

# THE AUK

## A QUARTERLY JOURNAL OF ORNITHOLOGY

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VOL. 67

APRIL, 1950

No. 2

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### LIFE HISTORY AND ECOLOGY OF THE SCISSOR-TAILED FLYCATCHER, *MUSCIVORA FORFICATA*

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BASIC facts concerning the life history of the Scissor-tailed Flycatcher are available in the literature, but little attention has been given in the past to the sociological and ecological aspects. This paper attempts to bring together and interpret known facts relating to the life history, ecology, and social behavior of the Scissor-tail.

Data were derived from field and library studies conducted between June, 1946, and August, 1947. No field work was done between November, 1946, and March, 1947, when the birds were wintering mainly south of the United States. During that time, questionnaires on the distribution and breeding range were mailed to persons who might be of assistance in the study.

Field work was conducted in Brazos County, Texas, with the exception of one trip to Refugio County, Texas, in June, 1946, and one to Angelina County, Texas, in May, 1947. Study areas, located on the campus of the Agricultural and Mechanical College of Texas, were worked intensively during the breeding season. Field observations of competent local naturalists were utilized in determining the earlier status of this species.

#### ACKNOWLEDGMENTS

I wish to express my appreciation to Dr. William B. Davis, Department of Wildlife Management, Texas A. and M. College, under whom this study was initiated and completed, for suggestions regarding field work and for guidance during the preparation of the report. Grateful acknowledgment is also due: Dr. Walter P. Taylor, former leader of the Texas Cooperative Wildlife Unit, for assistance in editing the report and for the use of certain equipment; H. B. Parks, curator of the Tracy Herbarium, for identifying plant materials; W. S. Heit, former instructor in the Department of Wildlife Management, for helpful criticism and photographic assistance; and Jack Wood, for assistance in the field. I am indebted to Dr. Herbert Friedmann, United States National Museum, for the loan of specimens.



SCISSOR-TAILED FLYCATCHER. PHOTOS BY ALLAN D. CRUICKSHANK FROM NATIONAL AUDUBON SOCIETY.

## DISTRIBUTION

This species has been recorded from 28 states in the United States and from at least six of the Central American countries. The breeding range is in south-central United States; the winter range is from southern Texas south to Panama. Migration routes are uncertain, but according to George B. Saunders, Biologist, United States Fish and Wildlife Service (*in litt.*), the general course of their migration in southern Mexico apparently follows the Pacific coastal plain. Those that traverse the Gulf Coast of eastern Mexico evidently cross the Isthmus of Tehuantepec. Accidental records are available from scattered points: *north* to New Brunswick, Maine, and Manitoba; *west* to California; *east* to South Carolina, Georgia, and the Florida Keys.

TABLE 1  
DATES OF SPRING ARRIVAL OF SCISSOR-TAILED FLYCATCHERS

Locality	Date	Authority
<b>TEXAS</b>		
Victoria County	March 10	Bent. U. S. Nat. Mus. Bull. 179: 1-555.
Cameron County	March 10	Bent. ( <i>op. cit.</i> )
Concho County	March 14	Lloyd. Auk, 4: 181-193.
Refugio County	March 12-14	Carroll. Auk, 17: 337-348.
Bexar County	March 19-21	Attwater. Auk, 9: 229-238.
Harris County	March 23	Bent. ( <i>op. cit.</i> )
Kerr County	March 20	Lacey. Auk, 28: 200-219.
Brazos County	March 21-22	Davis, W. B.—personal communication.
<b>OKLAHOMA</b>		
Caddo	April 11	Cooke. Auk, 31: 473-493.
Norman	April 3	Bent. ( <i>op. cit.</i> )
<b>KANSAS</b>		
Harper	April 5	Bent. ( <i>op. cit.</i> )

Definite breeding records are available from seven southwestern states—Texas, Oklahoma, Arkansas, Kansas, Missouri, New Mexico, and Nebraska. There is a doubtful record from Baca County, Colorado. North-central Texas is the approximate center of the breeding range and there Scissor-tails may be found in abundance from April to October. Dates of spring arrival and fall departure are indicated in Tables 1 and 2.

Post-breeding birds have been taken at widely scattered points in the United States. Following are some of the records of rare or accidental occurrence:

FLORIDA:—As many as 15 Scissor-tails seen together on Key West (Greene, 1944); March 2, 1885, male shot at Cape Sable (Goss, 1886); December 10, 1888, J. W. Atkins saw five near town of Key West, Monroe County and from November 11 to November 28, 1930, he saw one to four birds daily; one taken at Fulford, December 14, 1924 (Howell, 1932). GEORGIA:—Tomkins (1934) noted fine plumaged male

taken at Quarantine, June 5, 1933; another reported by Norris (*in Green, et al.*, 1945) at Tifton, January 2, 1943. SOUTH CAROLINA:—Sass (1929) observed a Scissor-tail on Edisto Island off the South Carolina coast, November 6, 1928. ALABAMA:—One reported in early spring of 1899 in Autauga County by Golsan and Holt (1914). LOUISIANA:—First record of a specimen for northern Louisiana was at Wisnor, Franklin Parish, April 10, 1933, by P. R. Thaxton (Lowery, 1934); Oberholser (1938) said it is reported to breed (no definite record available) and that it is a rare transient, from March 25 to April 10, and from October 4 to October 6, in southern Louisiana, and a casual summer visitor in southwestern part of state. VIRGINIA:—One specimen near Azlett, King William County, August 31, 1895 (Palmer, 1896); others reported by Ridgway (1907) at Norfolk. MARYLAND:—Palmer (1896) reported a bird near Bryans Point in 1895. NEW JERSEY:—Abbott (1872) reported a specimen shot on Crosswicks Meadows, five miles south of Trenton on April 15, 1871. CONNECTICUT:—Purdie (1877) reported a specimen shot by a Mr. Carpenter, at Wauregan, about April 27, 1876. MASSACHUSETTS:—Female collected at West Springfield, April 29, 1933, by Ludlow Griscom and now in Museum of Boston Society of Natural History (Bagg, 1934). VERMONT:—A Scissor-tail, which "now reposes in Dartmouth College," taken at St. Johnsbury about 1884 (Jencks, 1886). MAINE:—Kuschke (1937) reported a Scissor-tail seen on Matinicus Isle, June, 1936. NEW BRUNSWICK:—One collected May 21, 1906, by G. S. Lacey at Clarendon Station, near Scotch Lake, and given to the U. S. Fish and Wildlife Service (Cooke, 1906); another collected at Grand Manan, October 26, 1924 (Bent, 1942). OHIO:—Male taken near Marietta, May 20, 1894, by Frank H. Welder, skin now in his collection (Jones, 1903). WISCONSIN:—Adult collected at Milton, October 1, 1895 (Bent, 1942). MINNESOTA:—One taken at New London some time prior to 1912, and one seen in Jackson County on June 5, 1930 (Roberts, 1936). MANITOBA:—Seton (1885) reported a specimen shot at York Factory in summer of 1880 and that Scissor-tails were occasionally seen at posts of Hudson's Bay Company all the way west to valley of McKenzie River. COLORADO:—Two females taken in Baca County, near Campo, May 31 and June 1, 1923 (Bailey and Niedrach, 1937). ARIZONA:—One collected at Kayenta, July 8, 1934, and another seen at Sahuaro Lake, on Salt River, Maricopa County, July 12, 1935 (Bent, 1942). CALIFORNIA:—Swarth (1915) recorded one taken June 26, 1915, in northern part of Los Angeles County; one seen near Saugus, Los Angeles County, October 2, 1937 (Philp, 1938) and one seen at La Jolla, San Diego County, November 24, 1933; one noted daily, November 28 to December 5,

