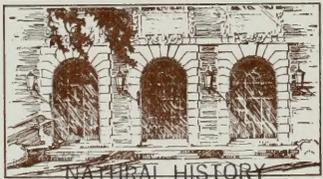




LIBRARY OF THE  
UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN

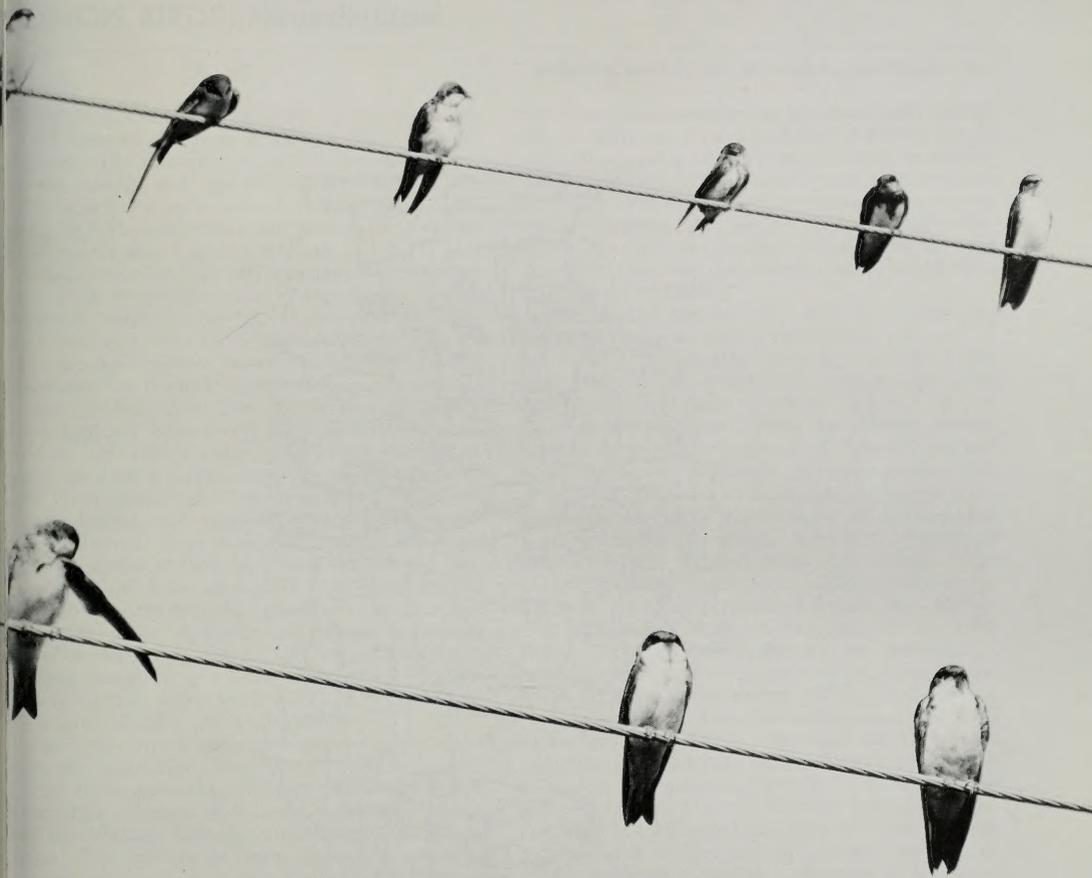
no. 66 - 99



NATURAL HISTORY  
SURVEY







# ILLINOIS BIRDS: Hirundinidae

RICHARD R. GRABER  
JEAN W. GRABER  
ETHELYN L. KIRK

Biological Notes No. 80

ILLINOIS NATURAL HISTORY SURVEY  
Urbana, Illinois—August, 1972

State of Illinois  
Department of Registration and Education

NATURAL HISTORY SURVEY DIVISION



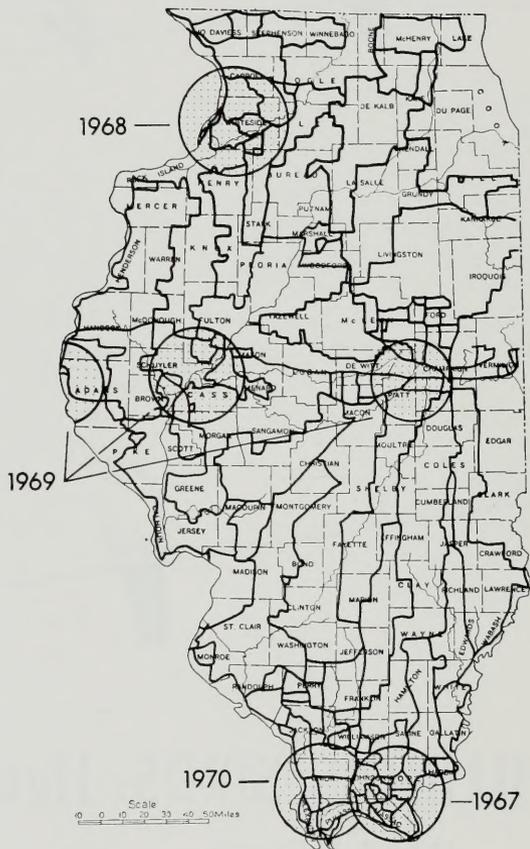


Fig. 1.—Routes travelled in summer (1957–1970) to study breeding distribution of the birds of Illinois. The encircled areas were special study areas where daily censuses of migrants and nesting populations of birds were carried out, 1967–1970.

# ILLINOIS BIRDS: Hirundinidae

Richard R. Graber, Jean W. Graber, and Ethelyn L. Kirk

THIS REPORT, the third in a series of papers on the birds of Illinois, deals with the swallows. The introductions to the first two papers, on the mimids and thrushes (Graber et al. 1970, 1971) also serve as a general introduction to the series, and the procedures and policies outlined in those papers also apply to this one.

One point that warrants emphasis and clarification is the geographic scope of the papers. Unless otherwise indicated, the data presented and the statements made refer to the state of Illinois (Fig. 1), but are not confined strictly within its political boundaries. In faunistic studies of this type, students usually confine themselves to politically defined areas, probably because (1) it is generally not feasible for one student, or several students working together, to study the whole world or even a continent, and (2) political units are generally well known, clearly defined, and reasonably stable areas to attempt to cover. More than most states, Illinois has its land limits marked by natural waterways, notably Lake Michigan and three major rivers. The legal northeastern boundary of Illinois lies over half way across Lake Michigan, and though we would gladly include the information, there are almost no bird records of any kind from the vast aquatic area of the state which lies beyond a mile or so from the shores of Lake and Cook counties.

As to the rivers, their political definition varies from one to another. Thus, the Ohio River is considered to be Kentucky, while the Mississippi River, from place to place, is Illinois, Missouri, or Iowa, and the Wabash River is, similarly, Illinois or Indiana. The biology of many species of birds is strongly influenced by these bodies of water. Among the swallows, for example, migrant populations are generally much higher along, or over, the major rivers, than away from them. Also, the great roosts of purple martins in the St. Louis area have, through the years, been located on both the Illinois and Missouri sides of the Mississippi River. In our reports, therefore, we have included data from both shores of the boundary rivers.

We hope that all students will be impressed by the paucity of the presently available knowledge on the birds of Illinois, and will thus be encouraged to fill in the great gaps. The swallows, being generally colonial or semicolonial, are a

particularly interesting group for distribution studies, and to determine their population trends we should know the location of every major colony or population in the state. We therefore appeal to all students of Illinois birds to examine the maps showing breeding distributions, and publish any additional information they may have. By this procedure we will ultimately learn the true distribution of all the Illinois species.

In bringing together the available information on the swallows we have received help, especially in the form of contributions of data, from many persons. We should particularly acknowledge John Schwegman of Vienna, Peter C. Petersen, Jr. of Davenport, Iowa, Peter Dring of Willow Springs, Loraine W. and James Funk of Liberty, Richard A. Anderson of St. Louis, Missouri, Sarah Vasse of Brussels, Elton Fawks of Moline, L. Barrie Hunt of Charleston, Mrs. Harry Shaw of Sterling, Lee G. Johnson of Rockford, Edwin C. Franks of Macomb, Dale E. Birkenholz of Normal, Miss Elda Goodmiller and Mrs. Glenn Williams of Elizabeth, Maurice L. Reed of Dixon, Mrs. Marian Cole of Deerfield, Ellen A. Hopkins and H. David Bohlen of Springfield, Michael D. Morrison of Sparta, Mahlon K. Mahoney of Kankakee, and Frank C. Bellrose and Robert Crompton of Havana.

Donald Webb identified chironomid fly specimens for us, and Lewis J. Stannard and R. Weldon Larimore provided data and references on the parasitism of cliff swallows by ticks. The staff of the Natural History Survey's Wildlife Research, Editorial, Art, and Photographic offices all made valuable contributions in the final preparation and editing of the manuscript, and in production of the drawings and photographs.

## VIOLET-GREEN SWALLOW (*Tachycineta thalassina*)

This western species is included in the Illinois bird list on the basis of a single adult male specimen taken May 4, 1897 by George F. Clingman in the Calumet region of Chicago, an accidental record (Woodruff 1907, and Coale 1925).

## TREE SWALLOW (*Iridoprocne bicolor*)

(Fig. 2 and 3)

### Spring Migration

The Illinois literature contains no descriptions of the actual migration flights of tree swallows, and whether they are diurnal or nocturnal is unknown.

This paper is published in part with private funds and by authority of the State of Illinois, IRS Ch. 127, Par. 58.12. It is a contribution from the Section of Wildlife Research of the Illinois Natural History Survey. Dr. Richard R. Graber is a Wildlife Specialist at the Survey. Dr. Jean W. Graber is a Research Assistant Professor of Animal Science at the University of Illinois. The late Miss Ethelyn Kirk served as Technical Assistant in the Section of Wildlife Research at the Survey.



Fig. 2.—Tree swallows in August. The adult (below) is in badly worn plumage and molting; the immature (above) is in fresh plumage. (Adults have metallic blue-green backs, immatures have gray-brown backs, but in all the underparts are immaculate or nearly so.)

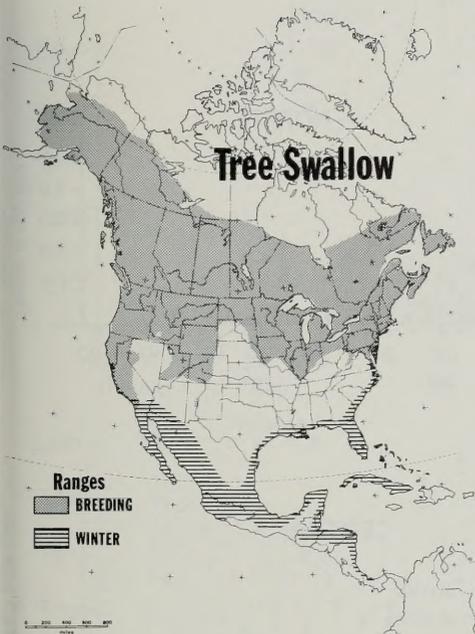


Fig. 3.—General distribution of the tree swallow. The outlined range may include large sections in which populations of the species are thin or even absent because of the nature of the terrain and paucity of suitable habitat.

Because swallows forage on the wing, it may be difficult to differentiate migration flights from feeding flights.

In Illinois the swallows, including tree swallows, usually appear earliest in the river bottoms, and often even weeks later in adjacent uplands. The number of birds also tends to be higher in bottomlands. Tree swallows have been seen in Illinois as early as March 11, and Nelson (1876-1877) refers to their arrival in numbers to northeastern Illinois on March 20, but more typically they come in April and May (Fig. 4). Usually, only a few birds are seen in March, and there is a small but notable pulse about April 1. The largest influx occurs from mid-April to late April, with lesser peaks from early to mid-May (Fig. 4). The migration may extend into June some years, as Loucks (unpublished manuscript, 1892) mentioned 200 birds flying over the Peoria area on June 11.

**Distribution**

The general distribution of the tree swallow is shown in Fig. 3. The Illinois distribution (Fig. 5)

is not well known. The present records indicate that most of the Illinois population is in the northern half of the state. Musselman (1933) hinted that the Illinois River was the principal nesting area for the tree swallow in Illinois, and indeed there are many nest records from the Illinois Valley. Sloughs in the Mississippi, Ohio, and Wabash bottoms of southern Illinois offer much habitat that looks promising, but, in general, the southern half of the state has not been investigated for breeding populations of this species. Ridgway (1874) recorded a nesting population near Mt. Carmel, but no nests have been reported there in this century.

**Nesting Habitats and Populations**

Tree swallows nest in isolated pairs as well as semicolonially. The nesting habitat most often described is a swamp or marsh with standing dead trees in or near the water. In Marshall County, Barnes (1890) found the tree swallow confined to the Illinois river bottoms.

The nest is placed in a cavity in a stump or dead limb. At Mt. Carmel, Ridgway (1874) noted that the swallows especially utilized cavities made by downy woodpeckers (*Dendrocopos pubescens*) and Carolina chickadees (*Parus carolinensis*). Tree swallows also readily use man-made nest boxes, and most of the recent nesting records are of this type, though tree swallows have not received nearly as much attention in Illinois as have bluebirds (*Sialia sialis*) and martins (*Progne subis*). The discrepancy may be related to the more specialized habitat of the tree swallow. There are several new, large reservoirs in the state, and nest boxes placed near the shores of such bodies of water may attract tree swallows and thus have a marked effect on the state population.

The only published population measurements are those of Beecher (1942) who found 40 nests (occupied nest boxes) in about 28 acres of modified woodland in Lake County. He also recorded an extremely dense population of 20 occupied boxes on 100 square feet. These figures do not include foraging habitat, however.

