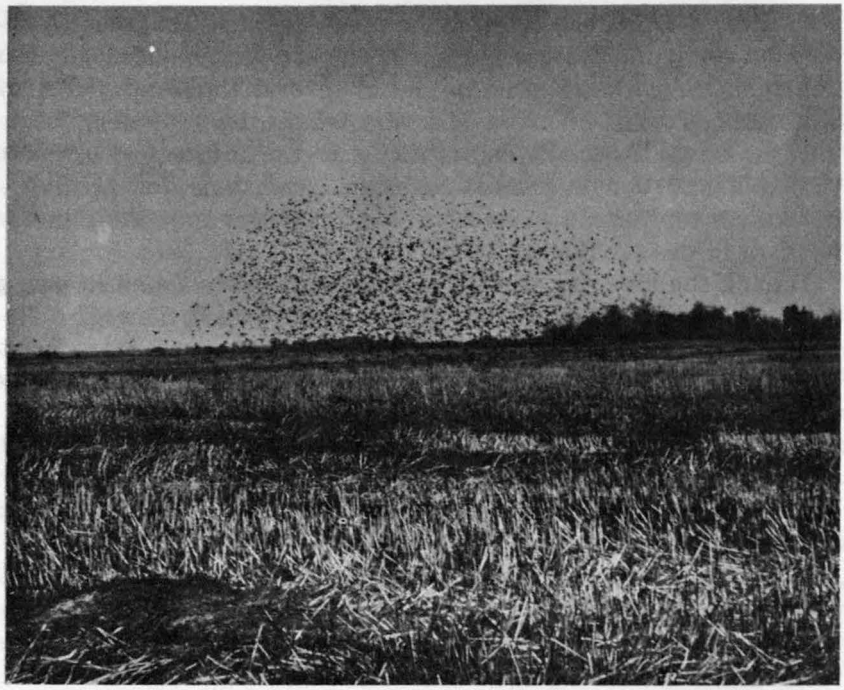


FIGURE 18.—Blackbirds gleaning rice stubble near Eudora, Chicot County, Ark., October 1963. Tons of waste rice, red rice, barnyardgrass and other weed seeds are removed by the millions of blackbirds that roam the countryside.

ern grackles are still in the area, but virtually all have departed northward by early April.

Grackles in the ricelands usually nest in colonies in shade trees of the towns, in cedar trees about old farmsteads, and in woodlots or oak groves out on the prairie. Nesting begins in late March, reaches its peak in May, and is virtually over by June. The latest date for young still in the nest on the Grand Prairie is June 19.

Clutch size on the Grand Prairie averages about five eggs per nest. An average of 2.8 young per nest reached flight stage in one colony of 45 nests. In another colony, one or more young survived to flight stages in 38 of 42 nests.

During the summer, grackles, cowbirds, and redwings congregate in large flocks; these flocks are composed either of mixed blackbird species or of only one species. The birds become more retiring and less mobile as they begin molting, and are usually found in ricefields adjacent to woods and marshes, which is probably why most rice damage occurs near woodland and marshland.

Brown-headed cowbird

This blackbird is named "cowbird" from its habit of following

cattle about in pastures. It is found mainly in cow pastures and ricefields during the summer and fall in the rice country.

During the nesting season from April to early August, most riceland cowbirds leave the open country for the bayou and river bottom forests where they breed. Cowbirds are the only nest parasites in the United States; their eggs are laid in the nests of other, usually smaller, birds, which incubate the egg or eggs and rear the young. During May, cowbirds are often seen feeding in newly sown ricefields bordered by woods.

By late June, the first small flocks of cowbirds, mostly juveniles, appear in the open country. For example, flocks of 50 and 200 were seen on the Arkansas Grand Prairie on June 21, 1951, and a flock of 500 was observed there on July 8. By August, flocks of 10,000 or more cowbirds are sometimes observed. In the fall and winter they are characteristically associated with burned crop stubble and feedlots (fig. 19).

FIGURE 19.—Cowbirds are a problem not only of the rice grower but also of the livestock feedlot operator.

Boat-tailed grackle

The largest of our blackbirds, this species is often known as "jackdaw" or "chock" in the rice country, where it is associated primarily with coastal ricefields; but some boat-tails are found 75 to 100 miles inland. The boat-tail population of the Gulf Coast is

less of a problem than the redwing because it is less abundant, its distribution is more limited, and it seldom feeds on rice in the milk stage. In some areas, boat-tails are often seen catching and eating crayfish (*Cambarus* sp.).

In the gulf coast country, most boat-tailed grackles nest in the marshes. Nest building at Avery Island, Vermilion Parish, La., usually begins by the first week in April. Clutch size averages three eggs (McIlhenny, 1937), and nesting activities are usually completed in June. A late nesting record is one at Holmwood, La., on July 16, 1955, when young were still in the nest.

ROOSTS

Blackbirds form roosts in the ricelands during every month of the year. Roost size varies considerably from season to season. There may be only a very few nonbreeding birds during the nesting season, when most of the population is dispersed, and millions of birds during the winter season (fig. 16). Most large roosting populations are composed of several species, including red-winged blackbirds, common grackles, brown-headed cowbirds, and starlings; boat-tailed grackles also are found in coastal area roosts. Rusty blackbirds (and sometimes robins, *Turdus migratorius*) join the roosting aggregations during the winter months, while Brewer's blackbirds usually roost by themselves in open-country stubble fields.

The percentage of blackbird species in roosting populations varies considerably. For example, common grackles often form 60 to 80 percent of the population in large winter roosts in the bottomland forest along the White River in Arkansas; at the same time, nearby Grand Prairie roosts often contain similar proportions of red-winged blackbirds. This difference in roosting composition is probably related to the food habits of these two species: the Arkansas redwing is essentially a bird of the prairie and feeds mostly on waste rice and weed seeds in winter, while the grackle feeds to a large extent on acorn mast found in the bottomland woods.

Winter roosts usually contain more birds than roosts at other seasons, and also are occupied for a longer period of time. Many roosts reach their greatest size in midwinter, while others reach peak size in late winter. Most roosts on the Arkansas Grand Prairie reach peak numbers during late February or early March. The location of large roosts is influenced by food supply. For example, 15 roosts, each containing an estimated million or more birds, were located in Arkansas in the winter of 1962–63. All of these roosts were in or within 25 miles of the rice belt. The distribution of major

roosts in Arkansas is similar every winter. Some 63 major winter roosts (fig. 16), each containing a million or more birds, were found in the southern rice region during the period 1960 to 1965 (Meanley and Webb, 1965).

Winter roosts are located in dense cover of diverse habitats. Principal sites are deciduous thickets in agricultural areas (figs. 20 and 21), canebrakes in riverbottoms (fig. 22), willow thickets at reservoirs or river sandbars, shrub swamps, and marshes. Most coastal-marsh roosts are located in phragmites cane, cattail, sawgrass, and bulrush. Most of the winter roost sites continue in use until the birds disperse to nesting grounds in the spring.

During the summer, virtually all roosts in Arkansas and Mississippi are in ricefields, while those in Louisiana and Texas are in either ricefields or coastal marshes. When ricefields are drained about 2 weeks before harvest, birds that have been roosting in them usually move to other ricefields that are still flooded. In late fall, blackbirds roost in typical winter roost cover. Many fall roosts are in use for only a few weeks during the migration season, and are abandoned as birds move southward; however, some fall roosts continue through winter.

Blackbirds move out of roosts each morning shortly after dawn and return in the evening, usually near sunset. Regardless of the location of the roost, most blackbirds apparently prefer to "get out

FIGURE 20.—Blackbirds at a typical thicket roost on the Grand Prairie near Slovac, Ark., in February 1951.

FIGURE 21.—Deciduous thicket roost near Slovac, Prairie County, Ark., in February 1951. Branches of the low haw tree were broken by the weight of roosting blackbirds.

and get going" before settling down to feed. They disperse over a wide area and often do not start feeding until they are a mile or more from the roost. Some birds travel many miles in the course of a day's feeding, even when the same kind and abundance of food is available within a mile of the roost; however, when birds roost in a ripening ricefield, considerable feeding may take place at the roost. In winter many blackbirds forage as far as 25 to 30 miles from their roosts, and roosts can be located by following flightlines that converge at the roost sites near sunset. Record redwing roostward-flight distances of 46 and 52 miles were noted in January 1965 (Meanley, 1965). These observations were in Texas, between rice-stubble feeding grounds and coastal-marsh roosts.

A great many predatory birds and mammals are associated with the large and well-established winter roosts. At a typical roost near Hazen, Prairie County, Ark., 79 predatory birds were observed on January 20, 1953, including 74 hawks of three species and 5 owls of three species. Mammals that commonly are found at major blackbird roosts include raccoons, foxes, possums, and often cats and dogs. These birds and mammals not only capture and eat healthy and sickly blackbirds but also consume many of the dead birds that accumulate at roosts with large roosting populations.

Much of the foregoing roost information, and more detailed

treatment of roosting behavior, is included in a 12-page article in *The Wilson Bulletin* (Meanley, 1965).

FIGURE 22.—Canebrake roost type in West Baton Rouge Parish, La., February 1963.

FOODS

Rice is the major food of blackbirds in the rice country. Farmers know that blackbirds spend much time in ricefields at seeding time, during the ripening period, and throughout the winter and early spring. However, more exact answers to questions on blackbird food habits are needed: What proportion of the blackbird diet is rice during the critical ripening period? What proportions during the year were weeds? Red rice? Insect pests of rice? Other grains grown in the rice area? These questions were answered in part by collecting a series of blackbird and examining their stomach contents.

The contents of 3,505 stomachs from eight species of birds were analyzed in the laboratory: 2,208 from the Arkansas Grand Prairie and 1,297 from Vermilion Parish, La. The Louisiana series was obtained in 1925 and 1926 (Kalmbach, 1937), and the Arkansas series was collected during the period 1949 through 1954 (Neff and Meanley, 1957). The Arkansas specimens of the major blackbird species were, with few exceptions, well distributed throughout the year, and virtually all of the habitats in which blackbirds regularly occur in the Arkansas rice district were sampled. Most of the Louisiana series were from the ricefield environment only.