TABLE 2

LAST DATES OF FALL DEPARTURE OF SCISSOR-TAILED FLYCATCHERS

Locality	Date	Authority
KANSAS		
Harper	Oct. 24	Bent. U. S. Nat. Mus. Bull. 179: 1-555.
OKLAHOMA		
Norman	Oct. 23	Bent ( <i>op. cit.</i> )
TEXAS		
Abilene	Oct. 16	Bent ( <i>op. cit.</i> )
Pecos	Nov. 20	Bent ( <i>op. cit.</i> )
Concho County	Oct. 20	Lloyd. Auk, 4: 181-193.
Tom Green County	Oct. 20	Lloyd ( <i>op. cit.</i> )
Brazos County	Oct. 23	Davis, W. B.—personal communication
Atascosa County	Oct. 27	Bent ( <i>op. cit.</i> )

1934, two miles south of Cayucos, San Luis Obispo County (Grinnell and Miller, 1944).

The frequency with which reports have been received from southern Florida may make it necessary to include that area as part of the winter range. The Georgia record for January indicates that the birds may winter in that state also. Irby Davis (*in litt.*) said that an occasional Scissor-tail is seen near Harlingen, Texas, up to the end of December. Both southern Texas and southern Florida seldom experience weather cold enough in the winter to destroy completely the insects which constitute the main source of food for these birds. However, if Scissor-tails do successfully winter in Florida, further data should be obtained on their movements in the spring.

This distributional study brings to light a number of facts that are of significance to all students of ecological zoogeography. First, Scissor-tails are limited to a rather narrow faunal area. Second, this range will expand when climatic and man-made conditions bring about suitable changes in adjacent areas. Bent (1942) set the northern limit of the breeding range as southern Kansas. Today, there are breeding records from northeastern Kansas and southeastern Nebraska. Third, as in so many other species of birds, post-breeding wandering is a factor to be reckoned with and may easily be responsible for extension of the breeding range. Fourth, wintering areas are not definitely geographically delimited and may vary from year to year with food supply and climatic variation. Fifth, there is a dearth of complete information on the winter habitat and range of this species.

#### BEHAVIOR OF ADULTS

Individuality is strong in the Scissor-tail. No two pairs exhibited the same behavior patterns throughout the breeding season. The location and construction of the nest, care of the young before and after leaving the nest, and defense of the territory vary with different birds. The majority of females would not feed their young while the observer was within the territory but, in one case, one fed young while a car was beneath her nest and photographs were being taken within eight feet. Another case of unusual individual behavior was exemplified by the female that built her nest on the cross-arm of a telephone pole. A nest was placed in the same location for two years, suggesting perhaps that either the same bird or one of the brood reared in that nest may have returned by choice to this unusual location. One male accompanied his mate on most of her missions while she was building the nest, but the majority of them sat on some nearby perch and watched the female.

Some females chose noisy locations for their nests, others preferred the open field or pasture. Nest construction was generally uniform, but all Scissor-tails did not use the same materials. Plant materials were preferred by the majority, but one female used 71.5 feet of string in 49 different pieces and four strips of cloth totaling 35 inches in length, although the more commonly used materials were available.

Despite the marked individuality, there are certain inherent characteristics that manifest themselves in all birds of this species. One of the strongest is pugnacity. Nestlings of eight to ten days of age showed concern at being removed from the nest and made attempts to peck the hand of the observer. Each day thereafter some or all of the brood exhibited a fighting attitude. Adults show belligerency in various ways. Intraspecific strife in defense of territory is common in this species. Even before territories are established and courtship is just beginning, the species displays a strong and sometimes violent intraspecific antagonism. Mr. V. M. Miller, College Station, Texas, gave the following eye-witness account of two Scissor-tails that fought until both were dead. "The two birds were first noticed fighting in the air and as I drove up near them they fell to the ground, still locked in combat. I stopped my car and watched as they fought, first off, then on the ground. Finally after almost ten minutes, one bird got the other on its back, stood on its breast and alternately pecked and pulled at the throat. This action put an end to the one on the ground, but apparently the exertion was fatal to the winner, because he backed off a few feet and died." The birds were not sexed. Whether this was a territorial duel or the result of attempts to win the same female is not known, but it is an example of the extremes to which the pugnacity of the Scissor-tail can be carried. Belligerence is shown toward all birds of prey. Even other passerines are frequently driven from the nest tree, depending on the nearness to the nest and the tolerance of the individual Scissor-tail.

To test the reaction of a pair of nesting Scissor-tails a mounted Barred Owl, *Strix varia*, was placed in the nest-tree. In five minutes, the dummy was discovered and the resident birds, plus a third Scissor-tail, scolded and flew "nervously" about it. After 10 minutes, the owl was placed on the ground and in the open. More than 100 birds were attracted to the area, including Mockingbirds, English Sparrows, Bronzed Grackles, and three Scissor-tails. Attacks by the Scissor-tails were frequent, and their dives came closest to the owl.

Antagonism toward human beings is equally strong. Most nesting pairs left the nest-tree before I had approached within 50 yards and, instead of flying away without protest, flew toward and over me.