The tree swallow, like other cavity nesters, is confronted with the problem of competition for nest sites. Nelson (1876-1877) observed fighting over a house between martins and tree swallows, with the martins dominating, but Beecher (1942) found no strife between the two species occupying two houses on the same post. Ridgway (1874) noted apparent competition for housing between prothonotary warblers (*Protonotaria citrea*) and tree swallows. Barnes (1912) attributed population decline of the tree swallow in Marshall County after 1890 to competition from the house sparrow (*Passer domesticus*), and Loucks (1895) also mentioned house sparrow competition with the tree

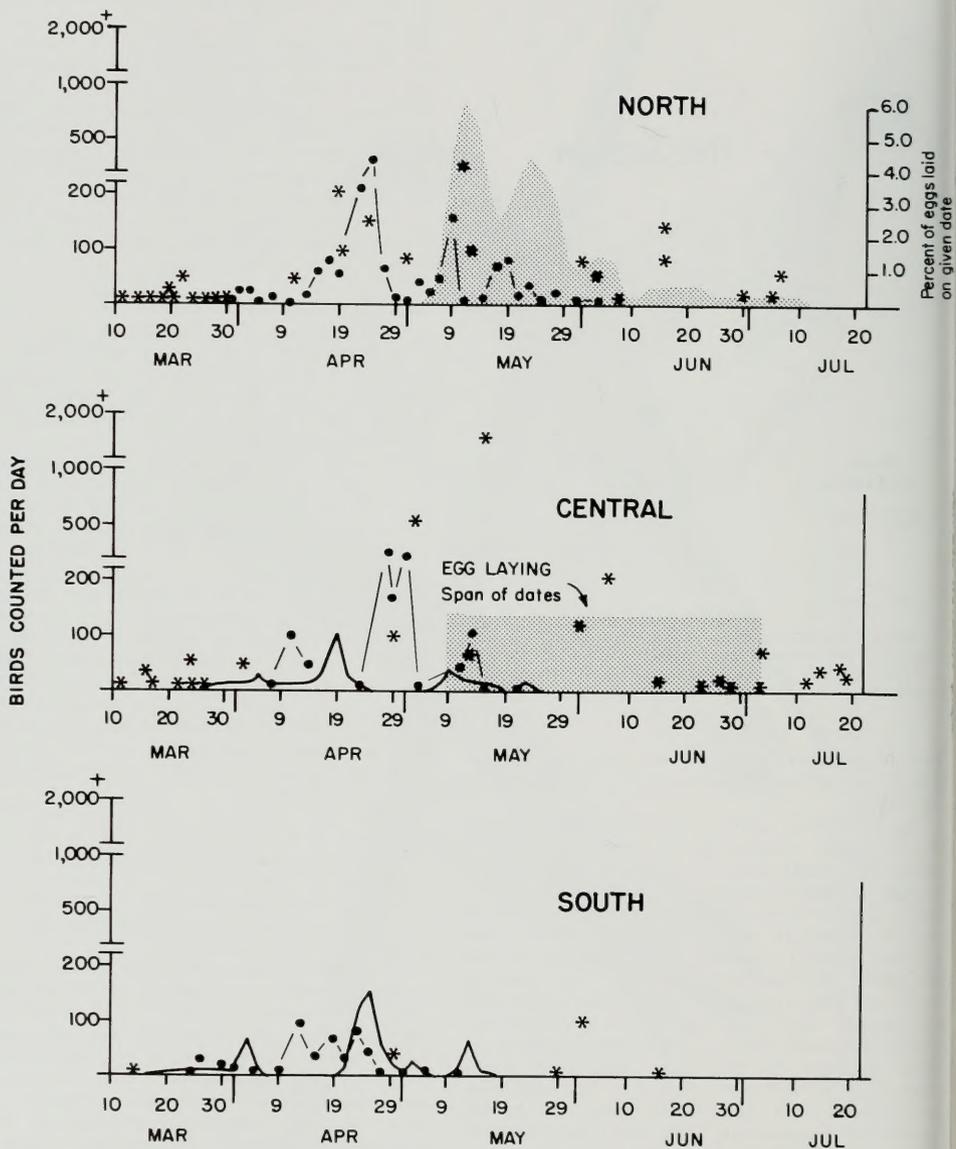
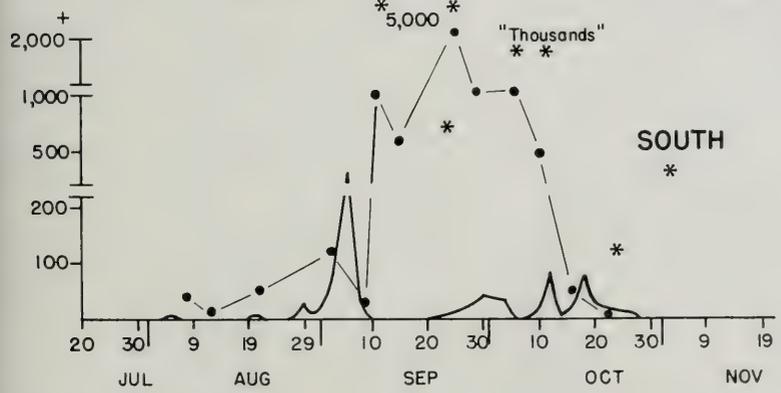
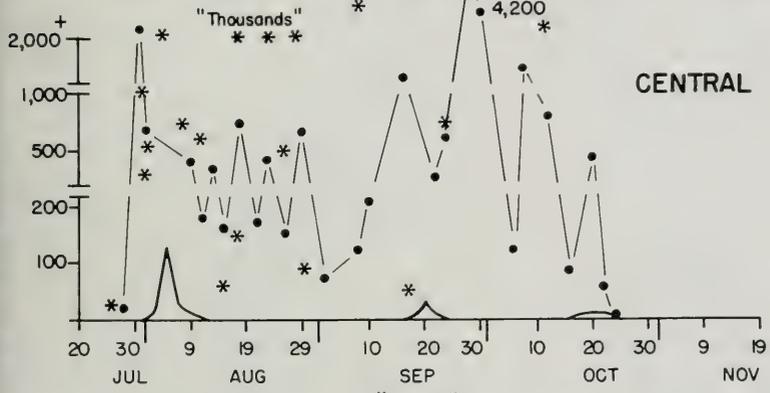
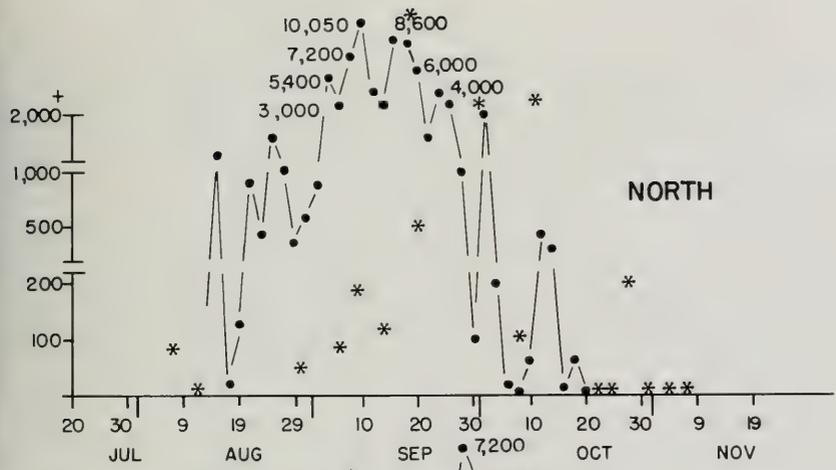


Fig. 4.—Egg-laying and migration seasons of the tree swallow in different areas of the state (see Fig. 1). Spring and fall graph lines (1967-1970) show the highest daily count of each 2 days (left scale). Asterisk symbols represent counts made in other years or by other observers. Shaded areas show the percent of eggs laid on a given date (right scale, North only) or the span of dates during which egg laying has been recorded. Dot symbols represent counts made on the western side of the state; lines without dots represent the eastern side.



## TREE SWALLOW BREEDING RECORDS

### NESTS OR YOUNG

- 1950 —
- ▲ 1900 — 1949
- BEFORE 1900

### PAIRS OR SINGING MALES (JUNE)

- 1950 —
- △ 1900 — 1949
- BEFORE 1900



Fig. 5.—Breeding records for the tree swallow in Illinois.

swallow. John Schwegman (personal communication) noted that starlings (*Sturnus vulgaris*) took over cavities that tree swallows had used at Mermet Lake (Massac County).

Natural cavity nests have been recorded most frequently in willows, often stubs standing in water, with the nests 4–15 feet high.

### Nesting Cycle

Very little has been published on the nesting cycle of the tree swallow in Illinois, though an excellent study by Peter Dring of Willow Springs is in progress. At present there are no published data on nesting success or productivity, and no data on any phase of the cycle from southern Illinois.

In Tazewell County, Loucks (unpublished notes, 1892) found tree swallows building nests as early as April 27. In the north most of the egg production comes in May, with laying starting as early as May 4, but some egg production occurs in June and July, as late as July 10 (Fig. 4).

Clutch sizes from the literature or museum collections (24 nests) varied from four eggs (16 percent of nests) to seven eggs (8 percent) with six-egg clutches (42 percent) and five-egg clutches (33 percent) being most common.

### Fall Migration

We do not know how early the southward flights begin, but we detected notable population changes in central Illinois by the end of July (Fig. 4). Northern Illinois departure dates have ranged in different places and different years from mid-August to November 7 (Clark & Nice 1950, and Ford 1956). Along the major rivers in western Illinois, large aggregations of tree swallows may be expected from late July to at least mid-October (Fig. 4). Daily counts of several thousand birds are not unusual along the Mississippi River, and in the St. Louis area Anderson & Bauer (1968) have recorded tens of thousands per day (see also Jones 1933). In the same area Wilhelm (1954) reported 300 as late as November 1.

We have found much smaller numbers of migrant tree swallows in the Rock River Valley than in the Mississippi and Illinois valleys. On the eastern side of Illinois, even in the Ohio Valley, no one has reported numbers of tree swallows comparable to those seen in the west (Fig. 4). However, relatively little study has been given to the Wabash and Ohio valleys, and higher populations than are presently known may ultimately be found there. Hess (1910) spoke of seeing "armies" of tree swallows in east-central Illinois in September, but there is no way to interpret his statement in numerical terms. In contrast to eastern Illinois generally, northeastern Illinois may have large numbers of tree swallows. Nolan (1955) recorded a peak population of 2,200 birds at Fox Lake on October 1, 1954.

We saw many more tree swallows in the fall (August–October inclusive) than in the spring (March–May inclusive). The ratio was 1 bird in the spring to 62 in the fall in the north (1968), 1 to 18 in central Illinois (1969), and 1 to 6 in southern Illinois (1967 and 1970). It is our impression that in the fall swallows tend to stay in the same areas for extended periods so that the same birds are counted over and over again, whereas in the spring they move through the state more quickly. This behavior would have a great bearing on the spring-fall ratio, but we still believe that the fall population greatly outnumbers the spring population.

### Winter Records

The regular winter range of the tree swallow lies no closer to Illinois than a few hundred miles to the south and east (Fig. 3), and the alleged record of a flock of 200 near Springfield on Decem-

ber 17, 1939 (Anon. 1940) must be considered invalid in the absence of supporting evidence. There are no valid winter records for Illinois.

#### Food Habits

There have been no studies on the food of the tree swallow in Illinois, but we have often observed that the large migrant swarms of this and other swallow species occur coincidentally with extensive swarms of midges (Chironomidae). When feeding, the birds will even flutter against trees and shrubbery to put the small flies into the air, though most of the insects are taken in regular flight. We believe that chironomids form an important part of the

diet of migrant swallows, but detailed quantitative studies are very much needed.

#### BANK SWALLOW (*Riparia riparia*) (Fig. 6 and 7)

#### Spring Migration

So far as is known the migration of the bank swallow is diurnal, and the actual flights have been reported only near large streams or rivers (Cooke & Widmann 1884, and Barnes 1933).

The earliest spring arrivals have been seen April



Fig. 6.—Bank swallows. The dark chest band is the distinctive mark of this brownish-backed species.

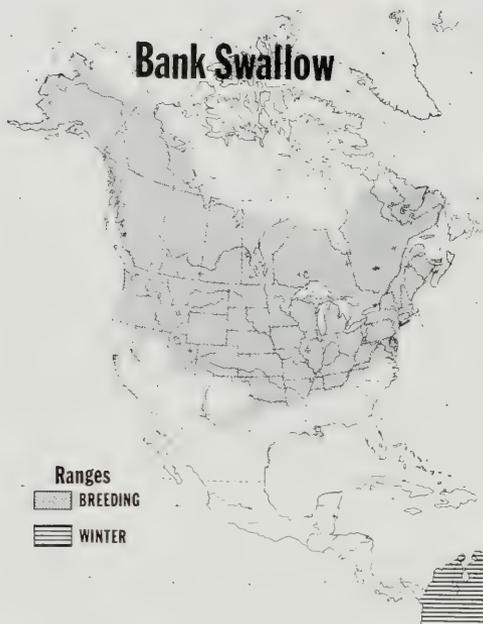


Fig. 7.—General North American distribution of the bank swallow. The outlined range may include large sections in which populations of the species are thin or even absent because of the nature of the terrain and paucity of suitable habitat. The breeding population is particularly spotty in the South. The bank swallow winters widely in South America and also has a wide distribution in the Old World where it is known under the common name of sand martin.

3 and 4 in southern and central Illinois, and April 11 in the north, but bank swallows do not usually arrive in numbers until after April 20, and the heaviest influxes occur around mid-May (Fig. 8). In the spring we saw the largest numbers in northwestern Illinois in 1968, but we do not know whether this represents regional or annual variation in the population.

#### Distribution

The North American distribution of the bank swallow is shown in Fig. 7. The Illinois distribution (Fig. 9) is far from adequately known, and the large areas with no nesting records in eastern and southern Illinois probably contain many bank swallow colonies that have not been recorded as yet. Blocher (1922) observed that bank swallows could be found almost anywhere along the Green River, and colonies are probably present along large stretches of all the major rivers (at least the Mississippi, Rock, Illinois, Wabash, and Ohio), but

there are no data on the numbers and spacing of colonies along any stream in the state.

#### Nesting Habitats and Populations

No one has attempted a precise definition of bank swallow habitat. Musselman (1921) indicated that the species occurred where clay banks and water were in proximity. Nesting colonies have been recorded in loess, till, clay, sandy, and black soil banks (Schantz 1923, Strong 1898, Silloway 1906, Ridgway 1887, and Hess 1910) as well as in natural cavities in rock cliffs, and in sawdust mounds (Fig. 10 and 11). Hess (1910) felt that bank swallows preferred black soil to sandy soil in east-central Illinois, but there have been no systematic studies of soil usage by either of the burrowing swallows (bank and rough-winged). Nesting banks have varied in height from 5 to 75 feet.

Nearly all of our observations on foraging bank swallows involve either water areas or grassland, especially pastures (Graber & Graber 1963). The bank swallow is a colonial nesting species, and there are no population estimates that take foraging habitat into account. Beecher (1942) found 150 pairs in 1.27 acres, and 20 pairs in 0.25 acre, of banks in Lake County. Gault (unpublished notes, 1912) found a colony with only 2 pairs, but groups of 20 to 200 pairs are more typical. The largest colony, with 6,000 burrows, located on a cliff near Rock Island, was reported by Fawks (1938), but by 1966 it was down to 250 pairs (Fawks 1966). Bank swallow colonies are at the mercy of men who excavate the banks, and of those natural forces that either erode away the banks or cover them with vegetation. However, the same eroding or excavating processes that destroy nest banks also create them (Ford 1915). At present there are no data from which to judge whether banks are being destroyed faster than they are being created. A few colonies have survived many years. The colony at Rock Island, for example, is probably at least 50 years old.