Daily rice consumption per bird

Farmers often ask about the mount of rice taken by a blackbird. In an attempt to determine this, rough rice in carefully measured quantities was offered as the sole food to caged wild-trapped blackbirds during a 1-week period. The average daily food intake per bird was determined to be near one-half ounce or 14 grams for three species: red-winged blackbird, 0.43 oz. (12.4g); brown-headed cowbird, 0.49 oz. (14.0 g.); and common grackle, 0.56 oz. (16.0 g.). Free-flying birds, being more active, may require more food than those in captivity; however, wild blackbirds may eat less rice and take more other food than do caged birds whose food is limited to rice.

Bird hulling of rice

Blackbirds normally hull rice seeds as they eat. The bird places the grain crosswise in its bill and then exerts pressure and revolves the grain at the same time; the hulls fall away during this process. Blackbirds thus usually swallow the rice seeds without hulls, but sometimes fragments of hulls also are ingested. Boat-tailed grackles often ingest whole grains, with hulls intact.

Red-winged blackbird

Redwings in the ricelands are primarily seedeaters (fig. 23). Vegetable food items composed 81 percent of their annual food in Arkansas and 78 percent in Louisiana.

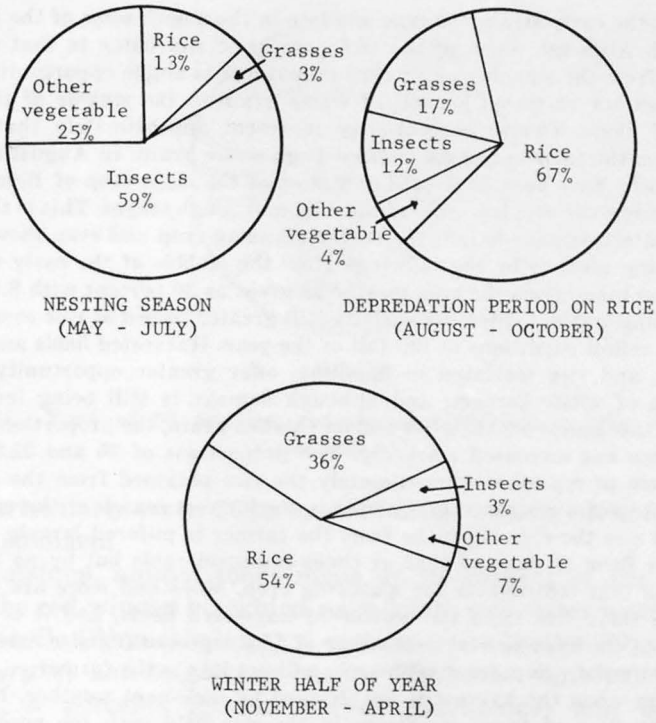


FIGURE 23.—Food of 986 red-winged blackbirds in the Arkansas rice area.

Rice formed 45 percent by volume of the red-winged blackbird's annual food in Arkansas, and was found in 626 of 986 stomachs. The monthly average of rice consumption ranged from a high of 81 percent in October to a mere 2 percent in July; during the August-October ripening period, rice formed 67 percent of the diet. In comparison, rice formed 54 percent of the annual food of Louisiana redwings, and occurred in 889 of 1,132 stomachs; it ranged from 91 percent in January to 6 percent in June, and constituted 59 percent of the diet during the 3-month ripening period.

Although the study by Kalmbach (1937) of redwing depredations on rice was made in the 1920's before rice culture had undergone numerous changes in the harvesting and drying of the crop, the pattern of blackbird foraging today is essentially the same as it was then. Early and late maturing varieties of rice were planted in Louisiana then, just as they are today, and blackbirds have always had a choice of gleaning grain from the stubble of early harvested fields or feeding on ripening heads of standing grain. Kalmbach (1937, p. 47–48) gave an enlightening interpretation of blackbird consumption of rice during the ripening period in the 1920's.

In July the early strains mature and late in the month some of the fields are harvested. Although much of the 18.6 percent of rice eaten in that month is obtained from the ripening or shocked crop, there is ample opportunity for the birds to gather scattered kernels of waste grain in the stubble of the newly harvested fields. Twelve percent may represent approximately that portion taken from the farmer and 6.6 secured from waste grain. In August all of the early strains have been harvested and most of the main crop of Blue Rose [a late-maturing variety] has entered the milk and dough stages. This is the period when greatest damage is inflicted on the standing crop and even though much rice is being gleaned by the redwings from the stubble of the early varieties, the portion taken from the crop may be as great as 30 percent with 8.4 percent representing waste. September with its still greater record of rice consumption begins to reflect conditions of the fall of the year. Harvested fields and threshing piles, and rice scattered in handling, offer greater opportunity for the gathering of waste kernels; and although damage is still being inflicted on stands of late maturing varieties and on shocked grain, the proportion of waste grain eaten has increased markedly. The proportions of 30 and 32.6 percent would seem to represent approximately the rice obtained from the crop and from waste grain respectively. October is the harvest season of the main crop, and what rice the redwing takes from the farmer is pilfered largely from the shocks—a form of damage that at times is considerable but by no means as serious as that inflicted on the maturing crop. More and more are the birds obtaining their rice from the stubble of harvested fields, and it is doubtful whether, of the hypothetical percentage of 75.5 representing rice eaten in that month, more than 25 percent represents a direct loss to the farmer.

In years when the harvest is not delayed by inclement weather, November marks the close of farm operations in the rice field with the possibility of damage by blackbirds greatly decreased. Probably not over 15 of the 88.4 percent of rice eaten in that month can be charged against the redwings.

Weed seeds, including red rice, were the second most important food of redwings in Arkansas and Louisiana. These included mainly barnyardgrass or wild millets (*Echinochloa colonum, E. crusgalli, E. walteri)*, several paspalums (*Paspalum boscianum, P. floridanum, P. dissectum*), and, in Louisiana, Mexican weed (*Caperonia palustris*). The proportion of weed seeds in the annual diet of both Arkansas and Louisiana redwings was near 24 percent.

Animal food items consumed were largely of destructive species. In Arkansas, the assortment included armyworms and cutworms (Lepidoptera), 8 percent; grasshoppers (Orthoptera), 5 percent; beetles and weevils (Coleoptera), 4 percent; and other insects, spiders (Arachnida), and miscellaneous animal matter, 2 percent. Thus, animal matter constituted 19 percent of the annual food. The diet of young redwings in the nest, however, was overwhelmingly (96 percent) animal items, and nearly 90 percent insects (fig. 24).

The destructive rice water weevil (*Lissorhoptrus oryzophilus*), usually known in its larval stage as the root maggot, was found in 202 stomachs of Arkansas birds, but was less than 1 percent of the total animal food. Since this insect is so tiny, the small volume masks the significance of the consumption of this pest by the red-

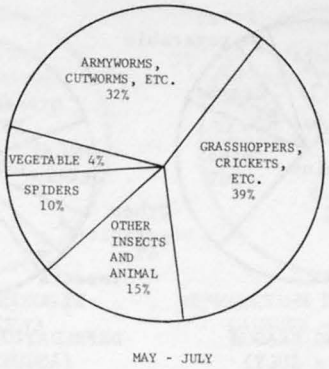


FIGURE 24.—Food of 93 nestling red-winged blackbirds in the Arkansas rice area.

wing, particularly when 20 or more of these weevils often occur in a single stomach.

In Louisiana, animal foods made up 22 percent of the annual food of the red-winged blackbird, as follows: rice water weevils and other weevils (Rhynchophora), 6 percent; rice beetles (*Dyscinetus trachypyrgus*) and sugarcane borers (*Eutheola rugiceps*) (Scarabaeidae), 3 percent; ground beetles (Carabidae) and darkling beetles (Tenebrionidae), 3 percent; caterpillars (Lepidoptera), 3 percent; grasshoppers, crickets, and katydids (Orthoptera), 2 percent; other insects, especially stinkbugs (Hemiptera), 3 percent; spiders and other noninsect forms, 2 percent. Animal items made up 98 percent of the diet of 22 Louisiana nestlings; this was 75 percent insects, 18 percent spiders, and 7 percent snails (Kalmbach, 1937, p. 53–55).

Kalmbach (1937, p. 69) concluded his economic appraisal of red-winged blackbirds in coastal Louisiana ricefields as follows:

> Study of the food habits of redwings revealed the fact that, although they are primarily rice feeders (nearly 54 percent . . .), much of this was waste grain. Approximately 44 percent of the redwings' food, comprising insects, red rice, and ricefield weeds, was to the birds' credit; 43 percent, consisting largely of waste grain, was considered neutral in its effect; and 13 percent, rice taken from the growing crop, was charged against the bird.

Brown-headed cowbird

A total of 560 stomachs were examined from cowbirds collected on the Arkansas Grand Prairie and adjacent wooded areas. These birds were overwhelmingly seedeaters; seeds constituted 95 percent of their yearly food.

Rice, the most important food item, made up 46 percent of the annual diet and 68 percent during the August-October depredation period (fig. 25). Weed seeds, mainly wild grasses found in ricefields,

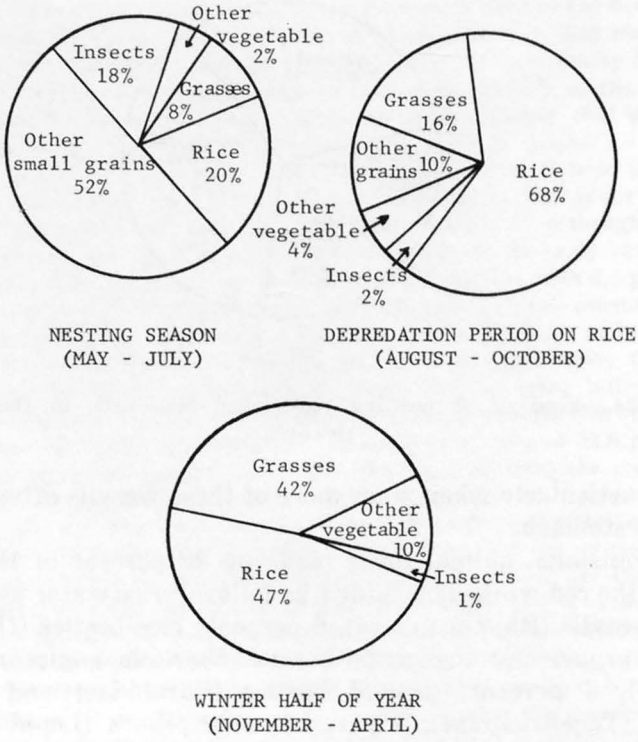


FIGURE 25.—Food of 560 brown-headed cowbirds in the Arkansas rice area.

were next in importance and constituted 33 percent of the yearly diet; most of these seeds were paspalums and barnyardgrass, which were also second only to rice as favorite foods of redwings. Oats, gleaned from the stubble, and grain sorghums formed 15 percent of the annual food. Miscellaneous vegetable items, mainly seeds and fruits of woody plants, made up the remaining plant food.