This behavior was accompanied by vocal protestations. If the nest-tree were climbed, both birds hovered close overhead and in some cases dived at my head. Stories of attacks on dogs and cats have been obtained from reliable sources.

The males perform in various ways. According to Mrs. Bailey (1917), one favorite performance is to fly up and, with rattling wings and penetrating bee-bird screams, execute an aerial seesaw, a line of sharp-angled 'VVVVVVV's, and at the angles rapidly opening and shutting the long white scissor-blades. This is the nuptial flight, performed during mating activities and occasionally thereafter.

Roosting is the daily expression of gregariousness; the migration flock may be the annual expression of the same instinct. In appearance, they are the same. At the roost, another behavior is displayed which will here be called "play." Just prior to dark, many of the birds indulge in aerial games of tag, chasing each other over and around the roost tree. This frequently ends in a brief fight with no harm to either participant. This is possibly an exhibition of pugnacity, but differs in intensity from that displayed during courtship and territorial defense.

Excitability is an easily recognized trait. Birds disturbed from the roost tree just before or during darkness show an irritability approaching "hysteria." They dash in all directions from the tree, much as a covey of quail bursts from the ground, to the accompaniment of rattling wings and screaming voices. Bent (1942) reported from Mrs. Bailey as follows: "At sundown when Mr. Bailey shot a rattlesnake at the foot of a big oak in camp the report was followed by a roar and rattle in the top of the tree and a great flock of scissor-tails arose and dispersed in the darkness."

Adult Scissor-tails exhibit a highly developed parental instinct. Not once was a brood allowed to starve, in spite of continued handling of the young and interference by man. One female reared a brood of three in spite of the death of the male. After the young birds leave the nest, the parents remain with them until they are able to fly long distances. The young are escorted to the roost at night and are followed by the parents during the day as they wander over the countryside. Family groups were observed in late August, and there is some evidence that these units remain intact through migration, as the migrating flock is not one large group, but is composed of smaller sub-groups. Harold L. Blakey (*in litt.*) on October 12, 1946, counted 39 Scissor-tails along the highway between Austwell and Victoria, Texas, a distance of 45 miles. These were in groups of 1, 3, 5, 6, 8, and 16 birds. Dickey and Van Rossem (1938) said that at Divisa-

dero, El Salvador, on October 23, 1925, a "good sized flight of several scores was noted flying southeastward by singles and couples at sunset. . . ." These observations suggest that this species is one that moves from summer to winter quarters and back in family groups, in contrast to the behavior of starlings, grackles, cowbirds, and other well known flocking species.

Further evidence of the strong parental instinct is given by the following observations. On August 21, 1946, three family groups were observed drinking and bathing in a tank located about a mile south of College Station, Texas. Both parents were with two of the three broods, only the female was with the third. All birds perched on a nearby wire and by ones and twos dived to water level, scooped the surface briefly and flew back, much like swallows. Young birds waited for the parent to lead the way and were slightly more awkward in recovery after touching the surface of the water.

Essentially a perching bird, the Scissor-tail may be first seen sitting quietly on tall prairie plants or limbs of dead trees. Frequently a telephone wire, a power line or more commonly the topmost strand of a barbed-wire fence is the chosen perch. From this vantage point, the bird darts at flying insects, sometimes straight up, sometimes 50 to 100 feet away, always displaying remarkable maneuverability. The long rectrices act as brakes and, with the assistance of rapidly beating wings, the birds may hover over one spot or make abrupt right-angle turns. When frightened from its perch, the Scissor-tail may fold its tail and, with rapid wing beats, fly swiftly to a new location. Occasionally it alights on the ground, making short forays for grasshoppers, but this behavior is awkward in tall grass because of the long tail which then is a hindrance.

#### TERRITORIALITY

One of the strongest behavior patterns exhibited by this species is the tendency to pick a certain restricted area for breeding purposes and to defend it against encroachment of other members of the same species. It is a mechanism that provides for a spacing of breeding pairs and obviously restricts the number of birds that can utilize a given area. Most of the competition is intraspecific, in support of which it can be stated that not once during the course of the study were two nests of this species found closer together than 76 yards. In at least six instances, however, nests of other species of birds were found in the same tree. Three of these belonged to Mockingbirds, *Mimus polyglottos*, also a strongly territorial species. Other species involved were: the Mourning Dove, *Zenaidura macroura*; Orchard



Oriole, *Icterus spurius*; and English Sparrow, *Passer domesticus*. The most unusual example to come to the author's attention was that of Scissor-tails and Red-tailed Hawks, *Buteo jamaicensis*, nesting in a large live-oak in the Divide Country west of Kerrville, Texas (Taylor, 1946). The hawks' nest was on the west side of the tree, the Scissor-tails' on the east. This is contrary to their usual behavior. Raptors usually are greeted with attacks as vigorous as the flycatchers can muster. Not only do the breeding birds of the immediate area conduct themselves in this manner, but they also are reinforced by all birds within hearing distance. On May 21, 1947, I watched seven Scissor-tails harrass a Red-tailed Hawk for 20 minutes as it circled high over the area. It seemed that all territorialism was temporarily forgotten to ward off a threat to the common welfare. After successful completion of their mission, the Scissor-tails fluttered down to treetop level and shortly were fighting among themselves to reestablish the sanctity of their individual territories.

On arrival in their breeding range at College Station in the latter part of March, the birds are in small flocks and spend the nights in a common roost tree. For four to six weeks the countryside into which they disperse during the day is common domain, but after mating is accomplished the males begin active defense of nesting sites chosen by the females. During nest construction and brooding, the male leads the most active defense as the female seldom leaves the nest, but after the young birds hatch the female frequently joins her mate in expelling any intruders that venture too closely.

Territory in bird life as first conceived, pertained entirely to intraspecific competition, but territorialism in the Scissor-tail includes the above discussed belligerency toward predators. Davis (1941) found that Kingbirds indulged in this interspecific behavior, and classified it as a type of fighting which was associated with the psychology of territoriality. He states that belligerency is a widespread characteristic of this group of flycatchers (Tyranninae). During the work with nestlings, I was repeatedly threatened by parent birds, which fluttered overhead and scolded continuously, or actually made determined dives to within a few feet of me. Often, the parents attracted other Scissor-tails to the area by their cries, and for a few minutes the parents would permit the intruding birds' presence, but very soon they would drive them away. If the pursuer happened to pass into the territory of the pursued, the rôles were reversed and the conflict continued until each bird had returned to its own territory. In study area III, two miles west of College Station, three breeding pairs occupied an area of 22 acres, and the nest locations formed a rough triangle.