#### Nesting Cycle

Information on the nesting cycle of bank swallows in Illinois is meager. In northern Illinois we first noticed these swallows working on their burrows on April 22, and carrying nesting material on April 29, but some groups of birds did not even arrive at their nesting banks until May 10. Further south, in Macoupin County, Silloway (1906) saw burrows being dug on April 25, and in the St. Louis, Missouri, area Widmann (1907) noted that most pairs did not begin nest building before May 5. Burrow depths recorded in the north by Petersen (personal communication), A. C. Murchison, Loucks, and Barnes (unpublished notes) varied from 18 inches

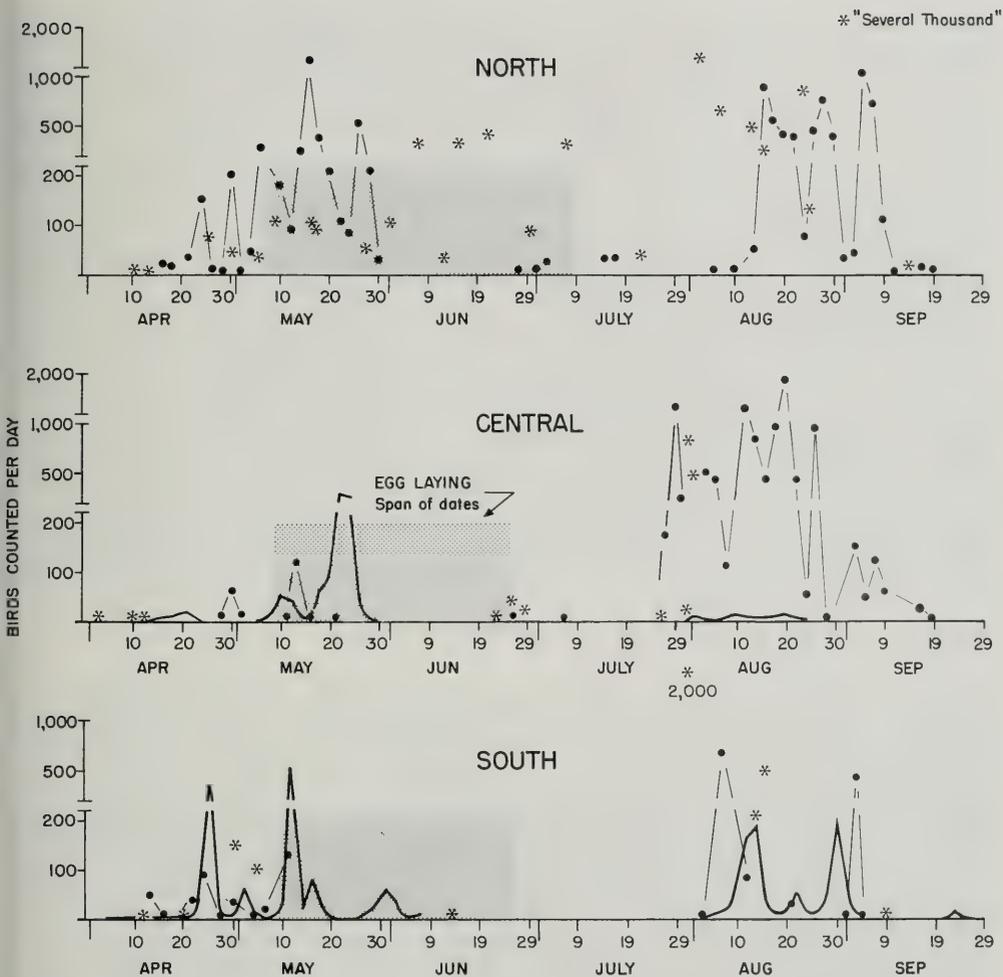


Fig. 8.—Egg-laying and migration seasons of the bank swallow in different areas of the state (see Fig. 1). Spring and fall graph lines (1967–1970) show the highest daily count of each 2 days (left scale). Asterisk symbols represent counts made in other years or by other observers. Shaded areas show the span of dates during which egg laying has been recorded. Dot symbols represent counts made on the western side of the state; lines without dots represent the eastern side.

to 6 feet, with 2–3 feet being most common. Near St. Louis, Missouri, Philo W. Smith (unpublished notes) recorded a burrow 6 feet in depth.

We have insufficient data to construct a quantitative curve of the egg laying season, but laying occurs from at least May 7 to July 9 in the north (Fig. 8). Much less complete information for central and southern Illinois (combined) indicates a

laying season from at least May 9 to June 26. At a Tazewell County colony we observed many young just ready to fledge on July 31, and John Schwegman (personal communication) saw bank swallows still entering their burrows, possibly feeding young, on August 14 in extreme southern Illinois. There are no published estimates of nesting success or productivity.

NESTS OR YOUNG

- 1950 -
- ▲ 1900 - 1949
- BEFORE 1900

PAIRS OR SINGING  
MALES (JUNE)

- 1950 -
- △ 1900 - 1949
- BEFORE 1900

**BANK SWALLOW**  
BREEDING RECORDS



Fig. 9.—Breeding records for the bank swallow in Illinois.

**Fall Migration**

We cannot say when the fall migration actually begins, but by July 15 we have seen groups of bank swallows arriving in areas where there are no colonies. After mid-July it becomes increasingly common to see flocks of bank swallows, sometimes numbering hundreds of birds, closely spaced along the power lines. It is a scene especially typical of the large river bottoms of western Illinois; by comparison, very small numbers are seen in east-central Illinois (Fig. 8). In August we often witnessed the strong affinity for heat which bank swallows and some other species of swallows show. In the hottest part of the day the birds would rest on the ground and press themselves against hot sand in the road.

During July and August bank swallows apparently roosted regularly in the large communal roosts of purple martins along the Mississippi River near St. Louis (Widmann 1898).

Peak populations came in August and early September, and bank swallows were virtually gone by mid-September. Our last record was September 23 in southern Illinois. Strode (1892) reported a great migration of thousands of bank swallows along the Spoon River on September 25, 1891. This observation may have been based on a misidentification of tree swallows, but in view of the bank swallow's

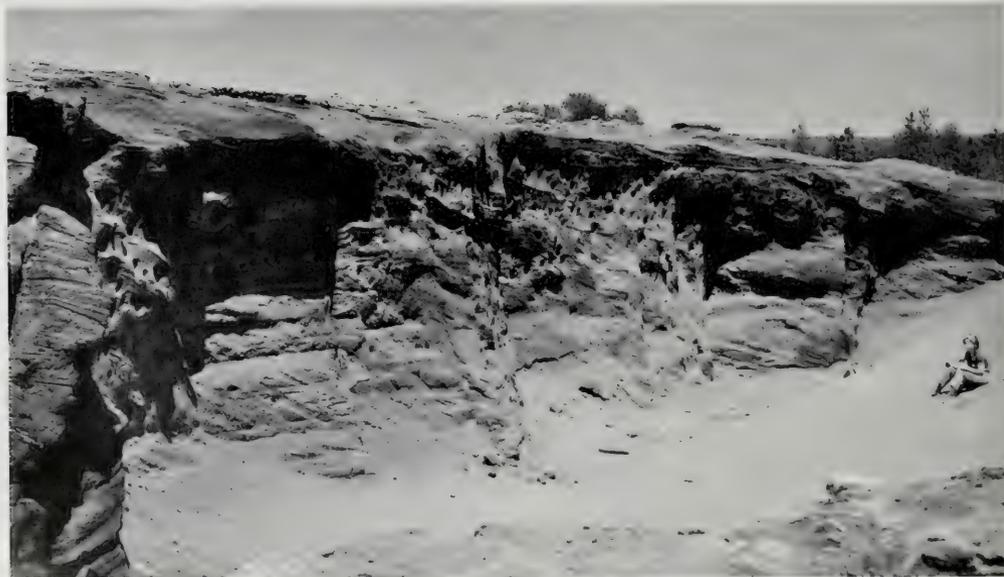


Fig. 10.—Site of nesting colony of bank swallows in a sawdust mound. Note the burrow entrances in the bank wall (near center).



Fig. 11.—Close-up of one burrow entrance in Fig. 10, showing young bird about ready to fledge.

enormous range in the north, the record cannot be discounted.

For the state as a whole, we saw about three bank swallows in the fall for every one seen in the spring, but in eastern Illinois the ratio was exactly reversed, three in the spring to one in the fall. Bank swallows are apparently more widely dispersed in the spring than in the fall, i.e., they are more concentrated on the western rivers in the fall.

There is one published banding record which indicates the winter destination of Illinois breeding birds. A bank swallow banded at Palos Park, July 16, 1939, was recovered January 6, 1940, about 3,300 miles SSE, at Iquitos, Peru (Cooke 1950).

## ROUGH-WINGED SWALLOW

(*Stelgidopteryx ruficollis*)

(Fig. 12 and 13)

### Spring Migration

The actual migration flights have apparently not been witnessed in Illinois in the spring, but they are presumed to be diurnal, as in the fall (see below). Rough-wings generally reach Illinois a week or two earlier than bank swallows (Fig. 8 and 14). Wid-

mann (1907) noted the arrival of rough-wings at St. Louis as early as the second week in March, but we did not record the species in extreme southern Illinois until March 30, and they did not appear in numbers until April 13 (Fig. 14). We have no March records for central or northern Illinois, and the earliest published records are April 6 and 9 (Silloway 1922, and Boulton & Pitelka 1939). Rough-wings are generally seen only in small numbers until after April 14 (it is unlikely for an observer to see more than 10 per day), and peak spring populations occur between April 20 and May 20 (Fig. 14). Rough-wings are much less gregarious than bank swallows, and appear to be less common (Fig. 8 and 14). Counts of rough-winged swallows were generally higher in western than in eastern Illinois, and the central Illinois counts were inexplicably lower than counts in either southern or northern Illinois (Fig. 14).

### Distribution

The general distribution of the rough-winged swallow is shown in Fig. 13, and the Illinois breeding range, so far as it has been recorded, is shown in Fig. 15. Illinois records are undoubtedly very incomplete. Rough-wing colonies are often located in the same banks where bank swallows nest, especially along major streams.

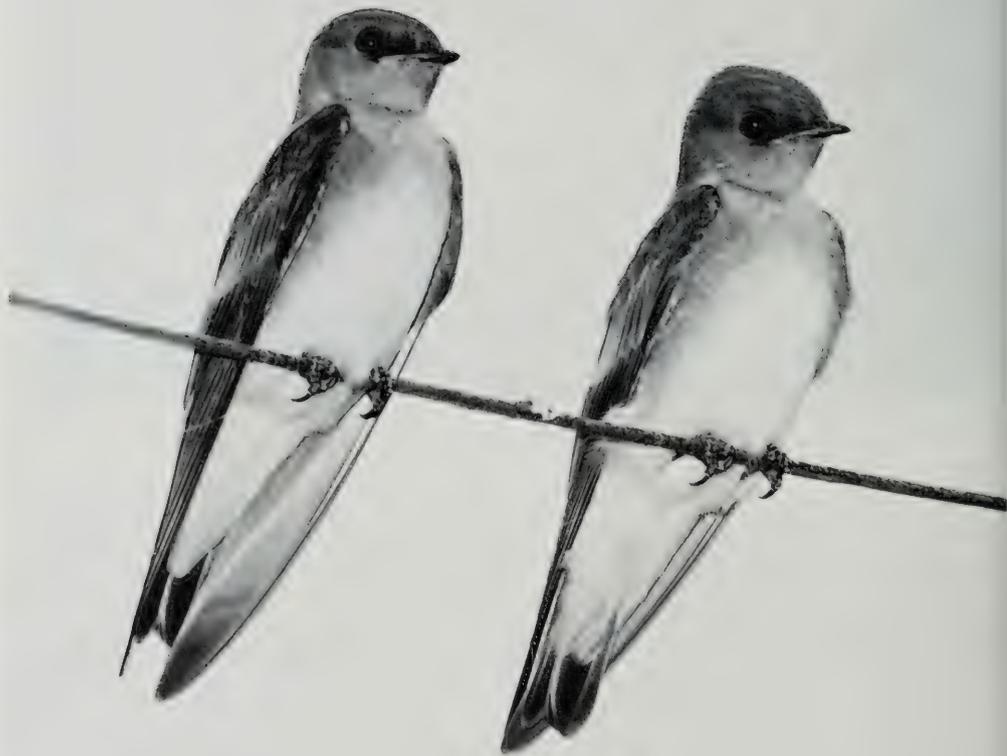


Fig. 12.—Rough-winged swallows in fresh plumage in early August. (The brown back and brownish gray wash on throat and breast are marks of this species.)

### Nesting

Rough-winged swallows are not nearly as strongly colonial as bank swallows. Hess (1909) seldom found colonies of more than five or six pairs, one or two pairs at a place being much more common, in east-central Illinois.

Rough-wings apparently nest in a greater variety of situations than do bank swallows. In addition to nesting in the banks of larger streams, rough-wings nest in the lower banks of small streams, in crevices in cliffs and even of buildings, in drain tiles, and in holes in bridges (Beecher 1942, Bodensten 1932, Mooney 1925, Moyer 1924, and Ridgway 1889).

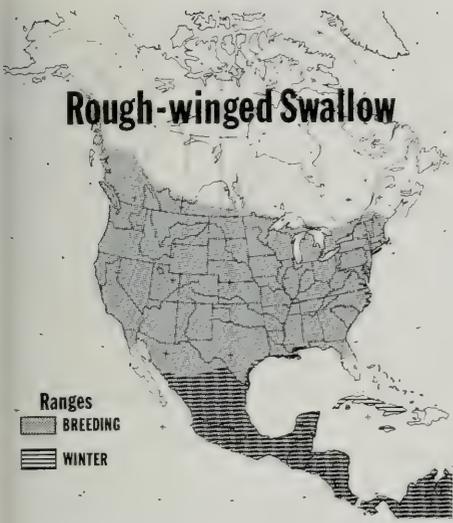


Fig. 13.—General North American distribution of the rough-winged swallow. The outlined range may include large sections in which populations of the species are thin or even absent, because of the nature of the terrain and paucity of suitable habitat. The species also breeds widely in South America. The break in the range at Panama marks the suspected southern limit of winter range of North American populations.

Hess (1910) found that rough-wing burrows were not generally as deep as those of the bank swallow. Only a few rough-wing burrows have been measured, nearly all in northern Illinois. They varied in depth from 10 inches to 3 feet, 18–20 inches being most common.