Animal food was only 5 percent of the yearly total. The two most important items were rice insect pests—the rice stinkbug (*Oebalus pugnax*) was found in 37 stomachs, and the rice water weevil in 148 stomachs. Many miscellaneous items, in very small quantities, made up the remainder of the animal food; these included other beetles and bugs, caterpillars, grasshoppers, and spiders.

Common grackle

An examination of 491 grackle stomachs indicated that on the Grand Prairie this species, like the redwing and the cowbird, is primarily a vegetarian (fig. 26). Vegetable food items formed 76 percent of the annual grackle diet, compared with 81 percent for the redwing and 95 percent for the cowbird.

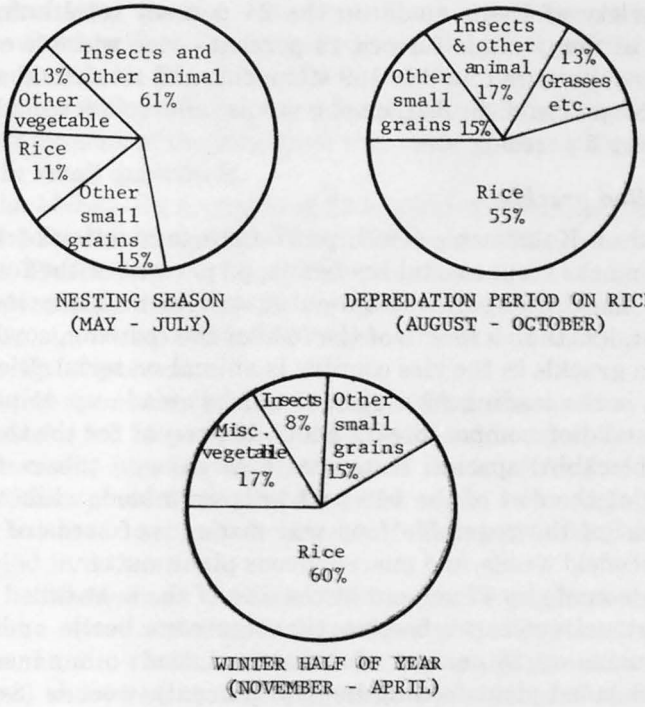


FIGURE 26.—Food of 491 common grackles in the Arkansas rice area.

Rice, the leading item in the stomach contents, formed 45.5 percent of the annual grackle food; this amount is similar to the 45.4 percent found for the redwing and the 45.9 percent for the cowbird. Rice was found in 379 of 491 grackle stomachs. During the depredation period (August-October), rice formed 55 percent of the food; this is less than the 67 to 68 percent found for both the red-winged blackbird and the brown-headed cowbird.

Corn and oats made up 15 percent of the annual diet; corn (8 percent) was taken by 115 birds and oats (7 percent) by only 29 birds. Seeds of native ricefield grasses made up only 0.5 percent of the food of grackles on the Grand Prairie, compared with nearly 25 percent for both redwings and cowbirds. The grackle, a larger blackbird, feeds more on other ricefield weed pests; seeds and tubers of sedges and rushes formed 5 percent of the annual food and occurred in 137 stomachs. Grackle consumption of fruits and seeds of the larger woody plants also was pronounced: fragments of acorns (*Quercus* spp.) made up 7 percent of the yearly food and were found in 110 stomachs; and berries of poison ivy (*Toxicodendron radicans*), 3 percent. Small amounts of other berries (hackberry, mulberry, grape) and unidentified seeds completed the list of vegetable foods that were taken by grackles.

A variety of items made up the 24 percent total animal food. Insects of many kinds formed 19 percent—rice water weevils and other weevils were found in 169 stomachs, and rice stinkbugs in 90. Small frogs, crayfish, fish, clams, snails, and spiders made up the remaining 5 percent.

Boat-tailed grackle

Based on Kalmbach's (1937, p. 57–62) examination of 143 jackdaw stomachs from coastal Louisiana, 52 percent of the food of this largest blackbird species is animal matter, principally insects. By contrast, less than a fourth of the food of the redwing, cowbird, and common grackle in the rice country is animal material. Rice, nevertheless, is the leading food of boat-tails; it made up 41 percent of the annual diet, compared with about 46 percent for the three other major blackbird species. Nutgrass (*Cyperus* sp.) tubers formed 5 percent of the diet of the 143 boat-tails examined, while the other 2 percent of the vegetable food was made up of seeds of red rice, other ricefield weeds, and miscellaneous plant matter.

Insects made up 47 percent of the diet of the boat-tailed grackle: two destructive scarab beetles, the sugarcane beetle and the rice beetle, made up 16 percent of the annual food; other insect foods taken included plant-feeding bugs (8 percent), weevils (8 percent), aquatic beetles (6 percent), other beetles (2 percent), grasshoppers (3 percent), caterpillars (2 percent), and miscellaneous insects (2 percent). Other animal matter constituted 5 percent of the annual diet—2 percent spiders and 3 percent snails and crayfish. Crayfish are pests to the rice grower when they bore holes in ricefield levees.

Minor species

In addition to the four blackbirds already discussed, food habits of three other members of the blackbird family and the starling were also examined. These other four species are of minor importance to rice farmers. The following conclusions on their foods are based on analyses of the contents of a small series of stomachs from each species.

Brewer's blackbird.—Vegetable food totaled 84 percent in 59 stomachs, all of which were collected in Arkansas during the winter half of the year. Rice constituted 36 percent of the total food and occurred in 47 stomachs; corn and grain sorghum together formed 22 percent and occurred in 31 stomachs; oats made up 15 percent and occurred in 14 stomachs. Since Brewer's blackbirds inhabit the rice areas only in late fall, winter, and early spring, obviously most of the grain they consume is waste from the stubble fields. Miscellaneous plant items totaled 11 percent of the food; these included mainly seeds of grasses and sedges found in ricefields.

Beetles, including the rice water weevil, made up 9 percent of the food, more than half of the 16 percent of the total animal food; they were found in 56 of the 59 stomachs. Grasshoppers and crickets formed 5 percent, but were found in only 18 stomachs. The remaining 2 percent of the total food was made up of a wide variety of insects in small quantities.

Rusty blackbird.—In a sample of 22 blackbird stomachs collected in the Grand Prairie area, vegetable foods formed 82 percent of the winter diet. The bulk of the plant food was waste grain: oats, found in seven stomachs, made up 26 percent of the total food; corn, found in six stomachs, totaled 18 percent; and rice, in nine stomachs, made up 13 percent.

Most of the remainder of the vegetable food was acorns, found in five stomachs for 19 percent of the total; hackberries, though in only one stomach, constituted 5 percent of the total food in the 22 stomachs. Other plant foods, chiefly grass seeds, were found in 11 stomachs, but made up only 1 percent of the rusty's food for the winter period in Arkansas.

Various beetles formed the bulk of the animal food, 11 percent of the total diet—aquatic beetles made up 4 percent, and were found in seven stomachs, and various other beetles, especially ground beetles, click beetles, and weevils, together made up 7 percent and were found in most of the stomachs. Snails and other mollusks were found in five stomachs, and totaled 5 percent of the food. The remainder of the animal food, 2 percent of the total food, consisted of ants, grasshoppers and crickets, true bugs, and undetermined insect fragments.

Bobolink.—A total of 30 bobolinks were collected—all in Grand Prairie ricefields during September and October. Rice was found in every stomach and formed 76 percent of the food. Other seeds made up 21 percent of the diet: paspalums, 14 percent; barnyardgrass, 3 percent; other grasses, 3.5 percent; and various other weeds, mainly ragweed (*Ambrosia* sp.) and smartweed (*Polygonum* sp.), 0.5 percent.

Insects were found in 13 stomachs and made up only 3 percent of the food. These were principally beetles (including weevils), plant bugs, and grasshoppers.

On the Arkansas Grand Prairie in spring, observations have been made of bobolinks feeding heavily on the grainheads of oats in the milk stage.

Starling.—Examinations were made of 60 starling stomachs, all taken on the Grand Prairie from October through March. These wintering birds were highly insectivorous, and animal food items made up 76 percent of the stomach contents while plant food items made up 24 percent; these proportions of plant and animal foods

taken by starlings are the reverse of those taken by all the blackbirds except the boat-tailed grackle.

Waste grain (rice, oats, and corn) was found in 20 stomachs and formed 15 percent of the total food. Fruits and seeds of poison ivy, deciduous holly (*Ilex decidua*), pokeberry (*Phytolacca americana*), grape (*Vitis* sp.), gum (*Nyssa sylvatica*), supplejack (*Berchemia scandens*), and acorns made up the rest of the plant food (9 percent of the total) and appeared in 11 stomachs.

Beetles formed 62 percent of the food: ground beetles made up 24 percent and were found in 54 of the 60 stomachs; weevils, including the rice water weevil, formed 21 percent of the food and occurred in 45 stomachs; scarab beetles in 33 stomachs made up 16 percent of the food; and click beetles (Elateridae), adults of the wireworm, were found in 29 stomachs but made up only 1 percent of the total food.

Grasshoppers and crickets from 17 stomachs made up 4 percent of the total food. Stinkbugs of several species were found in 15 stomachs, and armyworms and cutworms in 5; however, these items together formed only 1 percent of the food. The remainder, 9 percent of the total food, consisted of ants, spiders, horseflies, and frogs.

Crop Depredations

RECENT AGRICULTURAL CHANGES

The development of the combine method of harvesting (fig. 4) and the mechanical rice dryer in the 1940's did more to reduce crop losses by blackbirds than any other cultural practice or any device contrived for the purpose. Before those developments, the ripened crop was cut with a binder, shocked, and allowed to dry in the field (fig. 5) for several weeks before it was threshed. Inclement weather often forced the farmer to leave shocked grain in the fields until late autumn, when it was vulnerable to attack by migrant hordes of blackbirds and waterfowl.