Territories in this case included the ground within a radius of 35 yards from the base of the nest-tree. When one pair was disturbed, the two other males usually joined them and this resulted in heated aerial dog-fights until each bird had returned to his own home ground. This was the only place where the size of the territory could be measured with any degree of accuracy.

A population census was taken to determine the density of breeding birds. This was accomplished by examining each potential nest site on the basis of its utility to breeding birds on three study areas selected near College Station. Area I was a permanent pasture of 45 acres. It was 74 per cent covered with mixed pasture grasses, bisected by an intermittent stream which was bordered by mixed hardwoods, and contained 19 trees suitable for nesting, that is, isolated trees or clumps of trees, three of which were in use. Two of them, all postoaks, were 100 yards apart, while the third was 300 yards from the other two. There was occasional intraspecific territorial fighting, but this occurred for the most part when one pair, unduly excited by my presence, aroused the neighboring pair by its loud staccato calls. In this area, there were approximately 15 acres per breeding pair. Area II, likewise a permanent pasture, contained 62 acres, 80 per cent of which were covered with pasture grasses. It was bisected by the same stream as that in Area I. It contained scattered broadleafed trees or small groups of trees, 34 of which were judged to be suitable potential nesting sites. A survey of the breeding population showed four of them were occupied. No two nests were closer together than 100 yards. On this plot there were 15.5 acres per breeding pair. Area III contained 22 acres. During the two-year period of this study it was under cultivation during the growing season. Six suitable nesting sites were present, three of which were occupied in 1946, two in 1947. The two closest nests were 76 yards apart and, during the 1946 season, friction between two of the pairs was continuous. As mentioned above, the third pair occasionally joined in the fighting. In 1947, only two pairs occupied the same area. Almost no territorial fighting took place then as the nests were approximately 100 yards apart.

From these observations, it can be stated that the Scissor-tails' territory may comprise an area of 30 to 40 yards on all sides of the nest location, which is vigorously defended against other members of the same species. As a rule, other species are allowed to enter or to pass through the territory unmolested, except those recognized as predators. To one pair, the Blue Jay, *Cyanocitta cristata*, was a recognized predator. On July 2, 1947, while watching the activities of a pair of birds feeding three young, three successful attacks on a young Blue Jay

were made. Not only was he driven from the nest-tree, but also from adjacent trees. The limits of intolerance of the jay included an area at least 50 yards in radius from the nest-tree. Mourning Doves were allowed to perch on a telephone wire near by, but at least one dove was expelled from the nest-tree by both male and female Scissor-tails. A Lark Sparrow, *Chondestes grammacus*, that perched within three feet of the nest was attacked by the female. These data indicate that an area of complete intolerance to all species immediately surrounds the nest, with gradations of intolerance outside of that, their extent depending on the species involved.

#### NIDIFICATION

The first nesting was observed on June 6, 1946. The nest was 20 feet from the ground in a 25-foot post oak. At 9:00 a. m. the female entered the tree with nesting material. The framework of coarse stems of weeds and twigs, intertwined with pieces of cloth and paper, was just begun. Both male and female took part in the flights for materials, but only the female carried materials. The male escorted the female to the nest and sat on a fence near by until she had completed the arrangement of the new material. When she left the nest, he followed at least part of the way. Occasionally he accompanied her to the source of material, but more frequently he flew only a short distance and waited for her return. The female was flying more than 200 yards to obtain materials and returning to the same area each time. On one return trip a new male joined the pair, but he was immediately attacked by the first male.

The contours of the nest were shaped by the female, using not only her bill but also her feet in a scratching or pushing motion.

On June 8, the female was still adding material, although the nest was practically finished. This material was smaller in size and was added to the interior of the nest. On June 11, no nesting activity was observed, and there were no eggs in the completed nest. On the morning of June 12 there still were no eggs, but on the afternoon of the 13th there were two eggs.

On June 26, 1947, another nest-building operation was watched between 8:15 and 9:15 a. m. The framework was well started, indicating that the first work had been done at least the day before. The female was doing all the work. She spent as much as five minutes in the nest between trips, turning with her body to shape the interior, and using her feet and bill to push and pull the material into shape. She did not take time to feed while on a material-gathering mission but went straight to a limited area and returned directly to the nest.

There was no attempt to conceal the position of the nest or her activities. The male was absent until 8:40 when he arrived and sat quietly on a barbed wire fence 50 yards away. At 8:50 he left and attacked a Turkey Vulture, *Cathartes aura*, that was flying approximately 150 yards from the nest. The pursuit was carried on for about a quarter of a mile, and the vulture was driven from the area. At 9:05, the male returned to the nest-tree, flew up and greeted the female with a twittering "salutation," and inspected the nest. The female left again while the male sat quietly on a nearby limb. This time the female was gone for eight minutes, a period longer than usual. Twenty-one trips were made with nesting material in this one-hour period, all by the female. The male took no part in nest construction but guarded the nest in her absence and defended the territory against intruders.

Most construction is accomplished between 8:00 and 10:00 a. m. Activity is less during the hotter parts of the day, and practically ceases in the afternoon. This may account for the fact that nest construction requires from two to four days. In 1947, the earliest record for nesting activity was May 21 and in 1946 it was June 6. The latest nesting activity in 1946 was recorded on June 29 and in 1947, on July 5.

#### THE NEST

*Location.*—The wide range of nest sites observed during the study made it difficult to determine any preference regarding height from the ground or distance from the trunk of the tree. However, most of the nests were placed in isolated trees or isolated groups of two or three trees, that is, trees that stood alone in the middle of a pasture were preferred to those growing in numbers at the edge of the forest or along a stream. None was found along streams where the vegetation was concentrated or in the post oak woods of the uplands. Almost any species of tree that grew apart from the woods proved acceptable. The prairie, with its scattered scrub post oak and mesquite, is the preferred vegetation of the Scissor-tails in Brazos County. In Harris County, Texas, Nehrling (1882) found the birds nesting frequently in the "bosquets" on the prairies, in the borders of woods, in isolated trees in the fields, and even in gardens. In that part of Texas, the nests are in most cases placed in trees densely covered with *Tillandsia* and are difficult to discover. Bendire (1895) wrote that they prefer mesquite trees, less frequently live-oaks and post oaks, thorny hackberry or granjeno (*Celtis pallida*), huisache (*Acacia farnesiana*), honey locust (*Gleditsia triacanthos*), mulberry (*Morus* sp.), pecan (*Hicoria pecan*), and the magnolia (*Magnolia grandiflora*).