A photograph of a nest with eggs, removed from the burrow, was published by Hess (1909). Four nests were described as being made of dry grass, corn leaves and husks, and weed stems and rootlets (Loucks, unpublished notes 1891, Blocher 1922, and Goelitz 1915).

The nesting cycle of this species has received almost no attention in Illinois. Egg laying spans from at least May 7 to June 14 in northern Illinois (Fig. 14). Clutch sizes in 14 nests varied from

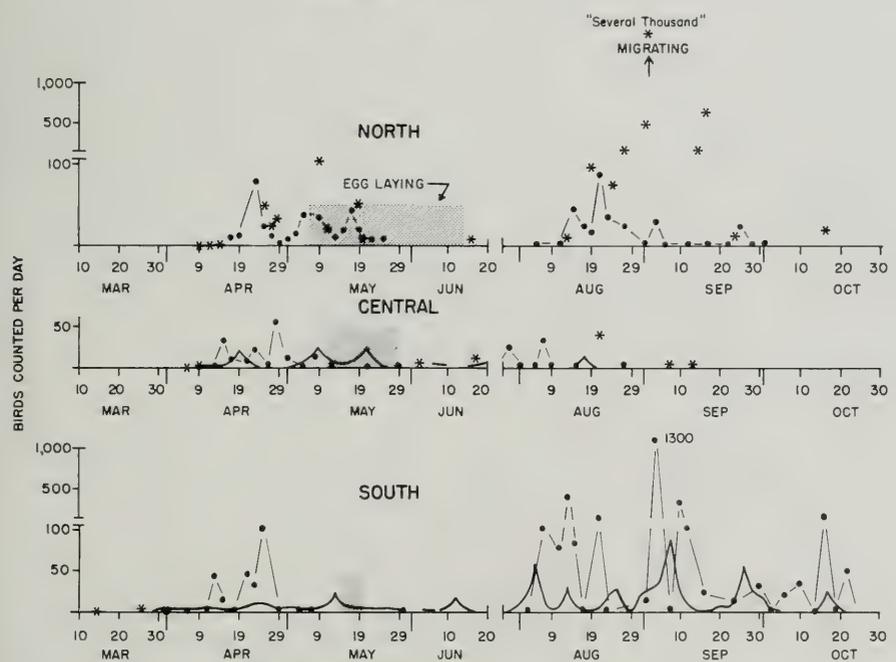


Fig. 14.—Egg-laying and migration seasons of the rough-winged swallow in different areas of the state (see Fig. 1). Spring and fall graph lines (1967–1970) show the highest daily count of each 2 days (left scale). Asterisk symbols represent counts made in other years or by other observers. Shaded areas show the span of dates during which egg laying has been recorded. Dot symbols represent counts made on the western side of the state; lines without dots represent the eastern side. Arrow symbol indicates date of actual migration.

## ROUGH-WINGED SWALLOW BREEDING RECORDS

### NESTS OR YOUNG

- 1950 -
- ▲ 1900 - 1949
- BEFORE 1900

### PAIRS OR SINGING MALES (JUNE)

- 1950 -
- △ 1900 - 1949
- BEFORE 1900



Fig. 15.—Breeding records for the rough-winged swallow in Illinois.

four to eight eggs. The eggs are white. There are no data on nesting success or productivity.

### Fall Migration

Some kind of movement, perhaps local, of rough-winged swallows begins in northern Illinois at least as early as July 23, when we have seen the birds in "new" areas away from nesting sites. In southern Illinois in early August, small groups (3-20 birds) appear widely, away from nesting sites. In mid-August and late August, many rough-wings are molting heavily, including their flight feathers.

The only observation known to us of an actual migration flight is that of Mr. and Mrs. Harry A. Shaw (personal communication) of Sterling, Illinois, who saw a fairly steady flight, involving several thousand rough-wings and some nighthawks, passing over Sterling between 2:00 PM and dark on September 2, 1968 (Fig. 14). The birds were moving south or slightly east of south. This impressive

migration coincides with the time of other peak counts of rough-wings in Illinois (Fig. 14), and such migrations should be looked for each year throughout the state. They may be of regular occurrence.

As in the spring, our poorest counts were in central Illinois. Our highest counts were in the south on the western side of the state (Fig. 14). As with other species of swallows, the largest aggregations of rough-wings were seen near the large rivers. For the state as a whole, we saw about 4 rough-wings in the fall for every 1 seen in the spring, but the ratio in the south was nearly 11 in the fall to 1 in the spring. In central Illinois the ratio was reversed with only 1 bird seen in the fall to 6 in the spring.

## BARN SWALLOW (*Hirundo rustica*) (Fig. 16 and 17)

Barn swallows begin to appear in Illinois in March (only slightly behind the tree swallows), at least as early as the 18th (Silloway 1906). The first conspicuous waves of barn swallows have been observed on April 3 in southern Illinois, April 19 in central Illinois, and April 25 in the north (Fig. 18). Peak spring populations were present from April 11 to May 17 in the south, April 25 to May 25 in central Illinois, and May 9 to 30 in northern Illinois (Fig. 18). There was a tendency for spring waves to come earlier to western Illinois, and later to the eastern side of the state (Fig. 18).

Local populations appear to be fairly consistent in the timing of their spring arrival. One Pope County barn colony usually appeared between April 11 and 13. A 25-year record of arrivals near Liberty, Illinois, showed the first barn swallows coming between April 1 and April 22, but most consistently between April 13 and 17 (Lorraine Funk, personal communication).

Though we believe the migration to be diurnal, there are, surprisingly, no published descriptions of the actual spring migration in Illinois, and we have observed the actual migration flight only in the fall.

### Distribution

The North American distribution of the barn swallow is shown in Fig. 17. The species also has a broad distribution in the Old World. The barn swallow is another species that probably nests in nearly every township in Illinois, but, as yet, the state distribution is incompletely recorded (Fig. 19).

### Nesting Habitats and Populations

Barn swallow nests have been recorded in two types of situations in Illinois: (1) barns, sheds,



Fig. 16.—Barn swallows (about one-half life size) attending a young bird which fledged prematurely. The long white-marked outer tail feathers are a distinctive mark of the species. (The back is glossy dark blue, and the underparts, chestnut-rufous.)

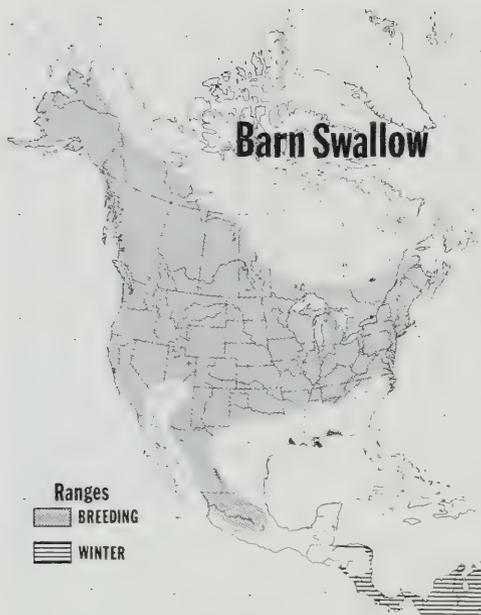


Fig. 17.—General North American distribution of the barn swallow. The outlined range may include large sections in which populations of the species are thin or even absent because of the terrain and paucity of suitable habitat. The barn swallow winters widely in South America, and also breeds in the Old World.

porches, houses, and other buildings, and (2) under cement or metal bridges and culverts. There are no quantitative estimates on the relative use of the two settings for any area of the state. One barn in Johnson County had 41 swallow nests (Petersen 1970), and we have seen bridges in the south with 20 or more nests.

The statewide censuses of 1957–1958 (Graber & Graber 1963) showed barn swallows foraging over a great variety of open field habitats, but favoring edge shrub areas (26 birds per 100 acres), alfalfa (13 per 100 acres), sweet clover (12 per 100 acres), pastures (10 per 100 acres), and ungrazed grasslands (7 per 100 acres). Guth (1965, 1966, 1967) conducted breeding bird censuses of an alfalfa-clover field in Tazewell County, and found densities of foraging barn swallows in different years of 4, 7, and 12 birds per 100 acres. Robertson (1941, 1942, 1944) found foraging densities of barn swallows over swampy prairie in Sangamon County to be about 3, 7, and 9 birds per 100 acres in different years.

The barn swallow has undergone striking pop-

ulation changes through the years in Illinois. Early in this century the species was most abundant in the northern part of the state (Graber & Graber 1963). Ridgway (1915, and in Gault 1922) reported that in southern Illinois the barn swallow (as well as the cliff swallow) had almost entirely disappeared as a breeding bird. This scarcity was also shown by the censuses of 1907–1909, when the June population for the whole southern third of the state did not exceed 20,000 birds. For the same area in 1957, we estimated the population to be about 500,000 birds, and it was even higher in 1958. The population also increased in central Illinois, from about 100,000 in 1907–1909 to 300,000 in 1957–1958, but the northern Illinois numbers did not change (about 150,000 in 1909 and in 1957–1958).

The remarkable recovery of the barn swallow in southern Illinois was not duplicated by the cliff swallow, and its populations remain very low in the south. Ridgway (1915) attributed the early 19th century decline of both species to interference from a growing house sparrow population in Illinois. How and why the barn swallow overcame this problem when the cliff swallow could not is a mystery, though one factor may be the cliff swallow's covered nest structure which is probably more attractive to house sparrows than are the open nests of barn swallows. There is an indication that house sparrow populations in rural habitats declined in southern Illinois after 1900, following the human population to urban areas (Graber & Graber 1963). This would have helped to remove competition pressure from the barn swallow. It is also possible that barn swallows made increased use of cement bridges and culverts for nesting. Furthermore, we have noted that isolated or recently abandoned farms in southern Illinois have nesting barn swallows, but no, or few, sparrows. Though we have found sparrows using barn swallow nests at colonies in all regions of Illinois, there is no recent evidence that sparrows actually displace barn swallows from active nests.

#### Nesting Cycle

Merrill (1947) recorded the same barn swallow nest being used 7 consecutive years (with annual remodeling) in Fayette County, but only Musselman (1939) has reported homing returns in Illinois on the basis of a banded bird, a female which returned "several years" to a barn in the Quincy area.

Nesting activities may begin very soon after barn swallows arrive in the spring, as we have recorded egg laying as early as April 15 in southern Illinois and April 23 in central Illinois, but not before May 6 in the north (Fig. 18). Most of the egg production comes between early May and mid-July, and the egg-laying curve has several peaks (Fig. 18). This suggests that two or more broods are raised, but though barn swallows have been reported to

raise two or three broods, this premise has not been substantiated from observations of banded birds in Illinois. Re-use of a successful nest is not proof of double-broodedness.

Surprisingly, for such an interesting nest structure, there are no published notes on the nest building phase of the cycle for the barn swallow. Loucks (unpublished notes, 1890) stated that the nest was made of mud and hay, loosely lined with white feathers. Studies of nest construction in relation to soil types would be of interest. Are barn swallow populations reduced in sandy soil areas?

For four June nests in southern and northern Illinois, we recorded nest-building periods of 8, 9, 9, and 12 days. Incubation periods for several nests in central and southern Illinois varied from 14 to 16 days, most frequently being 15, and nestling life was 16-20 days. Davis (1968) also recorded a nestling period of 16 days. Thus, one nesting cycle, including egg-laying for a four-egg clutch, would require 41-51 days, which is about the interval between the May and July peaks in egg-laying (Fig. 18), and further indication of double broods.

Most barn swallow nests receive five eggs. Many receive four, and six-egg clutches are not uncommon (Table 1). There is at least one record of a nest with seven eggs (Blocher 1926). Clutch size declines slightly as the season passes (Table 1). The disparity in the number of five-egg clutches in April and May between central and southern Illinois (Table 1) is puzzling, but sample sizes are small and more data are needed to determine if the differences are real.

Nesting success (Table 2) was similar for our samples of barn swallow nests in central and southern Illinois (65-70 percent of eggs produced fledglings), but the sample for northwestern Illinois showed very low success (only 21 percent). Larger samples of nests and more years of study are needed to show whether there is truly such marked regional variation in nesting success of barn swallows. We cannot account for the poor success observed in the northwest on any quantitative basis, because of the small sample. We saw one active barn swallow nest usurped by house wrens, as did Schafer (1916) also in the same region. House sparrows occupied a few inactive swallow nests in all regions. More nests fell and more eggs disappeared in the north-

TABLE 2.—Fledging success of barn swallows.

| Region    | Year | Number of Nests | Percent Fledged |      |
|-----------|------|-----------------|-----------------|------|
|           |      |                 | Nests           | Eggs |
| Northwest | 1968 | 17              | 26              | 21   |
| Central   | 1969 | 47              | 74              | 70   |
| South     | 1967 | 51              | 70              | 65   |

west than in the other regions. No other causes of nest failure have been recorded. The question of early-season versus late-season nesting success also needs quantitative study.

Davis (1968) has provided the only Illinois data on the care and feeding of young barn swallows in the nest. He observed that the adult birds made between 12 and 31 feeding trips per one-half hour, and he estimated that the adults made 626 trips per day to feed a brood of five 10-day-old nestlings. He captured the adults and observed that the food they were carrying was flies (species not reported), a minimum of five per trip.