Along with the gradual adoption of significant changes in rice harvesting and drying came a notable increase in rice acreage that apparently served to spread and dilute local blackbird populations. In the most intensively studied area, the Arkansas Grand Prairie, the research biologists closely associated with the problem agreed with the many area rice farmers who believed that a diminution in the blackbird population was apparent by the mid-1960's.

Much of the increase in rice acreage in eastern Arkansas and the area across the river in Mississippi resulted from planting rice in

newly cleared woodlands. Such new fields are often pockets surrounded by woods and brushy cover, and tend to be isolated from farm homes. In such locations, the crop is often damaged badly before the farmer learns of the attack, and severe loss is prevented only by harvesting the rice before it has matured to the optimum condition.

Heaviest damage usually occurs in the first fields to ripen, the last fields to be harvested (fig. 27), and fields adjacent to bayous and river bottoms with their accompanying woods. Such drainage systems in the ricelands attract blackbirds; they serve as flyways, watering areas, and loafing grounds. Similarly, much of the damage to Texas and Louisiana rice occurs in a narrow zone bordering the coastal marshes.

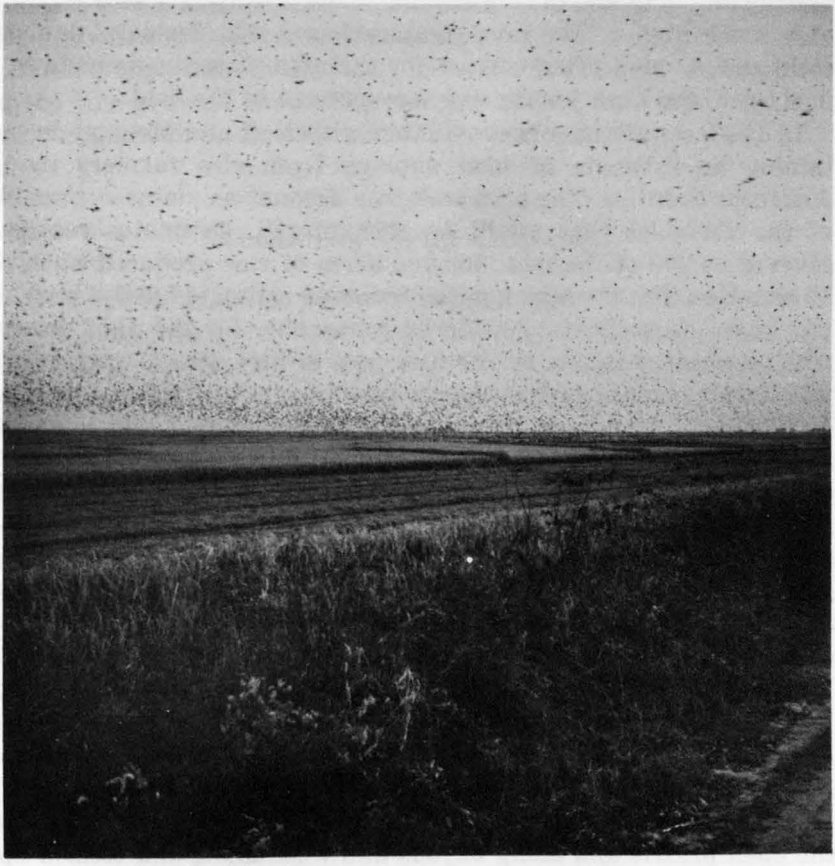


FIGURE 27.—Blackbirds at the last Arkansas Grand Prairie ricefield to be harvested in 1967—in late October. (Photo by Paul W. Lefebvre).

DAMAGE ESTIMATES

Although millions of dollars are believed to be lost annually from bird depredations on the rice crop, trustworthy statistics on the extent of bird damage are scarce. Loss figures ascribed to birds often are suspect and indefensible when subjected to rigorous analysis because so many variables are involved, and because of human fallibility. Reliable and standardized methods have not been developed.

Neff and Meanley (1957, p. 61–64) made a special study of rice damage by blackbirds in the Arkansas Grand Prairie during the period 1950 to 1954. In the considered opinion of the investigators, the annual average loss of rice to birds during the entire 5-year period did not exceed half a bushel per acre. Before combine harvesting and artificial drying became widespread, the loss was probably much higher. The investigators found that farmers' damage estimates, though often correct for the area of worst damage in a field, were too high for the average damage in the field.

In 1953, county agents cooperated with Neff and Meanley in obtaining an estimate of bird damage from rice farmers in 12 Arkansas counties. The plan took into account as many as possible of the variables that might be encountered. Estimates received covered 54,996 of the total 369,000 acres of rice produced in those 12 counties. The average loss to birds was estimated at 1.3 bushels per acre—an estimate considered reasonable for the 1953 season when numerous locally severe instances of bird attack were noted. This loss to birds of 1.3 bushels per acre is less than the wastage that occurs in combine harvesting; McNeal (1950) found that losses in combine harvesting in 1947 varied from 1.6 to 8.0 bushels per acre.

In 1963 the Arkansas Agricultural Extension Service conducted a blackbird damage survey covering a much larger area (22 counties and 426,000 acres) in rice production. Blackbird damage to rice that year, as judged by county agents and farm leaders, was estimated at $4,217,712, an average of $9.90 per acre for the 426,000 acres—about 4 percent of the potential crop in Arkansas (Stone and O'Halloran, 1966a, p. 16).

Blackbird use of ripening ricefields in the Arkansas Grand Prairie was studied by Kalmbach and Meanley during the period August 20–25, 1954. Feeding flocks were surveyed in 127 ricefields in various stages of development. The fields were located both on the open prairie and along bayous and woodlands, and totaled approximately 8,000 acres; field size averaged 63 acres. Flocks of birds were feeding in only 28 of the 127 fields; 10 flocks contained fewer than 100 birds, 14 contained between 100 and 1,000, and 4 flocks numbered over 1,000 birds. Several of these 28 flocks contained

birds of two or more species: redwings were recorded in 22 flocks, grackles in five, cowbirds in four, house sparrows (*Passer domesticus*) in two, and dickcissels (*Spiza americana*) in one. As calculated by the investigators, the bird damage to rice on the 8,000 acres surveyed would be a maximum of 1.2 percent of the 1954 crop.

Although most ripening ricefields are virtually untouched by blackbirds, a few fields are severely damaged. Thus a few rice farmers may suffer a major share of the total loss. The greatest importance of bird damage to the rice crop is therefore the severe and sometimes financially crippling losses suffered by some farmers rather than the average loss over the area.

Many other factors are more important than blackbirds in reducing crop yields. Strong winds, especially when accompanied by rain, cause lodging (beating down of the rice plants). Flattened rice is difficult to harvest, and sprouting occurs if the grain is mature enough when it lies exposed to water.

Weed competition in the ricefields is the most important problem to the rice grower. Insects (rice water weevil, rice stinkbug) and various plant diseases are other important problems.

Reducing Crop Damage

Although no practical method is known that will eliminate blackbird damage in a given area, many techniques are used effectively to alleviate the damage to ripening rice. Reducing bird damage is an integral part of rice culture, just as is insect or weed control. The farmer who plans his blackbird-control program and executes it systematically can effect an appreciable reduction in crop damage. He should realize that bird depredation is greater where ricefields are widely scattered than where they are closely spaced. Many farmers, in trying to control blackbirds, use relatively ineffective methods, use good methods improperly, or do not use a systematic approach. Some of the oldest techniques are still the best in many situations. Methods of avoiding or reducing rice damage fall into three major categories: (a) cultural practices, (b) frightening techniques, and (c) reduction in numbers of offending birds.

CULTURAL PRACTICES

Preventing spring damage

Early spring seeding invites bird damage. The farmer can usually determine whether migrant blackbirds have departed and the local breeding birds have scattered over the area to nest. Seeding after March 15 in Louisiana and Texas, and after April 15 in Arkansas

and Mississippi, will usually avoid attracting large flocks of birds. In Arkansas, long-grain varieties do not have to be sown before April 15 or short-grain varieties before May 1.

Timing the crop

Growers whose rice matures much earlier or later than the average usually suffer the most bird damage. In the Arkansas and Mississippi rice-producing areas, bird damage cannot be circumvented by adjusting planting and harvesting dates. The ripening period of rice coincides with the gathering of birds after their breeding season. Most of the blackbird nesting is over by mid-July. Immediately after nesting, family groups begin to merge, and flocks of 5,000 birds can be found in some ricefields in July. The flocks grow in size as the harvesting period approaches. Early and late planting increases the chance of severe bird damage. The earliest and latest fields to ripen in a given area stand out as attractive targets to marauding birds, which "gang-up" in them.

In the coastal ricelands of Louisiana and Texas, some farmers find it advantageous to plant an early variety with a short growing period of 100 to 115 days. Such very early varieties as Belle Patna are of special interest because of the possibility of making a second harvest from regrowth of the first cutting; this is known as a stubble or ratoon crop (Louisiana Rice Experiment Station, 1964). These early varieties can be planted in mid-March and harvested by late June or early July along the Texas and Louisiana coast, and the crop ripens during the least vulnerable time for bird damage, when the blackbirds are engaged in nesting activities.

Clean farming

Ricefields bordered by brush or woods are more attractive to blackbirds than are clean-farmed areas. The brushy field borders, rough roadside vegetation, and nearby woods should be removed, and this is increasingly the practice in areas where rice culture has been established longest. Brushy cover and woods are used by depredating blackbirds as places to retreat when harassed, as "siesta" areas during the heat of the day, and as "jumping-off" places to attack rice. Brushy areas near ricefields also harbor rice insects, and sometimes are prime nesting sites for blackbirds, especially redwings. Removal of such habitat reduces nesting success and productivity, since the birds returning to their traditional nesting grounds either abandon the nesting area or place the new nests closer to the ground in herbaceous plants where they are subject to a high incidence of predation. For example, in the northern section of the Louisiana ricelands (fig. 1), where clean farming is prevalent, there is very little bird damage compared with the southern section where

the ricefields are often bordered by groundselbush (*Baccharis* sp.) thicket and marsh.