Observations made on 32 nests during the course of the study are summarized in Table 3. Two were located in scrub live-oak trees scattered in the spartina flats near the edge of St. Charles Bay on Aransas National Wildlife Refuge, Aransas County; the remainder were in Brazos County.

*Description and Materials.*—To determine the preferred nesting materials of Scissor-tails in Brazos County, Texas, 10 nests were analyzed. Mr. H. B. Parks, curator of the College Herbarium, assisted in identification of the plants.

The outside diameters at the rim of the nest averaged 120 mm. and the inside diameters at the rim, 82 mm. The average height was 58 mm.; the average inside depth of the cup was 42 mm. The nests

TABLE 3  
LOCATION IN TREES OF NESTS OF SCISSOR-TAILED FLYCATCHERS IN TEXAS

Location	Height from ground	Distance from trunk
Water oak, <i>Quercus nigra</i>	15 ft. 3 in.	Main stem
	9 ft. 3 in.	3 ft. 3 in.
Cottonwood, <i>Populus deltoides</i>	17 ft.	Main stem
Live oak, <i>Quercus virginiana</i>	13 ft. 3 in.	4 ft.
	8 ft.	Main stem
	7 ft.	1 ft.
Retana, <i>Parkinsonia aculeata</i>	9 ft. 8 in.	4 ft. 6 in.
Mesquite, <i>Prosopis glandulosa</i>	13 ft.	Main stem
Elm, <i>Ulmus pumila</i>	9 ft. 10 in.	2 ft. 3 in.
	11 ft. 2 in.	2 ft.
	8 ft. 10 in.	3 ft. 10 in.
Pecan, <i>Hicoria pecan</i>	14 ft. 6 in.	11 ft.
	11 ft.	2 ft.
	17 ft. 4 in.	8 ft.
Hackberry, <i>Celtis mississippiensis</i>	15 ft. 7 in.	7 ft. 10 in.
	8 ft. 10 in.	5 ft.
Yaupon, <i>Ilex vomitoria</i>	14 ft.	3 ft. 6 in.
Pear, <i>Pyrus communis</i>	26 ft. 10 in.	2 ft.
Telephone pole	26 ft. 10 in.	2 ft.
	16 ft. 6 in. (ave.)	5 ft. 8 in. (ave.)
Postoak, <i>Quercus stellata</i>	7 ft. (min.)	2 ft. (min.)
	21 ft. 7 in. (max.)	16 ft. (max.)

averaged 31 grams in weight. The framework and exterior were rough, and plant stems or pieces of string were frequently left hanging. From outside to inside, the construction of the nest becomes more compact and materials used are smaller and finer in quality. Nests were sometimes poorly attached to the limbs on which they rested; two were found on the ground beneath the nest-tree six weeks after being used.

Miscellaneous plant parts composed 95 to 100 per cent of the bulk of most nests; animal matter consisted of traces of locally abundant materials (wool, feathers, hairs) which served the same purposes as the

more commonly used plant parts. For purposes of description, the nest was divided into three parts: (1) the framework; (2) the cup; and (3) the lining. The framework consisted of coarse materials, plant stems and inflorescences, and the stolons of Bermuda grass, *Cynodon dactylon*. Into this were woven the pieces of string, thread, cloth, and cotton which were found in all parts of the nest. The most commonly used plant for the framework was cudweed, *Gnaphalium spatulatum*. One bird used post oak catkins and sheep wool. Another used tissue paper and spanish moss, *Tillandsia usneoides*, but all included cudweed. One contained as much peppergrass, *Lepidium* sp., as cudweed.

The cup was more closely knit than the framework, and the materials employed were usually smaller in size. Here, for instance, was found a layer of inflorescence of *Gnaphalium*, rather than the whole plant as was the case in the framework. String, cloth strips, and cotton were commonly used, and the cup of one nest was strengthened by the use of soil. Evidently a sandy loam had been added in a wet condition and used somewhat as the Robin and Wood Thrush use mud, although the layer was very thin and did not extend throughout. One female used four caterpillar cocoons which served to strengthen the nest by binding the framework more closely to the cup. Less commonly used were sheep wool, Bermuda grass leaves, strips of bark of shredded cedar, *Juniperus virginiana*, chicken feathers, post oak catkins, leaves of cudweed, and thistle down.

A variety of materials was used in the lining, but the most common was dried roots. The pappus of the thistle, *Cirsium virginianum*, was used in half of the nests examined. One nest was completely lined with this material. Cotton fibers lined one nest, and the woolly leaves of *Gnaphalium* partially lined another.

Although a variety of materials may be used in different nests, certain plants are characteristic of nests of Scissor-tails in Brazos County. The framework usually contains the complete stalks of cudweed in varying amounts. The cup contains the dried inflorescences of this same plant in some quantity, and the lining is characterized by the presence of small dried plant roots and the pappus of various thistles.

#### THE EGGS

The eggs, three to five in number, rarely six (Reed, 1904) are laid, one each day, in May, June, and the first two weeks in July. Of 16 clutches observed in Brazos County, six were of three eggs, four of five eggs, and six of four eggs. According to Davie (1898), Singly said that in Lee County, Texas, the usual number of eggs in a set is

five, fully 80 per cent of the sets having this number. The average incubation period in three clutches observed by me was 14 days. Bendire (1895) stated that incubation lasts about 12 days.

The ground color is white or creamy white, marked with a few dark red spots, occasionally pale purple, chiefly at the larger end; the eggs vary in color from pure white, unmarked specimens which are rare, to those finely speckled with reddish-brown and often covered with large spots and blotches of brown and lilac. They resemble the eggs of the Eastern Kingbird, *Tyrannus tyrannus*, but average smaller and their size is more constant.

Of those eggs under observation, 80 per cent hatched. Never was a full clutch lost because of failure to hatch, but two-thirds were lost in one clutch and one-half in two others. Eggs that failed to hatch were removed from the nests by the adult birds three to four days after the first egg had hatched.

The Scissor-tail showed no inclination to desert the eggs after being driven from the nest. Repeated handling of the eggs did not prevent hatching or the continued brooding activity of the female bird.

Only one case of social parasitism occurred. One nest, discovered after desertion, contained three Scissor-tail eggs and four of the Cowbird, *Molothrus ater*.