#### Fall Migration

Some barn swallows remain near their nesting areas (barns, bridges, etc.) weeks after the last young have fledged, but generally the departures of swallows from local colonies can be detected during late July and August, even though the birds may not leave all at once. We have seen active migration as early as July 23 in northern Illinois, and migration flights have been observed widely in August. Our observations are much like those of Barnes (1933) who described the migration as a continuous passage of birds southward, singly, in pairs, and in small groups. We have also seen more concentrated migrations, involving hundreds of birds passing in a few minutes, particularly along the Mississippi valley in August. Such migrations often involve more than one species of swallow. In contrast to the circling foraging flights, the migration flights are straight, and the flight directions we have recorded were south (mainly) and southwest. All of the flights we have observed were probably within 250 feet of the ground, but flights at higher altitudes could easily be overlooked. There are no data on the timing of the flights through the day, and we do not

TABLE 1.—Clutch sizes of barn swallows in Illinois.

| Region  | Months    | Number of Nests | Average Clutch | Percent of Nests by Clutch Size |        |        |        |
|---------|-----------|-----------------|----------------|---------------------------------|--------|--------|--------|
|         |           |                 |                | 6 Eggs                          | 5 Eggs | 4 Eggs | 3 Eggs |
| North   | June-July | 22              | 4.5            | 14                              | 41     | 27     | 18     |
|         | April-May | 21              | 4.9            | 10                              | 71     | 19     | 0      |
| Central | June-July | 32              | 4.6            | 9                               | 50     | 31     | 9      |
|         | April-May | 26              | 4.8            | 27                              | 42     | 27     | 4      |
| South   | June-July | 30              | 4.3            | 0                               | 43     | 43     | 13     |

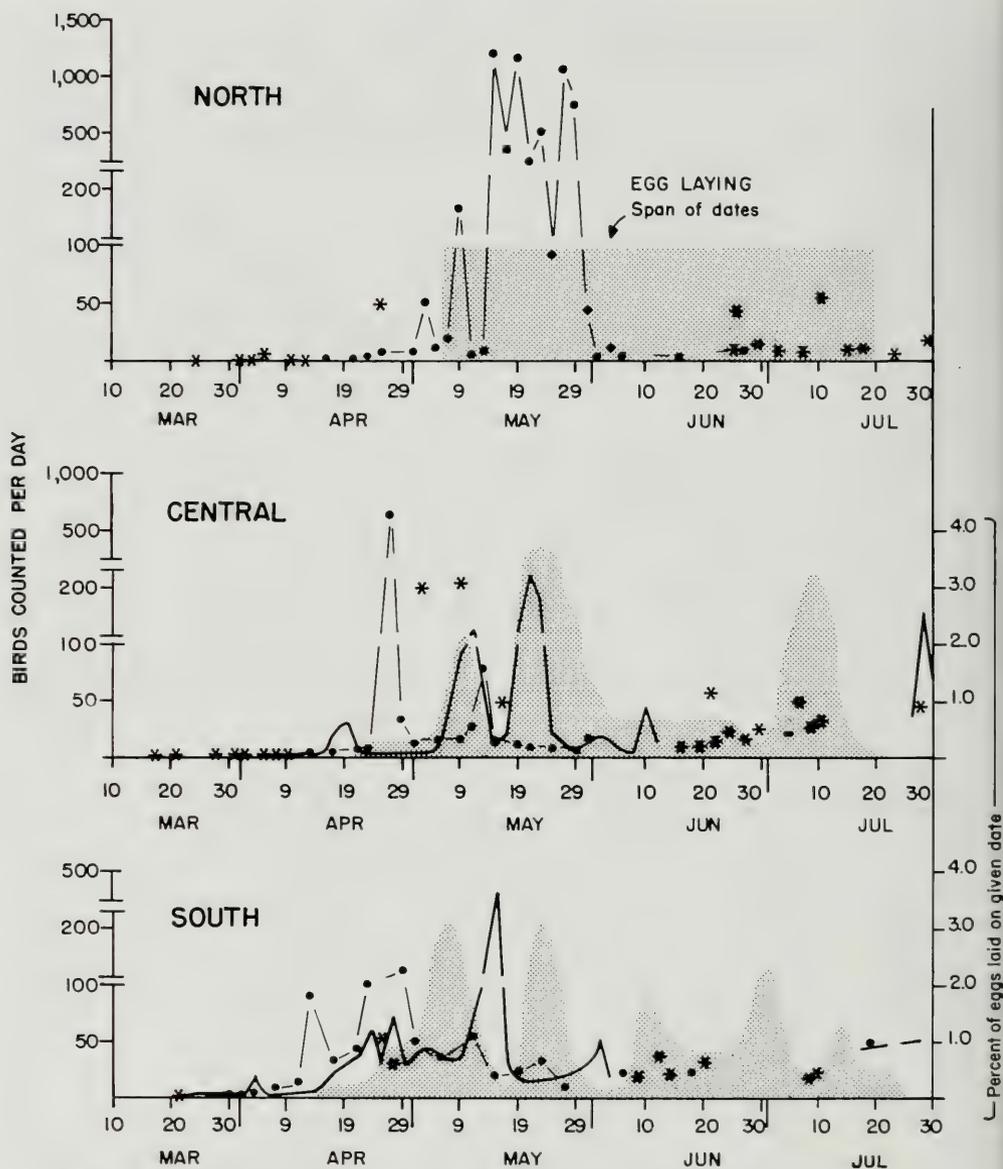
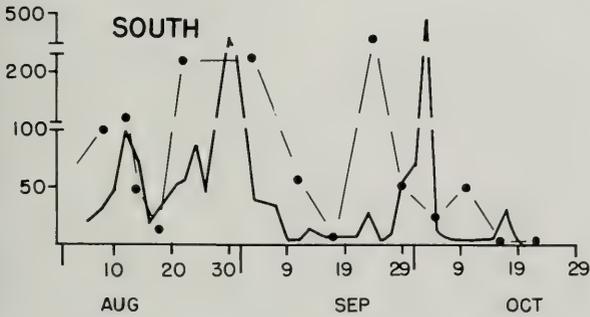
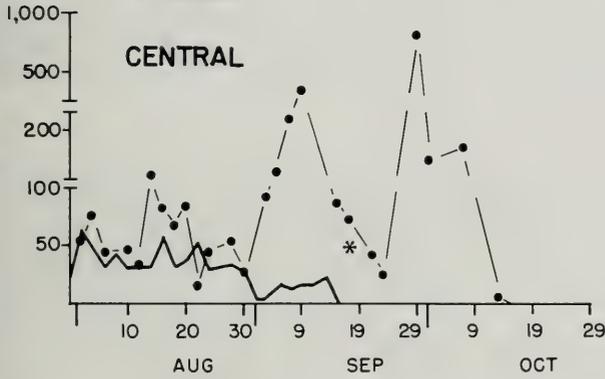
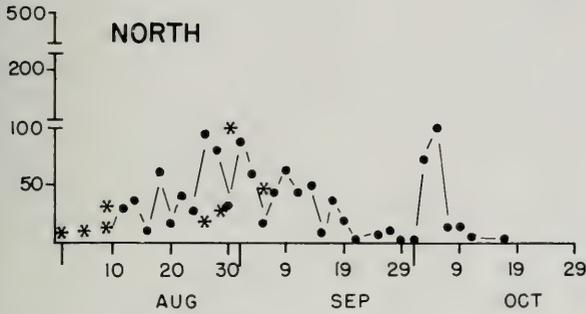


Fig. 18.—Egg-laying and migration seasons of the barn swallow in different areas of the state (see Fig. 1). Spring and fall graph lines (1967-1970) show the highest daily count of each 2 days (left scale). Asterisk symbols represent counts made in other years or by other observers. Shaded areas show the percent of eggs laid on a given date (right scale) or the span of dates during which egg laying has been recorded. Dot symbols represent counts made on the western side of the state; lines without dots represent the eastern side.



## BARN SWALLOW BREEDING RECORDS



Fig. 19.—Breeding records for the barn swallow in Illinois.

know whether the flights are restricted to narrow corridors, such as river valleys, or occur on broad fronts. A very spectacular flight of barn swallows and other species, perhaps numbering tens of thousands of birds, was witnessed by Loraine Funk (personal communication) on August 10, 1971, near Lake Meredosia. The birds were moving ahead of a storm, which may have concentrated birds from a large area.

Many observers record the last barn swallows of the year in August or September (Oberholser 1918, Clark & Nice 1950, and others), but large numbers of barn swallows may be seen in Illinois well into October (Fig. 18), especially along major water courses, and in 1971 a few were detected as late as November 6 on the Chicago lake front. We recorded peak fall populations in the state between August 12 and October 9. In southern Illinois, Nelson (1877) noted that barn swallows became abundant toward the last of August, and our censuses also show this pattern (Fig. 18).

In central and southern Illinois we saw about two barn swallows during fall migration (mid-July to mid-October) to one in the spring (April and May), but in northern Illinois the massive migration

of 1968 reversed the ratio, and we saw only one bird in the fall to four in the spring.

In Missouri, Widmann (1907) observed large aggregations of barn swallows and other species at marshes, where the birds roosted regularly in the fall. Large roosts of barn swallows have not been reported in Illinois, though Nelson (1877) did note large groups of barn swallows, cliff swallows, and martins appearing in the evenings in late August near Cairo. Presumably there was a roost in the area, but Nelson gave no description or location of it. Especially in the Mississippi Valley, we have observed hundreds of swallows resting on cornstalks during the late evening and early morning. In lieu of marshes, the swallows were apparently using cornfields as roosting areas.

### Winter Records

There is one winter record for the barn swallow in Illinois, two birds observed closely and repeatedly at the Carbondale Reservoir during a Christmas count on December 29, 1954 (Anon. 1955). There is no other evidence that the birds actually wintered through in Illinois, and the record should be considered accidental.

### Food Habits

Forbes' (1878) study included only two specimens of barn swallows, and no significant data on this species. The only other information on the food in Illinois, aside from Davis' (1968) observations on the feeding of nestlings, as mentioned above, is that of Chase (1896) who observed a barn swallow regurgitate pellets which were composed almost entirely of the hard indigestible wing covers of very small beetles. There is a great need for thorough studies of the food habits of this and the other species of swallows.

### CLIFF SWALLOW (*Petrochelidon pyrrhonota*) (Fig. 20, 21, 22, and 23)

#### Spring Migration

A few cliff swallows reach Illinois as early as March 29 or the first of April some years, but they are not usually seen until mid-April (Oberholser 1917), and not generally in numbers until late April or May (Fig. 24). Cooke & Widmann (1884) found that most of the local breeding population had returned to the St. Louis area by May 3. There appears to be great annual variation in the spring populations. In 1968, migrant cliff swallow populations were high. Censusing in northwestern Illinois (Fig. 24), we had one count (May 19) of nearly 10,000 birds, and about the same time Frank Bellrose



Fig. 20.—Site of cliff swallow colony on the Apple River in Jo Daviess County. A cluster of (darkish) nests may be seen on the cliff in the foreground, left of center.



Fig. 21.—Close-up of cliff swallow colony showing birds at their retort-shaped nests. One nest (center bottom, with bird facing) has the shell only about half completed. Note pale rump of bird in flight; this is a field mark of the species.



Fig. 22.—Cliff swallow, about life size, ready to enter nest. Note the whitish forehead, a field mark for the species. When a colony is disturbed, many birds remain in their nests, but peer out as the bird below is doing.

# Cliff Swallow

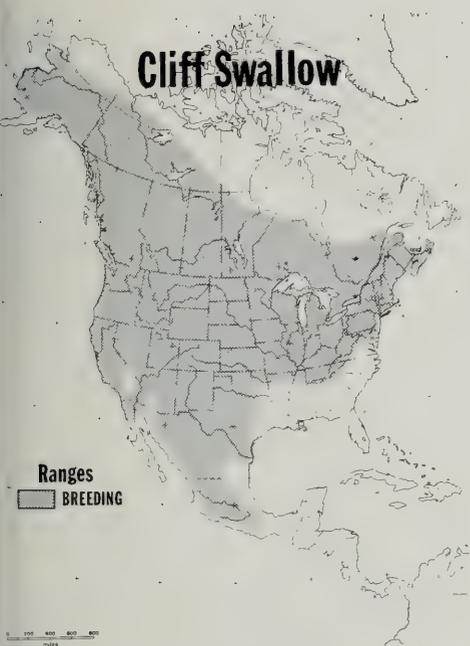


Fig. 23.—General breeding distribution of the cliff swallow.

The outlined range may include large sections in which populations of the species are thin or even absent because of the nature of the terrain and paucity of suitable habitat. Cliff swallows winter mainly in the southern half of South America.

now is probably in northwestern Illinois. Jo Daviess County has long been a dependable haven for this species (Kennicott 1853–1854).

We hope that further exploration of stream cliffs and bridges will turn up additional colonies throughout the state. Besides the nest records plotted (Fig. 25), there are breeding records for Cook, Lake, Champaign, and Piatt counties by Goelitz (1917), Ogle County by Allen (1868), and Sangamon County by Eifert (1945), but definite localities were not specified. There are no Illinois references on cliff swallow distribution in relation to soil types, but Butler (1891) believed that the swallow was almost strictly an upland species in southern Indiana because of the need for clay soils without sand for nest construction (see also Buss 1942).

## Nesting Habitats and Populations

The cliff swallow is generally a colonial nesting species, though nestings by solitary pairs also occur. We have found single active nests along stream cliffs that were at least several hundred yards from any colony. Schafer (1920) recorded solitary nests on barns, and, at the other extreme, 256 nests on a barn (1932). Most of the colonies recorded, however, numbered between 12 and 100 nests.

No one has attempted a precise definition of cliff swallow habitat for any season, and though there are descriptions of nest sites (see Fig. 21), almost nothing has been recorded on foraging habitats. Our few records for the nesting season showed cliff swallows foraging over grasslands, hayfields, small grain fields, and streams.

Natural nesting sites are cliffs, especially cliffs with overhangs, usually along streams. Colonies along the Apple and Fox rivers are typical. Most of the published nesting records, however, refer to barn colonies, i.e., nests placed under the eaves of barns (Hammond 1939), often well away from streams. The use of barns as nest sites probably goes back to the early history of white settlement. Most of the cliff swallow population at one time was in colonies of this type in Illinois, but such colonies have been declining for many years. We know of only one still extant, although there are probably still several left in the northwestern part of the state.

In general, the breeding population of cliff swallows in Illinois appears to be in decline. There was a particularly striking change in the nesting population between 1880 and 1910. Ridgway (1887, 1915) saw the status of the cliff swallow change in parts of southeastern Illinois from common to absent. Similarly, in east-central Illinois Hess (1910, 1921) found cliff swallows common in the 1880's, yet by 1909 he recorded the last known nesting for the area. The same pattern was observed by Barnes (1912) in Marshall County, and there are many references which show the fading population in the Chicago area (Lewy 1943;

(personal communication) found exceptional numbers near Havana, in central Illinois (Fig. 24). Similarly, Anderson (1963) found exceptionally high populations, many thousands, in the St. Louis area during the second week of May, 1963. Our counts for central and southern Illinois in other years were much lower, but the marked annual variation precludes any comment on possible regional variation. The migration needs study over a long period of years.

Gault (unpublished notes, 1892) witnessed the actual diurnal migration of cliff swallows near Glen Ellyn on May 15, when he saw flocks moving directly north. There is no other reference on, or description of, the actual migration flights.