Clean farming that eliminates cover along fence rows and field margins is objectionable because it diminishes wildlife. Nevertheless, it is an effective cultural practice that lessens blackbird depredations on rice. During the 1950's, Neff and Meanley campaigned vigorously for brush removal around Arkansas Grand Prairie ricefields. The clean-up operations that followed are believed to be partly responsible for the reduction in crop damage noted in that area in the 1960's.

Weed control

Weeds are usually the chief problem of the rice grower. Farmers should be aware that blackbirds are partial to weedy ricefields. Barnyardgrass and red rice, very important pest plants of ricefields, are frequent foods of the red-winged blackbird in most of the ricelands. Coffeebean (*Sesbania exaltata)* plants supply favored perches for blackbirds in some ricefields, although the seeds are not eaten. Increasing use of the herbicide propanil, and other cultural practices such as summer fallow, have done much to alleviate the weed problem.

Early field drainage

During the summer, most blackbird roosts in the rice country are in ricefields. Considerable damage may occur because of the presence of large numbers of roosting birds, especially in early and late maturing fields. Since red-winged blackbirds apparently prefer to roost over water, they can often be made to desert a roost field by removing the water; early draining of a field close to maturity is an effective practice.

Leaving winter stubble

Plowing rice stubble in the fall or winter not only helps to control weeds but also loosens the stubble for disintegration by winter rains and makes seedbed preparation easier in the spring. However, in rice areas where large numbers of blackbirds congregate each winter, some farmers intentionally leave the stubble unplowed until spring. The 200 million blackbirds and starlings wintering in or near the Southern ricelands consume an estimated 560,000 tons of weed seeds and waste grain during the 3-month period they are gleaning the stubblefields. This estimate on consumption is based on laboratory and field data indicating that each bird eats about 1 ounce of seed and grain per day during the winter. However, the effectiveness of this consumption in controlling weeds has not been evaluated.

SCARE METHODS

Bird-minding or the use of various methods of driving birds away from fields is the oldest form of crop protection known. In many instances it is the only effective, practical means of combating bird attack.

Effective frightening of birds from a field requires that action be initiated as soon as a few birds begin to feed in the field. A few blackbirds should not be allowed to remain in a field, since they decoy others and soon large flocks are using the field as a feeding ground. The longer they are allowed to remain, the more difficult they are to drive away. Persistence is important.

Several different bird-scaring techniques should be employed in a ricefield, particularly when bird pressure is high. Many farmers place automatic gas exploders in strategic locations in or around a field, keep them in operation throughout the day, and supplement this frightening method with rifle firing during periods of intense bird pressure. These measures require close watch over the fields when the rice is ripening.

.22 rifle

The .22 caliber rifle is still the best and most widely used device for frightening blackbirds from ricefields. Larger caliber rifles may be more effective because of their louder report, but are more expensive to operate and more hazardous. Shotguns, too, are costly to use, and are much less effective than rifles, but they may offer some protection against birds around small ricefields.

The rifle should be fired from a level slightly above the field so that the path of the bullet will be slightly downward through the area with birds. Firing from an elevated position not only lessens the hazard but also helps the rifleman to see where the birds are located.

Most farmers use the bed of a pick-up truck from which to shoot across fields. This arrangement has the advantage of mobility and therefore wide coverage, since most ricefields have roads on all sides. For better surveillance and control of the rifle shooting, a shooting stand (fig. 28) 15 or 20 feet in height is recommended.

Shellcracker

The shellcracker is a 12-gauge shotgun shell that discharges a firecracker projectile which explodes after traveling about 200 yards. The effective operator soon learns to aim and fire so the shellcracker explodes out over the ricefield where blackbirds are concentrating. Shellcrackers are more costly than conventional shotgun shells, but are an excellent tool for driving away depredating blackbirds, especially when used with other scaring techniques. Using an occasional regular shotgun shell to kill a blackbird

FIGURE 28.—The elevated shooting stand is very useful when the .22 rifle is used to drive blackbirds from a field. Eighteen such stands were noted in a few square miles near Pecan Island, Vermilion Parish, La., in 1951.

in the field may enhance the effectiveness of shellcrackers. Rice experiment stations and county agents usually have a list of manufacturers and suppliers of shellcrackers and other scare devices.

Automatic exploder

Gas exploders (fig. 29) are widely used to protect growing grain from birds. They produce loud explosions when acetylene gas ac-

cumulates in a combustion chamber and is ignited by a spark at automatically timed intervals. Recent models require little attention, automatically starting and stopping at preset times. Some exploders are stationary, concentrating the sound in the same direction after each explosion; others revolve slowly through 360 degrees, changing the direction of the sound slightly with each firing.

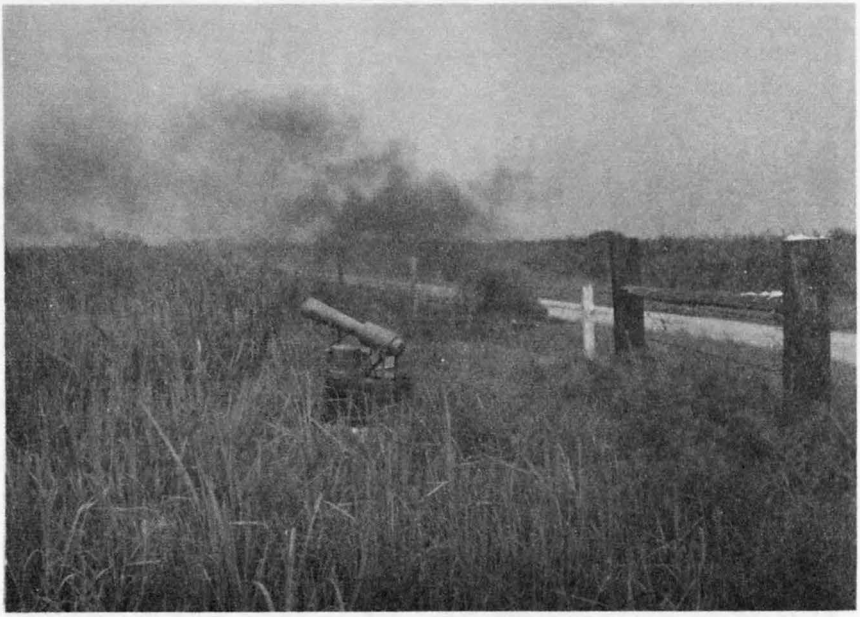


FIGURE 29.—The automatic exploder is one of the most widely used frightening devices around blackbird-infested grainfields. Black smoke, from burning tires in this photo, is not effective.

When properly used, exploders are effective in scaring blackbirds from ricefields; locations should be shifted often to cover different ricefield areas in response to where bird pressure builds up. Blackbirds become accustomed to a scare device that is operated day after day at the same site, and eventually ignore such explosions. Judicious use of rifle fire or shellcrackers as a supplementary measure contributes to success in frightening birds from rice.

Air patrol

A pilot experienced in herding blackbirds from ricefields and conscientious about the job can often effect some measure of control. Such a pilot may justify his hire, particularly in an open field without marginal brush or adjoining woods. Harassed blackbirds move to such resting cover as soon as they are disturbed, and re-

main there until the plane has left the vicinity. Men on the ground should drive the birds out of any such retreat cover so that the pilot can drive them away.

Even in clean-farmed rice areas occasional small groups of birds become so accustomed to the plane during continued aerial patrol that they refuse to rise from the rice, and serve to decoy other birds in if they are allowed to remain. Here again the farmer must assist from the ground in driving these small groups into the air.

CHEMICAL REPELLENTS

Exploratory studies on the utility of chemical compounds to repel blackbirds were conducted from 1951 through 1954 on the Arkansas Grand Prairie. Federal Pure Food and Drug regulations rigidly control the use of chemicals on a crop that is destined for human consumption or for poultry or stock feed. Consequently the number of chemicals available for application to the growing rice crop was limited in the early 1950's, and is now even more limited.

Dry rough rice samples, each treated with a different chemical formulation, were tested for repellency by offering the treated seed to caged blackbirds. Of the 56 compounds tested, those showing some promise were tried further in large field cages set up to enclose patches of maturing rice plants; 17 different formulations were sprayed on the rice, and blackbirds were placed inside the enclosures. Finally, aerial applications of seven formulations were tested in open fields of standing rice.

The Arkansas tests revealed several chemicals that showed distinct repellency in the preliminary cage tests, and a few that gave good results in the field enclosures of maturing rice. None of the aerial tests however, was effective. Even with a high rate of application, it was not possible to get enough chemical coverage of the grainheads to repel free-flying birds.

The search continues for a much-needed repellent substance that will protect rice from blackbird attack without otherwise affecting the crop or the environment.

REDUCING POPULATIONS

Under Federal law, rice farmers may legally kill blackbirds when the birds are committing or are about to commit depredations on their crops; however, any person killing blackbirds must furnish a game management agent (Federal warden) with whatever information regarding the operation the officer may require. Of course, the killing of such birds must also comply with State laws.

The most appropriate time of the year for reducing populations is during the rice-ripening period, when depredating blackbirds

gang into large flocks around ricefields. The farmer is then dealing directly with the birds that are damaging his rice. This period extends from about mid-July until early November. Earlier in the year, during spring and early summer, the local birds that later attack the rice are widely distributed over the ricelands and are occupied with breeding. Moreover, breeding redwings and grackles eat insects and other foods rather than rice (figs. 23 and 26), and feed their nestlings insects and other animal life almost exclusively (fig. 24). During the winter, few local blackbirds remain in the Arkansas and Mississippi rice belts, and the rice-depredating blackbird populations wintering in Louisiana and Texas are lost among the hordes of northern blackbirds.

Trapping

Farmers may remove blackbirds from ricefield areas by using traps. Success varies for many reasons, including type, size and placement of traps, number of birds present and season of year, baiting and other methods used to entice birds into traps, abundance and kind of food available to birds in the trap vicinity, and especially the know-how and persistence of the trapper.

Research biologists of the Bureau of Sport Fisheries and Wildlife recently have developed the decoy trap and the floodlight trap. These are effective and selective for catching blackbirds in large numbers.