There was no indication of a second brood being reared, although Bendire (*op. cit.*) stated that it is probable that two broods are raised in many instances in the southern portions of their breeding range.

#### GROWTH OF THE YOUNG

Eleven different measurements were made at 24-hour intervals from July 7 to 20, 1947, on a brood of three nestlings to determine growth rates. The first measurements were made on one chick (No. 103466) immediately after hatching. The first measurements on the other two were made 24 hours later, when No. 103468 was slightly more than 24 hours old and No. 103467 was slightly less than 24 hours old. The feet of the three birds were stained with gentian violet for purposes of recognition. Bands could not be secured to the legs until the birds were four days old. At that age, United States Fish and Wildlife Service bands, bearing the above-mentioned numbers, were attached to the tarsi.

Methods for making the measurements follow those outlined by Baldwin, Oberholser and Worley (1931). The scales were placed in a pasteboard box 14 inches deep, while being used in the field, to reduce wind currents and make the measurements more accurate.

Nestlings were removed from the nest each day for approximately

one hour while measurements were made. After they reached 10 days of age, the young showed fear, and this in addition to advanced feather growth made measurements difficult. On the 14th day, the young were capable of flight, and on the 15th day all birds were out of the nest, making measurements impossible.

The measurements showed that the width of the head at the eyes and parietals, and length of body were the most conservative measurements, increasing less than 100 per cent during the first 14 days. The least conservative measurements were: (1) total weight, which increased over 1,000 per cent; (2) extent of wing (400 per cent increase); (3) length of head (343 per cent increase); (4) length of bill (300 per cent increase); (5) length of middle toe (288 per cent increase); and (6) length of tarsus (278 per cent increase).

The similarity of the growth rates of the three nestlings indicates that each received about the same amount of food daily. In four other broods observed, there were no "runts" or individuals that were not able to keep pace with other members of the brood.

#### CARE OF THE YOUNG

On July 2, 1947, I spent a continuous 13-hour period watching the activities of a pair of birds with four young in the nest. Observations began at 6:00 a. m. and continued through 7:00 p. m. During this time, 92 trips were made to the nest by both parents, 23 by the male and 69 by the female. There was an average of 7.0 trips per hour, no feeding activity from 6 a. m. till 8 a. m., and a maximum number of trips per hour (14) between 4 and 5 p. m. Fecal sacs were removed from the nest 12 times during the day, four times by the male, eight by the female. Between 6:00 a. m. and 8:00 a. m. the adults were wary about feeding the young, hovering near the nest and then flying away. Both sat on a near by fence, feeding and preening. At 8:10, the female fed the young for the first time, followed almost immediately by the male. Only five trips were made between 8:00 and 9:00. Between 9:00 and 10:00 the young were fed 13 times. The female collected most of the food, largely grasshoppers and small moths, in a nearby pasture. She frequently crushed the insects with her mandibles before presenting them to the young. The male occasionally flew to a telephone line holding the insect in his bill and beat or rubbed it against the wire. Between 10:00 a. m. and 3:00 p. m., the adult birds slowed their activities, possibly because of the heat. They sat with bills open, panting noticeably. Between 10:35 and 11:00, the female sat on the edge of the nest with wings drooping, apparently in an effort to shade the young. At 12:40, both male and female attacked



and expelled a dove from the nest tree. At 1:15, the female assaulted a Lark Sparrow which ventured within a few feet of the nest. The young were fed only five times between 1:00 and 2:00 p. m. Between 2:00 and 3:00 p. m. four feeding trips were made by the female, one by the male. Both birds were absent 15 minutes, having joined other Scissor-tails of the area in attacking a Crow. Between 3:00 and 4:00 p. m. there was a noticeable increase in feeding activity and during the next hour reached its peak. Once between 3:30 and 4:00 p. m. the sun fell directly on the nest, and the female stood on the rim between the young and the sun. From 5:00 to 7:00 p. m., the young were fed 22 times, 11 feedings each hour.

On July 8, 1947, another nest was observed during feeding activity. Between 9:45 and 10:45 a. m., seven trips were made to the nest by the female, one by the male. On July 11, the same nest, with three young, was observed between 10:20 and 11:20 a. m. During this time the female made five trips to the nest, the male two. On July 16, detailed observations were made at the same nest with the aid of binoculars. Between 1:30 and 2:30 p. m., the young were fed three times by the female. She spent most of the hour shading the young, as the heat was intense. One feeding was closely observed. She perched on a wire for a brief period, flew out and down to capture a flying grasshopper and then back to the wire. Here she mashed the insect with her bill, beat it against the wire, shook it from side to side, dropped it temporarily, retrieved it, and continued the process of crushing. After three minutes of such preparation, she flew to the nest and fed the insect to one nestling by inserting her bill and the contents into the gaping mouth of her offspring. After this feeding she again placed her body, with wings drooping, between the young birds and the direct sun. While in this position her bill was constantly open and panting was noticeable.

On July 17, feeding activities were watched between 9:00 and 10:00 a. m. During this hour, the female made six trips to the nest, the male one. One other trip was made by the male, but instead of feeding to the young the grasshopper which he held in his bill, he ate it himself. A fecal sac was removed by the female at 9:45.

Care of nestlings after daylight hours is the sole responsibility of the female. When young birds were in the nest, all nests visited after dark contained the female. The male was never located at the nest at night, and apparently he shares none of the responsibility. In one case, the female was flushed by use of a spotlight. She flew 50 yards away, sat on a fence post, and scolded the intruder. She did not return as long as the observer was near.

Nestlings are not protected from rain by the parents. This statement is true for the brief, light to moderate precipitations which characterize the summer months in south-central Texas. No observations were made during a prolonged or intense rain.

These observations allow the following conclusions: (1) the female is more attentive to the young than the male; in 18 hours of feeding activity, the female fed 91 times, the male 30; (2) food consumed by young Scissor-tails is for the most part flying insects—grasshoppers in various stages of development, small moths, and occasionally hymenopterous insects; these are usually broken and crushed by the parents before being presented to the young; (3) usually, the food is gathered from within a 200-yard radius of the nest-tree; (4) the height of feeding activity is between 4:00 and 6:00 p. m., and no feeding takes place in the first hour of daylight; (5) during the middle of the day, the female spends more time shading the young from the direct sunlight than she does in feeding them.