## Distribution

The general distribution of cliff swallows is shown in Fig. 23, and the Illinois distribution, so far as it has been recorded, in Fig. 25. There are no recent nesting records for central Illinois. It is our impression that the range of the species in Illinois has been steadily receding to the north, leaving only relict populations in a few places, and most of the state population

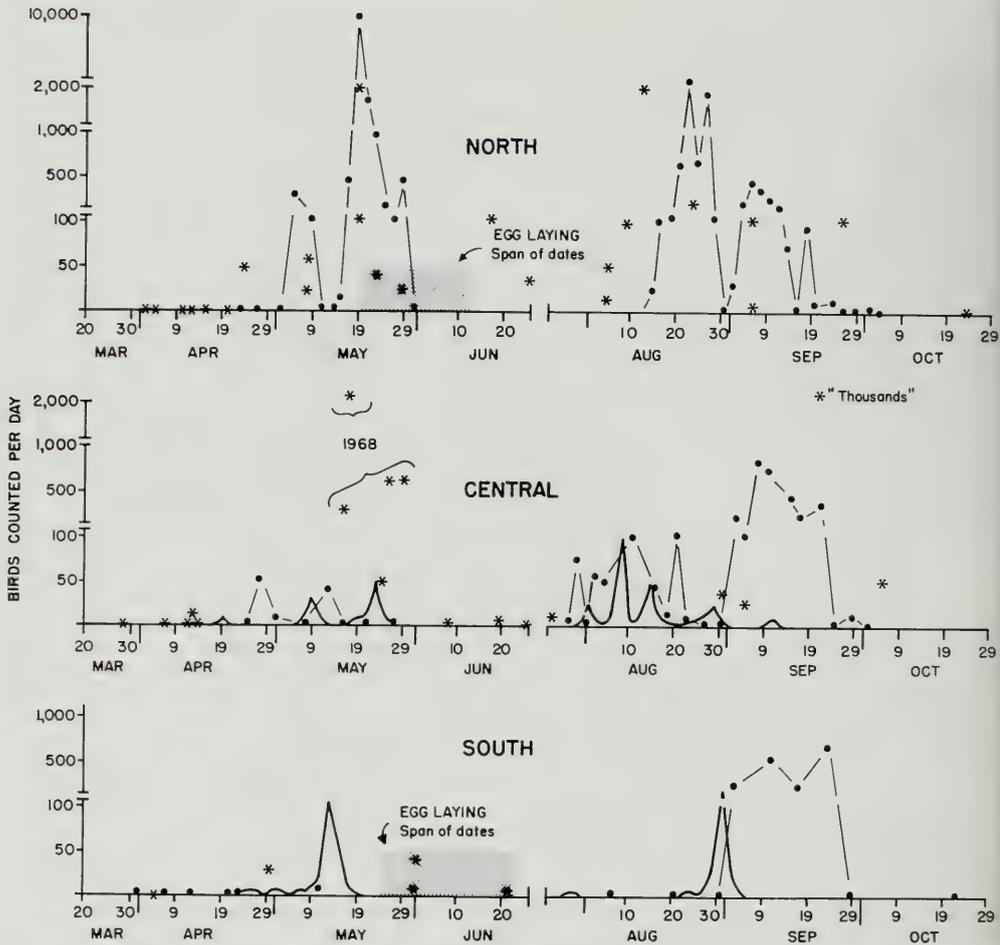


Fig. 24.—Egg-laying and migration seasons of the cliff swallow in different areas of the state (see Fig. 1). Spring and fall graph lines (1967-1970) show the highest daily count of each 2 days (left scale). Asterisk symbols represent counts made in other years or by other observers. Shaded areas show the span of dates during which egg laying has been recorded. Dot symbols represent counts made on the western side of the state; lines without dots represent the eastern side.

Eifrig 1919; Ford, Sanborn, & Coursen 1934; Gault 1922; and others).

Most observers blamed house sparrows, which usurped swallow nests, for the decline, and the evidence is strong in support of this view. The house sparrow was then well on its way toward colonizing the state, and its population was expanding rapidly (Barrows 1889). The competition was observed directly. Loucks (1895), for example, saw a large colony of cliff swallows completely displaced by house spar-

rows. Schafer (1920, 1921, 1922, 1932) has provided the best quantitative history of a colony, and its problems with house sparrows. Before the house sparrow's colonization of the state, the Schafer's barn in Rock Island County had about 200 cliff swallow nests each year. After house sparrows arrived, the cliff swallow colony began to decline, and by 1913 the swallows were gone. That year Schafer began a sparrow control program. He protected the swallows and destroyed house sparrows. One pair of swallows returned

## CLIFF SWALLOW BREEDING RECORDS

### NESTS OR YOUNG

- 1950 -
- ▲ 1900 - 1949
- BEFORE 1900

### PAIRS OR SINGING MALES (JUNE)

- 1950 -
- △ 1900 - 1949
- BEFORE 1900



Fig. 25.—Breeding records for the cliff swallow in Illinois. The record for Coles County represents attempted nesting by cliff swallows in burrows at a bank swallow colony.

in 1914, and by 1916 there were 3 pairs; by 1920 there were 65 pairs, and by 1932 there were 256 pairs. Cliff swallows did not generally receive this kind of protection. Fawks (personal communication) recorded a barn colony of 23 pairs of cliff swallows still in Rock Island County in 1958, but they had disappeared by 1971.

The problems of the cliff swallow with house sparrows continue. Every cliff swallow colony we have visited in recent years, including those in natural cliff sites, has some sparrow occupancy of nests.

A worthwhile goal for bird students in Illinois would be an annual census of the major nesting areas of this species. Because most of the colonies are located along a few streams, a virtually complete census of the state population could be made fairly easily each year, and would clearly show the survival problems of the species.

Despite the interest of many Illinois students in the cliff swallow, there is almost nothing recorded on the nesting cycle. Egg laying occurs from at least May 20 in the north to June 23 in the south. More study will

probably show that the egg-laying period extends much longer than this at both ends in both regions. There are no data for the central region. Schafer (1921, 1933) recorded that two broods were raised, and that one year all young were fledged by July 15.

There have been no measurements of nesting success or productivity, but a few causes of nest failure have been mentioned (other than the house sparrow, discussed above). Schafer (1923) recorded nest destruction by a red-headed woodpecker (*Melanerpes erythrocephalus*). Kimball (1889) recorded very high mortality of nesting birds in Winnebago County, apparently from starvation because of unseasonably cool weather that had reduced insect food in June right after nests had been completed. Kimball estimated that only 5 percent of the local population survived, and he examined many specimens found dead in nests and on the ground near nest sites. The specimens were extremely emaciated. Hammond (1939) reported on the loss of nests washed away by heavy rains, and Mrs. Albert J. Brown of Apple River told us of cliff swallow nests being washed away by flooding. Schafer (1932) recorded mortality of nestlings during exceptionally hot weather in June that seemed to cause birds to fledge prematurely. Dry weather also had an adverse effect sometimes, through its effect on the availability of mud for nest construction (Hammond 1939). Eifrig (1937) felt that the painting of barns had an adverse effect on cliff swallows, because nests did not stick well on painted barns.

Cowbird (*Molothrus ater*) parasitism of cliff swallows has been recorded in Illinois, but the incidence is negligible (Friedmann 1963).

The tick *Ixodes baergi*, which is parasitic on cliff swallows, especially nestlings, has been recorded in Illinois (Kohls & Ryckman 1962), but its influence, if any, on nesting success is unknown.

### Fall Migration

Gault (unpublished notes, 1897, 1900) observed diurnal migration flights of cliff swallows on September 5 and September 16, but the southward flights must begin before September. In central Illinois we have seen groups of cliff swallows far from any nesting area as early as July 30, and in northern Illinois Mr. and Mrs. Harry Shaw saw the buildup of nonbreeding aggregations of cliff swallows from 50 birds on August 4, 1971, to about 2,000 by August 13. Our data for other years show a similar pattern in northern and central Illinois, but aggregations of migrant cliff swallows appeared later in southern Illinois (Fig. 24). At Cairo, Nelson (1877) noted that the species became abundant the last of August.

In August and early September nearly all of the cliff swallows we saw were in badly worn plumage, and in August we often saw them basking in roadways in direct sunlight, pressing themselves against the hot sand. We cannot explain this behavior, but other spe-

cies of swallows, most notably bank and barn swallows, did the same thing.

Observers generally give departure dates for the cliff swallow in mid-September or late September (Oberholser 1917, and Schafer 1917-1918), and our censuses also showed that most of the cliff swallow population is gone from Illinois by the end of September. A few birds have been recorded as late as October 22 in the south and October 24 in the north (Fig. 24; Clark & Nice 1950). Frank Bellrose (personal communication) observed an exceptionally late aggregation ("thousands") on October 16, 1970, flying south along the Illinois River Valley near Havana.

As with other swallows, cliff swallows were seen in greatest numbers near the large rivers, and on the western side of the state (Fig. 24). Cliff swallows were numerous along the Rock River, as well as the Mississippi, whereas tree swallows were found in much smaller numbers along the Rock River than the Mississippi.

Because of the exceptionally large spring migration in 1968, when we censused in northwestern Illinois, the spring-fall ratio of cliff swallows for the region (2 birds in the spring to 1 in the fall) differed greatly from the ratios in central (1 bird in the spring to 16 in the fall) and southern Illinois (1 in the spring to 7 in the fall). In most years, the fall population probably far exceeds the spring population throughout the state.

#### Food Habits

Forbes (1878, 1882) examined the stomachs of six cliff swallow specimens, one of which was collected in Tazewell County in the summer. He gave no locality or season for the other specimens. Beetles, including a scavenger beetle (*Aphodius inquinatus*), were the dominant food items, with Hymenoptera (wasps and ants) next in abundance.

As in the case of other species of swallows, we have noted that the large aggregations of migrant cliff swallows coincide with conspicuous populations of midges (Chironomidae). In May, 1968, we observed cliff swallows feeding steadily on chironomids, notably *Chironomus crassicaudatus*.

#### PURPLE MARTIN (*Progne subis*)

(Fig. 26, 27, and 28)

#### Spring Migration

Cooke (1888) hinted that the purple martin's migration is nocturnal, but there is also some evidence of diurnal migration, as discussed below under Fall Migration. Martins have been observed to arrive at their nest sites at various times of the day, morning and afternoon (Gault, unpublished notes 1885-1905, Cooke 1888, and Cooke & Widmann 1884), and Wid-

mann observed a few birds in what was apparently northward migration at 5:30 P.M. on March 30, 1885 (Cooke 1888). In view of the popularity of this species and its tendency toward gregariousness, it is surprising that no one has reported a large scale migration of martins in Illinois.

The earliest arrival date reported for the martin in Illinois was February 24, 1923, at Metropolis (Conley 1926), an exceptionally early arrival. Alleged martin records for February in Illinois often turn out to be based on misidentifications, but probably there are reliable (though rare) records in this month. March records prior to the 10th are probably unusual even in southern Illinois (Johnston & Hardy 1962), and though there are reports as early as March 5 for central Illinois (Nolan 1956), and March 10 for the north (Boulton & Pitelka 1937), the very first martins, usually adult males, are not likely to be detected before March 15 in the south, and March 23 in central and northern Illinois. Martins are subject to stress and mortality from cold (Jones 1910, Kimball 1889, Smith 1943, and Musselman 1966) though they have been known to survive 2 or 3 days of severe cold (15° F.) and snow (Nolan 1956, and Schafer 1921). Most of the state population does not appear until April or May. Yearlings arrive later, often weeks later, than adults (Cooke & Widmann 1884). The migration is prolonged, regularly extending from March into June, and our peak counts came between mid-April and the end of May (Fig. 29). The counts were lowest in southern Illinois and highest in the north.

#### Distribution

The general distribution of the purple martin is shown in Fig. 28. Though martins almost certainly nest in every township in the state, the Illinois nesting distribution (Fig. 30) has not been recorded in sufficient detail; there are no published records for whole counties of the state.

Illinois citizens are showing increasing interest in attracting martins, in part because of the publicity given the species by the Griggsville Wild Bird Society. Griggsville, Illinois is called the Purple Martin Capital, and is the site of an industry based on the bird (the manufacture of nest boxes and auxiliary equipment), and of a news publication, "The Purple Martin Capital News," an interesting source of information on martins and other birds.

#### Nesting Habitats and Populations

Even from early historical times purple martins have rarely been found nesting in natural cavities in Illinois (Ridgway 1874, and Ries & Werner 1946). A notable recent exception is the record of Petersen (1966), who found martins nesting in tree stumps standing in the water of the Mississippi River near Thomson (Fawks 1966). There are no records of "nat-



Fig. 26.—Adult male purple martin.

ural" colonies in upland habitats, but this void may only reflect the inadequate level of ornithological exploration of Illinois. The percentage of the state population nesting in natural cavities is unknown, but probably very small. Martins have also been recorded nesting in the walls of buildings (Blocker 1933; Loucks, unpublished notes 1889), and in bridge superstructures, besides bird houses of many designs (Anon. 1968).

Aside from recommendations on the placement of nest boxes—13–18 feet high, in the open (Widmann 1905, and Gault 1934–1935)—there are no data on the characteristics of even the domestic habitat of purple martins, though Widmann (1907) believed that old river towns were most favored. There are, or have been, active colonies in the business districts of small cities, e.g., Durand, LeRoy and Griggsville, Illinois, and as near the Chicago loop as Lincoln Park, but the tolerance limits of martins to human traffic, as well as their essential habitat requirements, are unknown. More than most Illinois species though, the martin

seems safe from habitat destruction, what with the expanding acreage of human residential areas.

There are few population measurements for the purple martin in Illinois. Our strip censuses of urban areas in 1958 showed densities of 25 martins per 100 acres in northern Illinois towns, 11 per 100 acres in central Illinois, and 42 per 100 acres in southern Illinois. We recorded measurable populations of purple martins away from human residential habitat only in northern Illinois, where martins were foraging over fallow fields (about 4 birds per 100 acres), shrub areas (2 per 100 acres), oat fields (2 per 100 acres), soybean fields (1 per 100 acres), alfalfa fields (1 per 100 acres), and cornfields (0.2 per 100 acres).

In 1907–1909 Alfred Gross (personal communication) recorded June foraging densities for the martin in southern Illinois as follows: about 1 martin per 100 acres over fallow fields and pastures, 0.5 per 100 over cornfields, and 0.3 per 100 acres over hayfields. As all of these figures were based on cross-country censuses, the location of colonies in relation to available



Fig. 27.—Adult male and female martins at nest box. The bird on top of the box is a first-year male.

habitats was unknown. The problem of foraging preferences of purple martins and other swallows could better be studied at individual colonies so that habitat use can be determined in relation to habitat availability. At present there are no such data available, and studies are needed.

Most significant and interesting are the studies of Karl Bartel (1945, 1946, 1955, 1959), who, with the help of Alfred H. Reuss, Jr. in the early years, censused the nesting martin population of Blue Island, Illinois, annually beginning in 1936. Blue Island, a city of about 22,000 people in northeastern Illinois, has an area of about 3.5 square miles (U.S. Bureau of the Census 1960). Between 1936 and 1959, Bartel (1959) recorded a low population of 151 pairs (about 13 birds per 100 acres) in 1937, and a high of 331

pairs (about 29 birds per 100 acres) in 1945 and 1950. On the average, the population varied only about 11 percent from one year to the next, but the maximum variation was 29 percent between 1937 and 1938. Bartel also provided data on nest box utilization. Between 1936 and 1948, each year about 60 percent of the 53 available houses (yearly average) had martins. Over a period of years about 92 percent of the available houses were used by martins, based on data from Bartel (1946). Of 10 houses that were up 23 years, three had martins every year. At St. Louis, Widmann (1922) had 86 percent occupancy of nest boxes by martins in 1888. Comparative data are needed for other areas of the state.