Decoy trap.—The most practical way for the farmer to reduce blackbird numbers during the rice-ripening season is to operate large decoy traps. The decoy trap is a spacious poultry-wire enclosure with a bird entrance on the top. During operation it is kept stocked with several decoy birds, food, and water. This trap is far superior to small traps because it catches and holds more birds at a time and does not need to be tended so frequently. Also, it is highly selective, seldom taking species other than blackbirds or starlings; and the occasional nonblackbird usually can be released without harm. Cowbirds are easier to trap in the ricelands than are other blackbirds, but grackles and redwings can be taken in appreciable numbers when large populations occur in small areas.

In the late summer of 1963, 20 large (18 feet wide, 40 feet long, 5 feet high) decoy traps (fig. 30) were tested in the Arkansas rice belt (Caslick et al., 1963). About 40,000 blackbirds (mostly cowbirds) were trapped; the average catch was 39 birds per trap per day. During the same period, one rice farmer reported taking 10,000 birds in his decoy trap (fig. 31), while 6,000 cowbirds were caught in three other farmer-built traps in 3 weeks (fig. 32). A free 7-page leaflet on construction and operation of the traps used in Arkansas in 1963 is available (U.S. Bureau of Sport Fisheries and Wildlife, 1964).

FIGURE 30.—Stationary decoy trap adjoining a ricefield near Weiner, Poinsett County, Ark. Note door on left and elevated gathering cage on right. This is one of 20 traps, 18 by 40 feet and 5 feet high, tested by research biologists in Arkansas during the late summer of 1963. Top and walls are 1-inch-mesh poultry wire.

FIGURE 31.—Farmer-built decoy trap in Poinsett County, Ark., September 1963. Top and walls are 1-inch-mesh poultry wire. Approximately 300 cowbirds were in the trap when this photograph was taken.

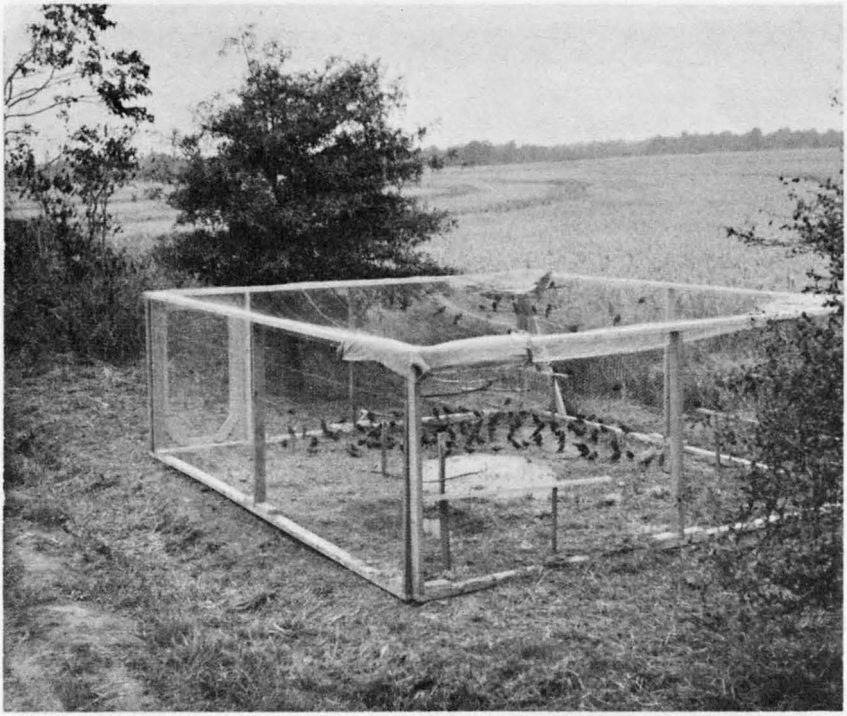


FIGURE 32.—Portable decoy trap, 16 by 18 feet, made of poultry-wire panels. Top is fish netting. This trap is between two ricefields in Poinsett County, Ark. (September 1963).

Trap location should be determined by observing where birds regularly occur in appreciable numbers. The trap site should be easily seen by blackbirds moving through the area, and the trap should be exposed so that movement of trap decoys can be detected by the blackbirds outside the trap. Traps should be located near trees or brush. Trees are often important bird stopover points, and an open area between a small grove of trees and a ricefield is often a good trap site. Blackbirds flying across open country often head for such an "island" of trees. A brushy field border used as a base of operations by birds attacking a ricefield is also a prime site for a decoy trap. Other good locations are near blackbird roosts and along blackbird roost flightlines.

The ideal decoy trap is portable and is made of prefabricated panels all of one size, about 10 or 12 feet by 6 feet. The trap should be high enough for the operator to move about in it without stooping. Some rice farms are so situated relative to bird movements and concentrations, however, that a permanently constructed decoy trap will endure for a number of years.

Traps 30 to 40 feet long and 10 to 20 feet wide are probably of optimum size. Traps of these dimensions will hold a few hundred birds without requiring daily servicing. Materials for 30- to 40-foot traps cost from $75 to $100, but some farmers build traps of this size out of scrap material for less than $50. Larger traps are more costly and more difficult to operate and move.

In making panels for a portable trap, 1-inch-mesh poultry wire is stapled on wooden frames of 2- by 2-inch stock. Frames of uniform size (10 or 12 feet by 6 feet) are lashed together to form traps of various sizes in multiples of the selected panel size (fig. 33). The

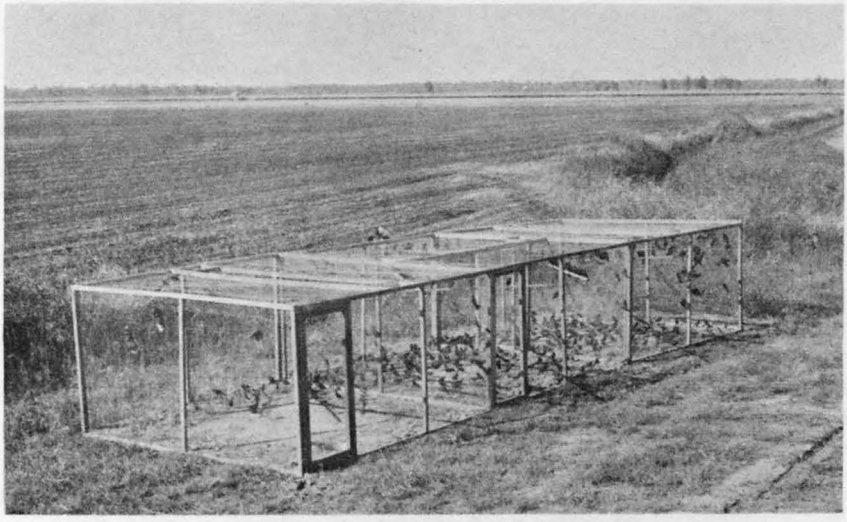
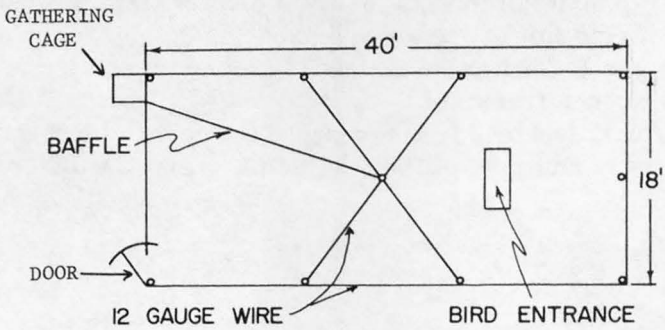


FIGURE 33.—Blackbird decoy trap used near Eudora, Chicot County, Ark., in October 1963. This multiple trap is made of a series of prefabricated 10- by 6-foot poultry-wire panels, and is 30 feet long, 10 feet wide, and 6 feet high. Decoy birds were kept in each trap section at all times during operation.

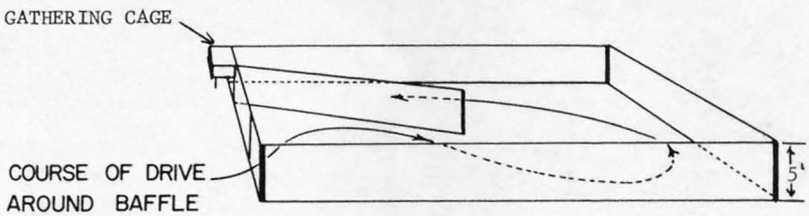
panels are interchangeable except for those built to contain a door or a hole for a gathering cage. Two or three panels can be hooked or tied together and used as a baffle to form one wall of an alleyway leading to a gathering cage; the side of the trap forms the other wall (fig. 34).

The top is made of 1-inch-mesh poultry wire or 1-inch-mesh fish netting. The top entrance through which birds enter the trap (the "dropthrough") is made of 2-inch poultry-wire netting (fig. 35) or of 2- by 4-inch-mesh welded wire. The top entrance can vary in size, but usually is about 2 by 4 feet. To lessen the possibility of escape, the top entrance should be suspended well below the level

of the top of the trap (figs. 35 and 36). Smooth 12-gauge linear wire should be stretched across the top for added trap stability (fig. 34), and the trap walls should be guyed as needed.



Top View



Pictorial View

FIGURE 34.—Details of the decoy trap.

The gathering cage should be elevated and fastened securely against a hole in the upper corner of the end of the decoy trap. The end of the cage against the trap must be readily closed by the operator inside the trap in order to hold the birds he has herded into it (figs. 37 and 38).

Proper placement of the various parts of a completed decoy trap are shown in figure 34. Gathering cage, hinged door, baffle, and bird entrance are included.

In operation, the decoy trap should contain ample food, water, and decoy blackbirds. After baiting, the trap will attract blackbirds that can be used as decoys. The trap will operate effectively if 15 or more decoys are used. The operator should leave some decoys in the trap when he removes the catch or he will have to start all over again to trap decoy birds, which may be a slow process. Decoy birds should be of the same species as the birds to be trapped.