#### FEEDING HABITS

Scissor-tails take their food mainly in the air. The usual method of feeding is one diagnostic field character. The birds perch in wait for their prey on some prominent outpost, many times with wings vibrating and tail drooping in readiness for instant action. On the approach of a suitable insect they launch into the air, seize it with a quick movement and click of the beak, and return to their stand. When on the ground, the method may be similar, but the dash usually is shorter. Doubtless some insects are picked off the ground.

Beal (1912) stated that in 128 stomachs examined, 96.1 per cent of the contents was animal food, practically all insects and spiders and that 3.9 per cent was vegetable matter, chiefly small fruits and seeds. Of the animal food, less than one per cent belonged to useful families of insects, the rest being practically all harmful. Grasshoppers and crickets averaged 46.1 per cent.

Nehrling (1882) said that in September, after the breeding season, the Scissor-tails gather in large flocks, visit the cotton fields where multitudes of cotton worms, *Aletia argillacea*, and their moths abound, and with other small birds eagerly feed on these insects.

In August, 1946, the writer examined three stomachs. One, a juvenile male, contained grasshoppers exclusively. Another, an adult male, contained mostly grasshoppers, three blue bottle flies (*Calliphoridae*), a carpenter bee (*Andrenidae*), and unidentifiable ichneumonids, parts of one coleopteran, and one hard, thick-coated seed. The third, from a juvenile female, contained grasshopper remains

exclusively. Two birds, found dead on the highway, were examined in June, 1947. One stomach was empty, but the other contained two recently caught grasshoppers.

#### ECTOPARASITES

A dozen, freshly killed birds were combed in August, 1946, but no parasites were found. One brood of five had a light infestation of mites, *Liponyssus bursa* (identified by Dr. R. W. Strandtmann, University of Texas Medical College) at five days of age, and at eight days all members of the brood were heavily infested. The bill and face, as well as all body surfaces, were affected. No ill effects were observed; all birds remained in the nest and developed normally. Lighter infestations of the same mite were found in three other broods. Nests collected three days to a week after departure of the young were heavily infested with this mite.

#### SONGS AND CALLS

Despite its lack of efficient vocal equipment, the Scissor-tail gives forth various harsh and unmusical phrases. These cannot be construed as songs in the usual sense, but for lack of a more descriptive word, have been thus described by various authors. Here, "songs" are understood to be polysyllabic phrases to differentiate them from the more or less monosyllabic call notes.

*Twilight song*.—Mrs. Nice (1931) said, "on June 2, 1929, near Cashion, Oklahoma, I had the privilege of hearing the 'twilight song' of a Scissortail Flycatcher nesting next the house in which I was staying. At 5:01 a. m. this bird began to shout *pup-pup-pup-pup-pup-pup-pup-perleep* 16 times a minute for about four minutes. Then for three minutes nothing was heard but a few *pups*. At 5:07 he began again with a new note—*pup-pup-pup-peroo*, lower and less loud than the first phrase, the number of *pups* varying from none to three, the most common being two. A minute later he started to fly about, but kept up a continuous chatter of *pup-peroo* till 5:12.

"He and his mate then flew away, but were back at the nest at 5:18 with loud *pups*. At 5:27 just as the sun was rising over the prairie, the female sat on the barbed wire fence with wings held straight out from her body and her tail spread to its furthest extent. Later the male assumed this same attitude, at the same time saying *peelyer per*. At 5:42 he retired to the nest and gave a last *pup-pup-peroo*. The *pup-pup-pup-pup-pup-perleep* was about one second long; intervals between beginnings of phrases varied from 3.5 to 4 seconds. The *pups* were uttered rapidly, giving the effect of a stutter; the emphasis was on the *perleep*."

The twilight song is uttered during the closing hours of the day, as well as in the morning. In early July, 1947, on the Texas A. and M. campus, roosting birds were heard giving a call which agrees with that described by Mrs. Nice. In this case, only the males were singing. The 'pups' or 'tuks' came in threes, all of the same value and evenly spaced. The climax follows close on the third 'tuk' and builds rapidly up the scale to a screech, sounding like 'terreeet.'

*Flight song.*—Mrs. Bailey (1917) said that one of its favorite performances is to fly up and, with rattling wings and penetrating bee-bird screams 'ka-quee-ka-quee-ka-quee-ka-quee' execute an aerial seesaw, a line of sharp-angled V's, at the angles rapidly opening and shutting its long white scissor-blades. Similar performances may be seen during the breeding season as part of the sexual display. The above hardly describes the song adequately. It might better be regarded as similar to the twilight song, but uttered in a faster tempo and representing the "height of nervous excitement." The song matches the flight in intensity, that is, the bird utters the single, staccato notes during level flight, and as the abrupt, vertical dash builds upward in altitude the vocal accompaniment ascends the musical scale, giving the impression that one stimulates and accompanies the other. The same action has been noticed when the birds are going to, or returning from, an attack on a hawk and, therefore, may be the result of excitement.

*Alarm note.*—Usually when perched on a wire or twig, the Scissor-tail is quiet. When disturbed by the presence of a stranger, or interrupted during nesting, both male and female voice their disapproval by using a single-syllabled 'tuk' or 'pup'. This is repeated as long as the disturbing element remains in the area. It is used by parents when communicating with nestlings. When one week old, the young recognize the call. At 10 to 12 days, they give the same note, almost as strongly as the adult, and this usually brings a similar response from the parents.

*Salutation or recognition call.*—The male frequently guards the nest in the absence of the female and as she returns he flies out to meet her. As the two approach each other, a stuttering series of staccato, single notes and phrases are emitted. These are harsh sounding and are accompanied by fluttering wings and a widely-fanned tail. While she feeds, the male flies to some nearby perch and, after she has finished, she joins him. Again, both flutter their wings and hover briefly, much as a Sparrow Hawk does when it prepares to dive to the ground for a grasshopper. In almost all instances, this call is given when the two adults meet and is presumed to be some form of greeting. It lacks the intensity of excitement and volume shown in the flight song. It might be described as a twittering series of monosyllabic monotones.

*Call of nestlings.*—Nestlings are able to squeak at hatching. These faint sounds cannot be heard more than 3.5 feet away and are uttered when the nest is shaken. At five to six days of age, nestlings use a 'churr' note which is similar to that of nestling birds in general. This churring is a begging note and, at the same time it is given, the nestling sticks its head up and opens its mouth in apparent expectation of a meal.