The ups and downs of the Blue Island martin population could not be explained on the basis of any

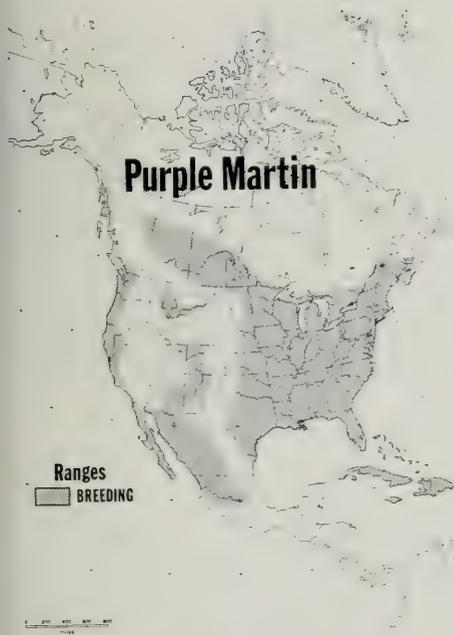


Fig. 28.—General breeding distribution of the purple martin. The outlined range may include large sections in which populations of the species are thin or even absent because of the nature of the terrain and paucity of suitable habitat. The winter range of the purple martin is in South America, but poorly known.

physical factor, or any single factor. One factor difficult to evaluate was inconsistent care of nest boxes. The factors most often mentioned in the literature as affecting martin populations are weather (Musselman 1966, and Bartel 1947), and competition from house sparrows, starlings, and house wrens (Ridgway 1915, Barnes 1890, Bartel 1946, and Widmann 1905). Eifrig (1937) felt that martins declined with the decline of horse stables, reflecting a reduced fly population. There are no precise quantitative data to show the influence of any of these factors on martin populations. However, a crash in the martin population was observed widely in the Midwest in 1966, coincidentally with subfreezing spring temperatures after the martins had arrived, and dead martins were found in and around nest boxes (Petersen 1966, and Musselman 1966). Martin populations were still somewhat depressed the following year in Illinois and Iowa (Petersen 1967).

#### Nesting Cycle

Though there are few published data on the nesting cycle for any Illinois population of purple martins,

Widmann's (1884, 1922) studies of the species in the St. Louis, Missouri, area are important and pertinent. He estimated the time requirement for a successful nesting, to fledging, to be about 8 weeks—2 for nest building and egg laying, 2 for incubation, and 4 for the development of the nestlings. He believed that an additional 2 weeks of parental care were required after fledging. Widmann's figures are similar to those of Allen & Nice (1952) for a Michigan population, except that they recorded incubation periods of 15–19 days.

The early spring arrival of the purple martin in relation to its nesting has been a point of discussion by Widmann (1922), Johnston & Hardy (1962), and others. Though nest building has been recorded as early as March 24 in southern Illinois (Johnston & Hardy 1962), and April 18 in the north (Gault, unpublished notes 1906), the earliest egg date is "mid-April" in the south; it was May 5 in the north (Fig. 29), showing lapses of 2–3 weeks between nest building and egg laying. Widmann (1922), and Johnston & Hardy (1962), suggested that the early arrival and nest occupancy of the martin is related to intraspecific competition for cavities, going back to the times when only natural cavities were available, and probably in short supply.

Nest building, which is carried out by the female, is prolonged, interrupted sometimes for days at a time, particularly during inclement weather (Widmann 1922, and Johnston & Hardy 1962).

A variety of materials have been used for nest construction—paper, dry leaves, twigs, catalpa pods, asparagus stalks, dry grass, rags, string, straw, weed stalks, cow manure, and mud, the mud being used to form a solid wall or mat that slopes down from the box entrance to the rear of the box (Widmann 1880, Gault 1934–1935, Johnston & Hardy 1962, Loucks, unpublished notes 1889, and Silloway, unpublished notes 1920–1924). These students, as well as Barker (1965), observed that martins also often bring fresh green leaves to their nests. This behavior seems to be something more than just nest construction, as the leaves are brought after the nest is largely complete and from time to time through the nesting cycle. Leaves of pear (*Pyrus* sp.), poplar (*Populus* sp.), elm (*Ulmus* sp.), peach and apricot (*Prunus* sp.) have been recorded in Illinois nests (Barker 1965, Launer 1967, and Reiss 1971), but other species are probably used. Various functions have been ascribed to this behavior, including: the addition of moisture to the nest chamber, cooling of the nest cavity, concealment of the eggs, and fumigating the nest to discourage ectoparasites. None of these theories has been proved.

The mid-April laying date recorded by Hardy in Southern Illinois may be exceptional (Johnston & Hardy 1962), as it occurred in a particularly mild spring. He believed that more typically the egg-laying

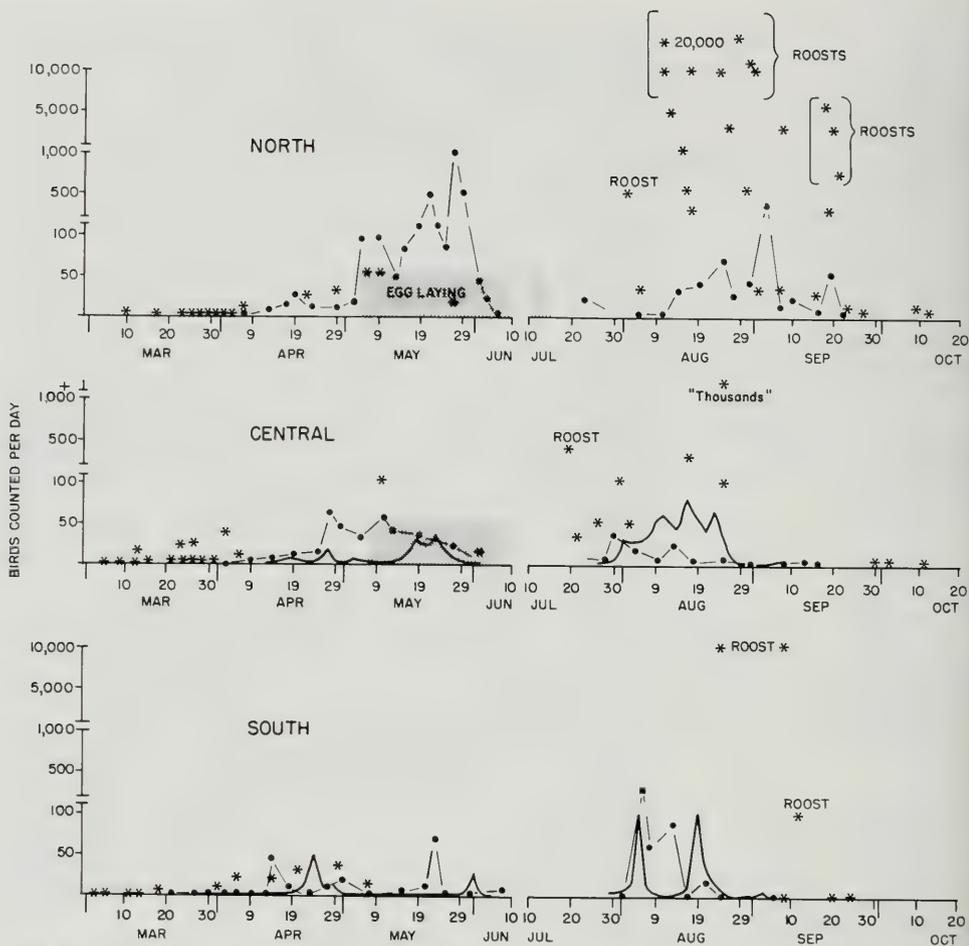


Fig. 29.—Egg-laying and migration seasons of the purple martin in different areas of the state (see Fig. 1). Spring and fall graph lines (1967–1970) show the highest daily count of each 2 days (left scale). Asterisk symbols represent counts made in other years or by other observers. Shaded areas show the span of dates during which egg laying has been recorded. Dot symbols represent counts made on the western side of the state; lines without dots represent the eastern side.

period was from "mid-May" to "early June." Based on fledging and hatching dates (Widmann 1884, and Cooke 1888), egg laying at the St. Louis colonies extended from about April 28 to June 25. In northern Illinois, egg laying has been recorded from May 5 to July 15 (Fig. 29), but the timing of peak production is unknown for any population in the state.

At St. Louis, Widmann (1922) found the usual first clutch to be five eggs, with six eggs in only about 20 percent of the nests, and four eggs the usual clutch

for renestings after failures. For northern and central Illinois we have clutch records for only 12 nests, as follows: 3 with six eggs, 6 with five eggs, 1 with four eggs, and 2 with three eggs. Far more data are needed on this phase of the cycle. Widmann (1922) reported a high incidence (20–25 percent) of "addled" eggs, and in northern Illinois Gault (unpublished notes) recorded an incidence of 17 percent between 1907 and 1914.

We have found no published data on nesting suc-

PURPLE MARTIN  
BREEDING RECORDS

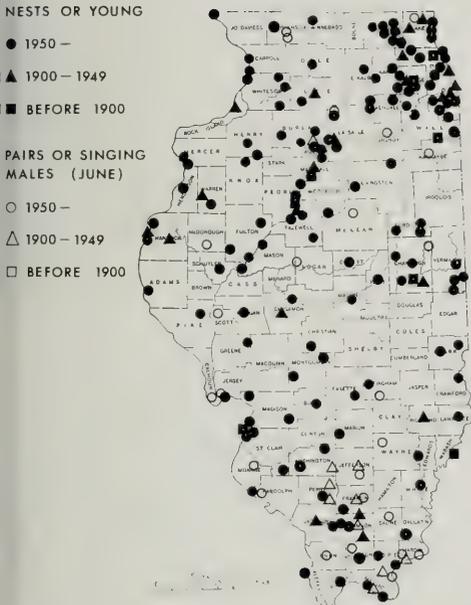


Fig. 30.—Breeding records for the purple martin in Illinois.

cess or productivity for any Illinois population of purple martins. At St. Louis in 1888, Widmann (1922) recorded hatching success of about 58 percent and fledging success of 50 percent (of all eggs laid) in a sample of 45 nests with 220 eggs. Widmann believed that success was very low for eggs produced in early May because of the martins' tendency toward inattentiveness early in the season, allowing for interference from house sparrows, house wrens (*Troglodytes aedon*), and other nest usurpers. Though there are numerous references to the martins' problems with sparrows, quantitative data on the effects of sparrows, wrens, starlings, or other cavity nesters on martin populations are lacking. Brinkman (1967) described an interesting case in which a large colony (21 nest boxes) of martins flourished in Hoyleton, Illinois for years until the (human) owners of the colony moved away. In succeeding years the boxes were completely taken over by starlings. Other species mentioned as nest competitors or predators are the red-headed woodpecker, crested flycatcher (*Myiarchus crinitis*), blue jay (*Cyanocitta cristata*), and bluebird (Ridgway 1915, Reiss 1971, Meany 1945, and Silloway 1906). In urban areas none of the latter species could be considered a significant problem to the

martin now, as none of them competes as well as the martin does with sparrows or starlings.

The phenomenon of young martins leaving their nests prematurely is not uncommon, and has been variously ascribed to excessive heat stress, high ectoparasite infestations, and starvation during periods of cool weather (Weber 1954, Widmann 1922, Gault 1934-1935, and Bartel 1946). Widmann and Gault both believed that grounded young martins were usually soon abandoned by the adults; thus it is important for the young to be competent flyers at the time of fledging, and the nestling period is consequently long. Because of the heat problem Gault (1934-1935) and others have emphasized the need for well-ventilated nest boxes, and even the use of double roofs for insulation (Widmann 1905). Persons wishing to attract purple martins with nest boxes should read Widmann (1905), Gault (1934-1935), Bartel (1947), Wade (1968) and Anon. (1968) for valuable information on box design and placement.

References to the production of two or more broods of martins in one year (Eaton 1878, Johnston & Hardy 1962, and Hamilton 1969) have apparently not been based on observation of banded birds. Widmann (1922) was very doubtful of double-broodedness in this species, and Johnston & Hardy (1962) believed that it was very unusual.

Widmann's (1884) day-long observations on the feeding of nestlings are the only quantitative data on this phase of the nesting cycle. He watched 16 nests and found that both parents fed the young, though the female (1,823 feeding trips at all nests) was more active than the male (1,454 feeding trips at all nests). At different nests, each pair made from 20 to 312 trips during the day (4:30 A.M.-8:00 P.M.), depending upon the number and size of the young (312 trips to a nest with four young about 2 weeks old). The youngest birds were fed mainly crushed small beetles, and older nestlings got dragonflies, grasshoppers, and butterflies. In northern Illinois Gault (1934-1935) also observed that butterflies, notably monarchs (*Danaus plexippus*), and dragonflies, notably the large *Anax junius* were favored as food for young martins. There is no other information on the food of either young or adult martins in Illinois. The often repeated claim that martins eat 2,000 mosquitoes per day is not founded on reliable evidence. Because martins feed on the wing, quantitative determinations of food consumption are extremely difficult to make, but even qualitative determinations based on stomach examinations or field observations are very much needed.

Roosting

By the first of August in Illinois most of the young martins have fledged. Some reach this stage during June in the south (Johnston & Hardy 1962), and late June in the north (Schafer 1922). After fledging, the young, and some adults, often return to roost each

night in the nest box for a time. Widmann (1898) believed that martins tended to leave the nest boxes, even as roosting sites, as soon as possible because of the infestation of mites. He noted that the adult males deserted the box first, then the adult females, and finally the young, after they had been flying about a week. Martins, young and old, may return to the vicinity of the nest box almost daily for at least short periods, particularly mornings or evenings, often well into August, even though they make no apparent use of the box. In this period most martins actually spend the nights at some communal roost.

The communal roosts are most often located in dense groves of trees. Dense willow groves 10–20 feet high along water courses are particularly favored (Widmann 1898), but large roosting or preroosting aggregations have been seen on city buildings, power lines, and sand bars in rivers (Widmann 1922, Tanner 1933, Musselman 1932, White 1933, Wright 1939, and Lobik 1954). A large roost on the Des Plaines River was located in about 30 acres of hawthorn thicket (Craigmile 1939). Typically, the birds mass each evening at the same "staging areas" (power lines, sand bars, etc.), then move, as it is getting dark, to the roosting trees. For excellent accounts see especially Widmann (1922), Anderson (1965), and Lobik (1954). Other species than martins, notably other swallows, starlings, robins, and blackbirds, may share a roost (Craigmile 1939, Bailey 1932, and Taverner 1906).