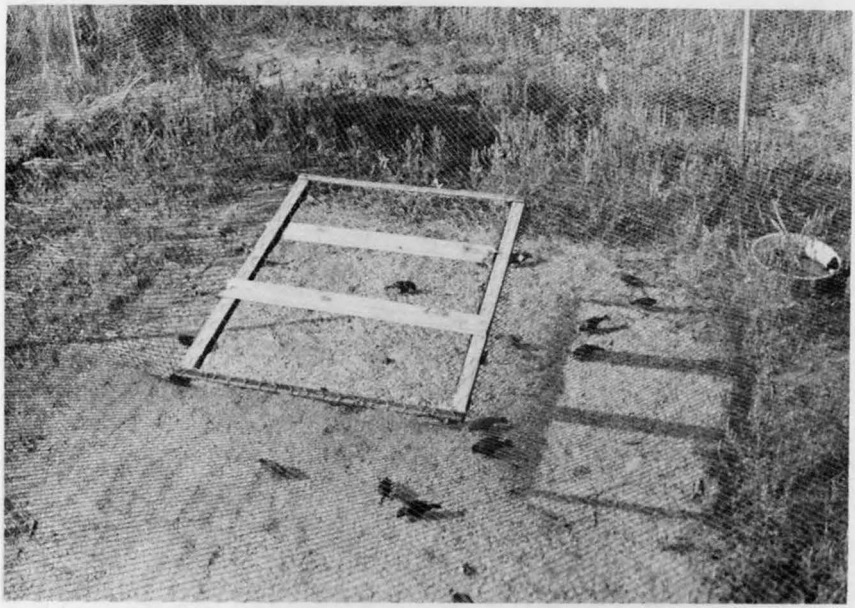


FIGURE 35.—Top view of bird entrance or "dropthrough" of a decoy trap.

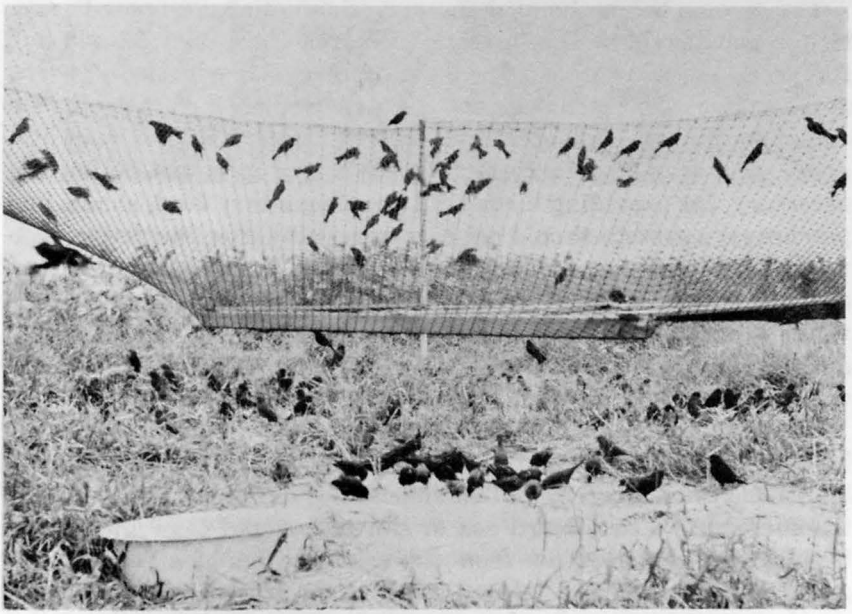


FIGURE 36.—Dropthrough entrance in top of a decoy trap. Grain bait is strewn on the ground beneath the entrance. When the entrance hangs within 3 feet of the ground, birds seldom escape. They usually fly to higher parts of the trap.

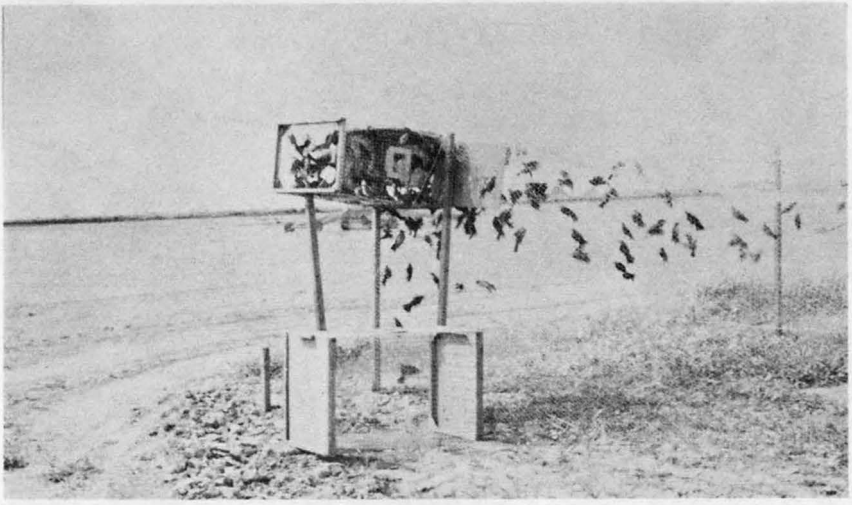


FIGURE 37.—Gathering cage in upper corner of a decoy trap. The operator herds the birds through the trap alleyway leading to the gathering cage, and then closes the cage from inside the trap.

The ground below the bird entrance should be kept free of vegetation, and should be kept strewn with fresh bait (figs. 32 and 36). Rough rice is a recommended bait for blackbirds in rice-growing areas, and cracked corn is a good inexpensive bait anywhere. Bread and apple chunks are especially attractive to grackles and starlings. A growing crop or crop residue within the trap is useful, but not necessary, for providing birds with supplementary food, shade, and perches; the growth should not become so rank that the decoys cannot be seen readily by birds outside the trap. Burlap sacking spread over the corners of the trap provides shade (figs. 30 and 32). Clean water should be available in the trap in a large shallow container; a simple wire-mesh ramp will allow the birds easier access to the water.

To collect the birds, the operator enters the trap and drives the birds around the baffle and into the gathering cage (figs. 34, 37, and 39). Birds to be killed should be disposed of humanely. They can be transferred to a cardboard box or canvas-covered cage and gassed by inserting an extension from the exhaust pipe of a gasoline engine. Where traps are located near water (canals, streams, reservoirs), the birds can be placed in burlap sacks and drowned. Dead birds being buried or otherwise discarded should be examined for bands, and bands found should be reported so that the important research effort put into the banding of blackbirds will not be lost.

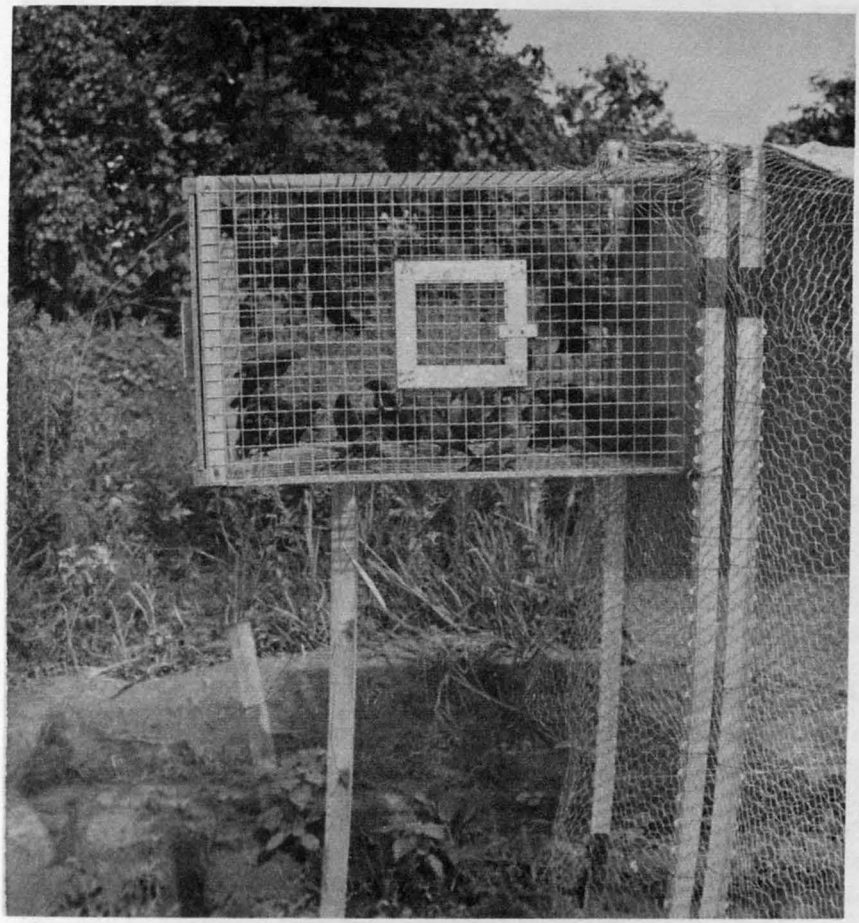


FIGURE 38.—Gathering cage in place and closed at a decoy trap.

Floodlight trap.—This trap (fig. 40) is useful for reducing rice-eating blackbird populations at some roosts in deciduous brushland or young conifer plantings. A successful operation requires concerted effort and hours of work by many men, and the equipment is costly and difficult to erect. Furthermore, it can be operated successfully only at certain accessible roosts; and even then success depends on considerable experience by the operators, and on favorable weather. It is unsuitable for use in ricefields and most marsh roosts.