#### FLOCKING

During the fall the species is gregarious, banding into flocks of considerable size before and during migration. This behavior continues through the winter and the spring migration to the breeding grounds. In the spring the birds arrive in flocks and spend the nights in a common roost tree. At 6:30 p. m. on March 23, 1947, at College Station, 12 Scissor-tails were seen in a large hackberry tree that was still bare of leaves. They were grouped together, feeding and calling. At 6:45 p. m. they flew down to an evergreen privet and settled for the evening. Shortly, they were flushed from the bush, and re congregated in a live-oak after a few minutes of flying around nervously and calling excitedly. Here they spent the night. This was the first flock seen by the writer in 1947 and evidently was the first migratory flock to arrive in the vicinity. For the next month, similar behavior was observed in the evenings. During this time, only an occasional Scissor-tail was seen during the day in the tree or on the campus. However, the size of the roosting flock increased. On April 23, the hackberry tree, in which the flock was first seen, was completely leafed out and was still being used as the roost. Pairing had begun, but as yet the territories either had not been selected or were not being defended. At 6:30 p. m. that day, after sundown, a few birds were present in the vicinity. At 6:35 p. m., birds were arriving steadily. Congestion was acute on the outer branches of the tree, causing much commotion. Some of the perched birds fluttered their wings to maintain balance; others left one perch to find a more suitable one. This maneuvering was accompanied by much fussing and squawking. Some of the birds that had not flown to the roost were uttering the harsh, explosive evening "song." At 6:45 p. m. birds were coming in from all directions. Some flew high over the chosen tree, then closed their wings and dived to treetop level where they gracefully banked in for the landing. The birds appeared to demonstrate an ability to remember landmarks since they were all using the same tree that had been occupied by the first flock of the year, even though it had changed aspect from bare limbs to green foliage. Some Bronzed Grackles and a few Mourning Doves also entered the roost tree, causing considerable jostling and shifting of the

various species. Loud squawks indicated interspecific friction. At 7:00 p. m. birds were still arriving steadily, but their flight was rapid and "nervous"; at 7:15, darkness had put a stop to all activity.

On May 10, between 7:15 and 7:30 p. m. the same roost-tree was visited; again the birds were congregating. No nesting activity had been observed up to this date, but some of the males had been observed performing the nuptial flight.

On May 21, between 7:20 and 8:00 p. m., 138 Scissor-tails were observed entering this same roost-tree. The majority came from the west, but birds arrived from every direction. The early arrivals sat on telephone wires or nearby trees, and a few individuals engaged in "games of tag," chasing each other through the open spaces and fighting for brief periods. On this same date a female was seen carrying nesting material near the campus.

On May 28, between 7:30 and 8:00 p. m. at least 136 Scissor-tails entered the tree; this figure is lower than the number actually using the tree. Only three approaches could be watched, and occasionally the birds arrived in such numbers that they could not be accurately counted.

In August, 1946, another roost tree, a large osage orange, *Maclura pomifera*, was discovered by watching the line of flight of birds just before sundown. The birds were approaching from all sides, and before dark more than 200 birds had congregated there. The roost-bound birds were noticeable one mile southwest of the tree, and the succeeding night the roosting flight was observed approximately one mile north of the tree. Again, the birds began passing overhead in ones, twos, and small groups about one-half hour before dark, flying in the direction of the tree which had been used the night before. This roost was used until the birds left in early October. The size of the area served by one roost-tree appears to be at least one mile in radius.

During the breeding season, the female remains on the nest during the night. Not once could the male be found either near the nest, in the nest-tree, or in the immediately surrounding trees. Adult females as well as males were seen roosting in chosen roost trees throughout the breeding season. The females were probably unmated birds or those that had been unsuccessful in nesting. Males apparently always congregate together to roost. In the morning, roosting birds disperse before sunrise. The male is present at the nest shortly after sunrise.

Young birds join the roosting flock as soon as they are able to fly considerable distances. On July 8, 1947, between 7:20 and 8:00 p. m., 12 to 15 immature birds entered the roost-tree. One family of four young and the adult female fed from a nearby power line before going to roost.

In a normal day during the breeding season, therefore, male Scissor-tails leave the roost-tree, return to their nesting areas, and defend the nest and territory, demonstrating typical territorialism. But, at dusk, they congregate with a smaller number of non-nesting females at a chosen roost to spend the night.

Davis (1940) reports a similar behavior in the Fork-tailed Flycatcher, *Muscivora tyrannus*, of South America.

#### SUMMARY AND CONCLUSIONS

This paper combines previous observations of many workers with those made by the author during an 18-month study in Brazos County, Texas.

This member of the genus *Muscivora* inhabits the prairie-deciduous forest ecotone of south-central United States from March to October; it winters mainly in Central America.

During the breeding season, the Scissor-tail is highly territorial. The female chooses the territory, builds the nest, broods the eggs, and is more attentive to the young than is the male. In matters of nest location, construction and territorial defense, different pairs express individualism, but in care of the young they are uniformly efficient. Three to five eggs, red-splotted on a creamy background, are laid between the middle of May and the middle of July. The nest is located from six to 27 feet from the ground in an isolated location and is constructed in two to four days. Materials used are predominantly miscellaneous plant parts, with occasional feathers or animal hairs. The favored plant in Brazos County is cudweed, *Gnaphalium spatulatum*.

The favored summer food item is grasshoppers. Stomach analyses show that a wide variety of flying insects may be consumed, most of them belonging to families considered harmful or injurious to agriculture. The nestlings are fed, for the most part, on grasshoppers which are carefully crushed by the parent before they are offered as food. The manner of gathering food in short forays and returning to the same perch is characteristic.

The Scissor-tail expresses itself by several distinct phrases. Some are staccato monosyllabic calls, others are polysyllabic and analogous to songs in other species. The most spectacular is the flight song which is an integral part of the nuptial flight. A more subdued and melodious attempt is the "twilight" song of early morning and dusk.

From the time of arrival in the spring until departure in the fall, males, unmated and unsuccessful females, and birds of the year convene nightly to roost in a specific tree. Females with eggs or nestlings do not share this behavior. These females remain on the nest at

night, and are joined at daylight by the male, which flies from roost to nest, defends his territory during the day, and returns again to the roost at night. As many as 250 individuals have been counted as they entered one tree just prior to dark.

Approximately 20 per cent of all eggs laid fail to hatch. Social parasitism (cowbird) caused the abandonment of one clutch in 1947, and unknown predators destroyed three of 16 nests under study in 1946.

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