Basically, the floodlight trap is a large funnel of netting that tapers back to a tent containing bright lights. The net funnel is supported by masts and props, usually 30 to 40 feet high and 100 or more feet across. The funnel mouth is placed as close as possible to

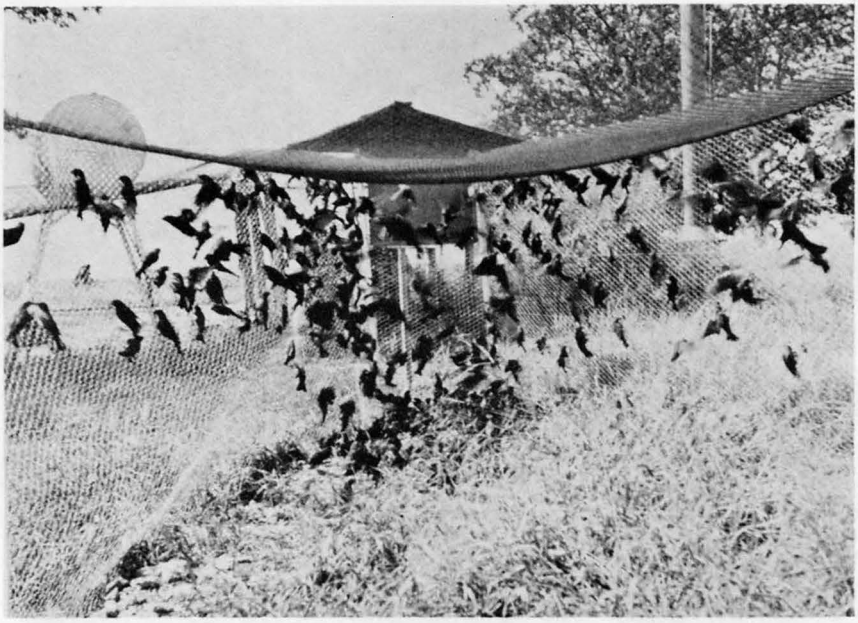


FIGURE 39.—Cowbirds being herded up the alleyway (between baffle and wall) toward the gathering cage in a decoy trap.

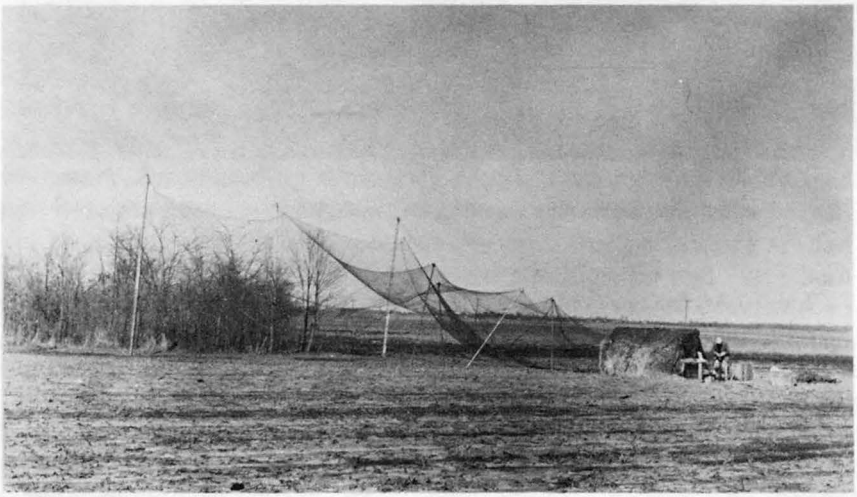


FIGURE 40.—Floodlight trap near Forrest City, Ark., February 1962. From 50,000 to 100,000 blackbirds are sometimes caught in a single night's operation at such a winter roost, but most of them are birds from the north and not rice eaters.

the edge of the roost; the throat of the funnel extends back 50 feet or more to the tent, to which it is connected. Three to five 1,000-watt floodlights are set within the tent and are directed toward the roost through the open front of the tent, which can be closed quickly by zippers; power for the lights is supplied by a generator about 100 feet behind the tent. The trap is operated after dark when the roosting birds have settled down for the night. When the floodlights are lit and several men have encircled the roost, the men flush the birds by making a disturbance, and herd them toward the light. At the end of the drive, the captured birds are held in the tent which has been zippered shut. The trapped birds are killed quickly with hydrogen sulphide, carbon monoxide, or another lethal gas injected into the tent.

The light trap is operated most successfully at roosts with low, dense vegetation and high bird densities, and where the front of the trap can be placed within a few feet of roosting birds. Dark, cloudy, calm, cold nights are most favorable. Floodlight trapping at summer roosts is generally unsuccessful.

The largest light-trap catch made in a single night was 120,000 starlings and blackbirds at a small woodlot roost near Walnut Ridge, Ark., in January 1961. In two February nights in 1964, 73,000 blackbirds and starlings were taken at a canebrake roost in southern Georgia; and on February 26, 1960, 40,000 starlings were trapped at a deciduous thicket roost in Illinois. Fewer birds were caught at many other roosts where conditions were less favorable for trapping or where the catch was deliberately limited because the objective was to take only a certain number of live birds for banding or experimental studies.

More detailed information on the floodlight trap, including its development and experimental operations on 101 nights during the 1957–62 period by biologists of the Patuxent Wildlife Research Center, is available from the Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior, Washington, D.C. 20240 (Mitchell, 1963). Specifications for equipment and directions for assembling and operating the light trap are obtainable from the same source (Mitchell, 1964).

Poisoned baits

Grain treated with strychnine or other poison compounds has long been used to control blackbirds during the time of spring seeding in the ricelands, but use of strychnine-treated baits is not recommended. Strychnine placed in newly sown ricefields and other open areas is not selective, and its indiscriminate use often results in killing doves and many valuable songbirds.

Finesse is needed to poison blackbirds with bait during the rice-

ripening period when so much milk- and dough-stage rice grain is available. Many farmers have poor results with treated baits because they lack an understanding of the requirements of this control technique. Among the most frequent errors are (1) the use of an ineffective poison, (2) the use of the wrong grain bait (polished instead of rough rice), (3) the use of an inadequate formula in preparing the bait, and (4) unwise selection of baiting sites. Rough rice should be used in baiting because blackbirds are used to feeding on it rather than on polished rice. Although blackbirds often hull the seed in feeding, treated rough-rice grains are effective because the poison comes in contact with the tongue and other parts of the mouth during hulling; also, bits of hull are often swallowed.

Farmers should realize that virtually every concentration of depredating birds presents an individual problem. Bird activity, the terrain, weather conditions, season of the year, numbers of innocent or protected species of birds using the same fields—each of these factors is important. In general, baiting is not economically justified in December and January in Arkansas and Mississippi, for nearly all the blackbirds then present are migratory birds from the North, and therefore are not guilty of rice damage during the summer-fall ripening season.

Cowbirds can be poisoned in large numbers during the ripening period of rice. These blackbirds feed not only in ricefields but also in pastures where they are vulnerable to baiting. For effective and safe poisoning in pastures, bait should be thinly scattered in a systematic grid pattern. Treated bait should never be concentrated in piles, because it then becomes hazardous to livestock.

By close observation of bird activity from spring through early fall, locations in addition to pastures can be found where the use of poisoned bait will reduce local blackbird populations. These include fallow fields being prepared for planting in early spring, newly seeded oatfields, bare summer fallow fields, dirt service roads near ricefields, open scantily vegetated spots in soybean fields, and freshly burned lespedeza, rice, or oat stubble. Bait should be placed in such areas only if blackbirds are noted constantly using them. Such sites bordering ricefield roosts usually are ideal for baiting operations. In the evening before going into the ricefields to roost, many blackbirds congregate in fallow fields to feed, and on dirt roads to dust or pick up waste grain or gravel.

Poison and poisoned grain are hazardous when carelessly used. When improperly handled, carelessly strewn about, stored without proper labeling, or used where clearly unwise, they become a menace to the community. Advice on bait poisons and how to use them are available from extension service offices.

Roost bombing

Systematically designed experimental dynamite-bombing of winter roosts was conducted during the winters of 1951–53 to determine its feasibility for blackbird control. Tests were conducted in late winter at a 20-million-bird roost near Slovac, Prairie County, Ark. (Neff and Meanley, 1952). The roost was in a 14-acre thicket composed mostly of haw (*Crataegus* sp.) and persimmon (*Diospyros virginiana)*—an ideal situation for this type of control. When 100 dynamite-shot bombs were hung in trees throughout the roost, painstakingly connected electrically, and simultaneously exploded at night, about 200,000 birds could be killed.

Although thousands of blackbirds were killed with this technique, it is not considered practical for several reasons: the labor, time, and hazard involved; the large number of crippled birds that result; and the unsuitability of most roost sites for bombing.

Roost spraying

Farmers' and rice growers' organizations sometimes try to control blackbirds by using an airplane to spray roosts with lethal chemicals. Spraying blackbird roosts with contact insecticides is very dangerous, because the chemicals must be used at high concentrations to be effective against birds. These concentrations are harmful to other wildlife and domestic stock; moreover, only a few drops of certain chemicals coming in contact with the human skin can kill. Also, if used on summer roosts in ricefields, such high concentrations may be toxic to rice plants. More research is needed before spraying of roosts can be recommended for use by farmers.

Recent research is aimed at developing a means of lethal control in late-summer ricefield roosts, where the roosting blackbirds are the birds that do most of the damage to rice. Various chemicals are being screened to find one that will kill blackbirds quickly, will decompose rapidly without leaving harmful residues, and will not injure rice.

U.S. Government Technical Assistance

The U.S. Department of the Interior is involved in finding measures that may afford rice farmers protection from blackbird depredations, and in demonstrating them to the farmer. These Federal research and service activities are functions of the Bureau of Sport Fisheries and Wildlife.

RESEARCH

Biologists of the Division of Wildlife Research are engaged in studies to learn new approaches for controlling bird damage to rice and other crops, and to develop more effective ways of using existing techniques. Life history, behavior, and physiology of blackbirds are under investigation in the laboratory and in the field to provide clues on when, where, and how to control pest birds. The goal is to find efficient ways that are acceptable to the public for managing problem birds; these methods must contain maximum safeguards for man, wildlife, and the environment.

Much research is directed at developing selective and safe bird-control chemicals. A new avicide for controlling blackbirds and starlings in feedlots is an example of recent progress. Large-scale and rigorous field testing of a bird-frightening chemical is showing promise, as is the technique of aerial application of wetting agents on roosting birds during the winter.

As new control materials become available, safe methods are developed for using them in areas where blackbirds are concentrated. New chemical materials and ways of applying them must be registered by the Federal Government before they become available for use by qualified damage control specialists.

SERVICES

When new, effective, and safe control methods are developed, they are made known to farmers. Information on available bird-control techniques, and assistance with local blackbird problems, may be obtained from State or district supervisors of the Division of Wildlife Services. County agricultural agents can supply these names and addresses.

Additional information on controlling bird damage to crops is given in the following publications that are available from the Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior, Washington, D.C. 20240:

Wildlife Leaflet 409, Bird Control Devices—Sources of Supply.
Wildlife Leaflet 365, The Rope Firecracker.
Wildlife Leaflet 476, Protecting Corn from Blackbirds.

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