Loucks (unpublished notes) found a few martins roosting with tree swallows in the Peoria area on June 4, 1893, but notable aggregations at roosts are not usually detected before July, with peak numbers occurring generally in August (Lobik 1954, and Anderson 1965). The roosts vary in size from a few martins to several hundred to tens of thousands (Bailey 1932, Taverner 1906, Smith 1942, Widmann 1898, Anderson 1965, and Hill 1922). Near Arsenal Island (St. Clair County) Widmann (1884) observed a roosting aggregation of 10,000 or more martins on August 24, and though the numbers remained about the same for another 2 weeks, after September 1, an increasing percentage of the birds at the roost were young. Large numbers were still present on September 8, but only about a hundred were left on September 12, and the last few were seen September 18.

Anderson's (1965) observations at a large roost on the Missouri River, near St. Charles, Missouri, show the seasonal build-up and decline of a roosting population. On July 10, at his first visit to the roost, he estimated the martin population to be about 30,000 birds. By August 3 there were 90,000 and on August 13 there were 130,000. After this peak the numbers declined coincidentally with cold-front passage. By August 22 only 900 were left, and all were gone by September 1. The roost in this same area in 1968 peaked at 30,000–40,000 (Hamilton 1968). At a roost in northeastern Illinois, the population peaked (more

than 10,000 birds) at the end of August, and declined after the first week in September. By September 15 all but a few were gone (Lobik 1954).

The precise roosting locales may change from year to year, but there appears to be something of a tradition in the general location of large roosts. Two regions with long histories of large roosts are the Chicago area, especially the lake front from North Evanston to Lincoln Park (Evans 1918, White 1933, Wright 1939, and Lobik 1954), and the St. Louis, Missouri area, at sites on both sides of the Mississippi River (Widmann 1922, and Anderson 1963). Widmann's (1922) conjecture that the large roosts near St. Louis represented the martin populations of half the states of Missouri and Illinois needs corroboration with banding data. The locations of only a few Illinois roosts have been published.

### Fall Migration

Both Widmann (1922) and Anderson (1965) have observed what were apparently late evening (including after dark) migration departures of martins from roost areas, following the passage of cold fronts in August and September. The indication is that fall migration is nocturnal at least in part. Barnes (1933) and Strode (1892) referred to (diurnal?) southward flights in late July and late September in western Illinois, and in the north Gault (unpublished notes, 1894) saw a small southward flight at 8:00 A.M. on August 17.

Most observers report that the last martins of the season are seen around nest boxes during August. The evacuation of roosts occurs in late August and September, as discussed earlier. In extreme southern Illinois, Nelson (1877) saw few purple martins in early August, but "immense numbers" in late August. Our fall counts for southern and central Illinois were relatively high throughout August, but in the north peak numbers were seen in late August and early September (Fig. 29). This is contrary to expectations, as we would expect to see migrant populations later in the south than in the north. However, with the available data we cannot differentiate annual variation in the migration from regional variation, if any, and the relatively late migration we observed in the north may have been a matter of annual variation. Such year-to-year variation was noted by Mitchell (1930), who found that in most years some martins at the colonies in Hinsdale, Illinois, lingered until August 20–25, whereas in some years they left in late July or early August. The causes of this variation have not been determined. In some years a few martins have been found in central and northern Illinois in October (Oberholser 1918, Jones 1933, and Robert Russell, *file* Graber 1962), but we have no October records for southern Illinois, a gap which probably reflects the paucity of observers in the south.

The ratios between our spring and fall counts of purple martins show no consistent pattern. In the

north we saw three martins in the spring to one in the fall; in central Illinois the ratio was even, and in the south we saw one bird in the spring to two in the fall. We suspect that martin populations, and swallow populations in general, have a very spotty distribution, particularly in the fall, with large numbers of birds in certain areas and few elsewhere. Such a distribution makes it difficult to obtain counts which truly reflect the population of a region.

A purple martin banded at Ohio, Illinois, on July 12, 1925, was caught at Sipe Springs in central Texas about November 23, 1929 (Cooke 1937). This is the only published band recovery which indicates flight direction from Illinois, and is also interesting as a longevity record. Even older was a martin banded at Columbus, Missouri, on June 18, 1932, and found dead almost 6 years later in Hillview, Illinois, May 13, 1938 (Cooke 1942).

#### LITERATURE CITED

- ALLEN, J. A. 1868. Notes on birds observed in western Iowa in the months of July, August, and September; also on birds observed in northern Illinois in May and June, and at Richmond, (Wayne Co.) Indiana, between June third and tenth. *Memoirs Boston Society of Natural History* 1:488-526.
- ALLEN, R. W., and M. M. NICE. 1952. A study of the breeding biology of the purple martin (*Progne subis*). *American Midland Naturalist* 47 (3):606-665.
- ANDERSON, R. 1963. Spring survey. *Bluebird* 30 (2):20-28.
- . 1963. Summer survey. *Bluebird* 30 (3):16-23.
- . 1965. A preliminary study of a purple martin roost. *Bluebird* 32 (3):3-4.
- ANDERSON, R. A., and P. E. BAUER. 1968. A guide to finding birds in the St. Louis area. *Webster Groves Nature Study Society*. 44 p.
- ANONYMOUS. 1940. Bird-Lore's fortieth Christmas bird census. *Springfield, Illinois. Bird-Lore* 42 (1):11.
- . 1955. Fifty-fifth Christmas bird count. *Murphysboro, Illinois. Audubon Field Notes* 9 (2):172.
- . 1968. Here's a look at various types of martin housing now in use. *Purple Martin Capital News* 3 (2):8-13.
- BAILEY, A. M. 1932. A starling roost in the Chicago area. *Wilson Bulletin* 44 (1):40-41.
- BARKER, M. R. 1965. Air-conditioned martins. *Audubon Magazine* 67 (6):342.
- BARNES, R. M. 1890. List of birds breeding in Marshall County, Ill. *Ornithologist and Oölogist* 15 (8):113-116.
- . 1912. Breeding birds of Marshall Co., Ill. *Oölogist* 29 (8):325-328.
- . 1933. 1932 migrating swallows. *Oölogist* 50 (2):34.
- BARROWS, W. B. 1889. The English sparrow in America. U.S. Department of Agriculture (Division of Economic Ornithology and Mammalogy) *Bulletin* 1:1-405.
- BARTEL, K. E. 1945. Purple martins in Blue Island. *Audubon Bulletin* 56:4.
- . 1946. Do purple martins increase from year to year? *Inland Bird Banding News* 17 (6):40.
- . 1947. Increase of purple martins. *Audubon Bulletin* 61:5-6.
- . 1955. Martin cycle down . . . bronzed grackle up. *Inland Bird Banding News* 27 (4):38.
- . 1959. Purple martin fluctuations. *Inland Bird Banding News* 31 (6):63.
- BEECHER, W. J. 1942. Nesting birds and the vegetation substrate. *Chicago Ornithological Society, Chicago*. 69 p.
- BLOCHER, A. 1922. Roughwing swallows. *Oölogist* 39 (7):107-108.
- . 1926. Large sets. *Oölogist* 43 (4):49-50.
- . 1933. Losses. *Oölogist* 50 (12):157.
- BODENSTEN, A. J. 1932. Where are the birds. *Oölogist* 49 (8):89.
- BOUTON, R., and F. A. PITELKA. 1937. The season. *Chicago region. Bird-Lore* 39 (3):257-258.
- , and ———. 1939. The season. *Chicago region. Bird-Lore* 41 (3):191-192.
- BRINKMAN, G. 1967. Decline and fall of an empire . . . *Purple Martin Capital News* 2 (5):15.
- BUSS, I. O. 1942. A managed cliff swallow colony in southern Wisconsin. *Wilson Bulletin* 54:153-161.
- BUTLER, A. W. 1891. A catalogue of the birds of Indiana. *Indiana Horticultural Society Transactions, 1890 [Appendix C]*. p. 1-135.
- CHASE, V. H. 1896. The barn swallow. *Wilson Bulletin* 8:8.
- CLARK, C. T. and M. M. NICE. 1950. William Dreuth's study of bird migration in Lincoln Park, Chicago. *Chicago Academy of Sciences Special Publication* 8. 43 p.
- COALE, H. K. 1925. Violet green swallow in Illinois. *Auk* 42 (1):137-138.
- CONLEY, C. L. 1926. Purple martin in winter. *Audubon Bulletin* 17:26.
- COOKE, M. T. 1937. Some returns of banded birds. *Bird-Banding* 8 (4):144-155.
- . 1942. Returns from banded birds: some longevity records of wild birds. *Bird-Banding* 13 (3):110-119.
- . 1950. Returns from banded birds. *Bird-Banding* 21 (1):11-18.
- Cooke, W. W. 1888. Report on bird migration in the Mississippi valley in the years 1884 and 1885. U. S. Department of Agriculture (Division of Economic Ornithology) *Bulletin* 2:1-313.
- , and O. WIDMANN. 1884. Bird migration in the Mississippi Valley. *American Field* 21 (1):9.
- CRAIGMILE, E. A. 1939. A popular bird roost. *Audubon Bulletin* 30:13-15.
- DAVIS, R. E. 1968. Food requirements of barn swallow nestlings. *Inland Bird Banders Association News* 40 (2):63.
- EATON, D. H. 1878. List of birds in Peotone [Illinois] and vicinity. *Forest and Stream* 11 (3):47.
- EIFFERT, V. S. 1945. Birds in your back yard. *Illinois State Museum, Popular Science Series* 2:1-238.
- EIFRIG, C. W. G. 1919. Notes on birds of the Chicago area and its immediate vicinity. *Auk* 36 (4):513-524.
- . 1937. The changing status of birds as regards their abundance. *Illinois State Academy of Sciences Transactions* 30 (2):295-297.
- EVANS, W. C. 1918. From sunset to sunrise with the martins during the flocking time. *Bird-Lore* 20 (4):296.
- FAWKES, E. 1938. Bird-Lore's second breeding bird census. *Second-growth hardwood. Bird-Lore* 40 (5):359.
- . 1966. Field notes—Sept. 1966. *Audubon Bulletin* 139:22-23.
- FORBES, S. A. 1878. The food of birds. *Illinois Horticultural Society Transactions* 23:140-145.
- . 1883. The regulative action of birds upon insect oscillations. *Illinois Natural History Survey Bulletin* 1 (6):1-32.
- FORD, E. R. 1915. Recollections of city bird-nesting. *Oölogist* 32 (10):156-157.
- . 1956. Birds of the Chicago region. *Chicago Academy of Sciences Special Publication* 12:1-117.
- , C. C. SANBORN, and C. B. COURSEN. 1934. Birds of the Chicago region. *Chicago Academy of Sciences. Program of Activities* 5 (2-3):17-76.
- FRIEDMANN, H. 1963. Host relations of the parasitic cowbirds. *United States National Museum Bulletin* 233:1-276.
- GAULT, B. T. [1922]. Check list of the birds of Illinois. *Illinois Audubon Society, Chicago*. 80 p.
- . 1934-1935. Martins and martin-house. *Audubon Bulletin* 24-25:34-38.
- GOELTZ, W. A. 1915. Large sets of 1915. *Oölogist* 32 (9):147-148.
- . 1917. 1916 list of Illinois nests. *Oölogist* 34 (5):87.
- GRABER, R. R. 1962. The fall migration. *Middlewestern prairie region. Audubon Field Notes* 16 (1):35-37, 41-43.
- , and J. W. GRABER. 1963. A comparative study of bird populations in Illinois, 1906-1909 and 1956-1958. *Illinois Natural History Survey Bulletin* 28:383-528.
- , and E. L. KIRK. 1970. Illinois birds: Mimi-dae. *Illinois Natural History Survey Biological Notes* 68. 38 p.
- , and ———. 1971. Illinois birds: Turdi-dae. *Illinois Natural History Survey Biological Notes* 74. 44 p.

- GUTH, R. W. 1965. Twenty-ninth breeding-bird census. Alfalfa-clover field. Audubon Field Notes 19 (6):614-616.
- . 1966. Thirtieth breeding-bird census. Alfalfa-clover field. Audubon Field Notes 20 (6):665-666.
- . 1967. Thirty-first breeding-bird census. Alfalfa-clover field. Audubon Field Notes 21 (6):667-668.
- HAMILTON, J. L. 1968. Fall survey. September 1st through November 30th. Bluebird 35 (1):8-12.
- . 1969. 1968 summer survey. Bluebird 36 (2):15-19.
- HAMMOND, V. F. 1939. Cliff swallows. Audubon Bulletin 31:5-7.
- HESS, I. E. 1909. Migrating chimney swallows descend school chimney. Oölogist 26 (6):92.
- . 1910. One hundred breeding birds of an Illinois ten-mile radius. Auk 27 (1):19-32.
- . 1921. Old friends. Oölogist 38 (6):77.
- HILL, F. W. 1922. Glencoe, Cook Co. Audubon Bulletin, Fall, 1922:35-37.
- JOHNSTON, R. F., and J. W. HARDY. 1962. Behavior of the purple martin. Wilson Bulletin 74 (3):243-262.
- JONES, L. 1910. Personals, our members here and there. Wilson Bulletin 22 (2):127.
- JONES, S. 1933. The season. St. Louis region. Bird-Lore 35 (6):332-334.
- KENNICOTT, R. 1853-1854. Catalogue of animals observed in Cook County, Illinois. Illinois State Agricultural Society Transactions 1:577-595.
- KIMBALL, F. H. 1889. Mortality among cave swallows. Auk 6 (4):338-339.
- KOHLIS, G. M., and R. E. RYCKMAN. 1962. New distribution records of ticks associated with cliff swallows, *Petrochelidon* spp., in the United States. Journal of Parasitology 48 (3):507-508.
- LAUNER, W. L. 1967. [Letters to editor.] Purple Martin Capital News 2 (11):20.
- LEWY, A. 1943. An old colony of cliff swallows. Chicago Naturalist 6 (3):67, 72.
- LOBIK, P. H. 1954. On the stoning of purple martins. Audubon Bulletin 91:10-12.
- LOUCKS, W. E. 1895. Odd and unusual nesting sites. Oölogist 12 (2):35-37.
- MEANY, R. E. 1945. Martin houses. Audubon Bulletin 56:1-3.
- MERRILL, I. 1917. The barn swallow. Audubon Bulletin 62:1-2.
- MITCHELL, C. A. 1930. Are the purple martins weather prophets? Chicago Academy of Sciences. Program of Activities 1 (4):n.p.
- MOONEY, C. L. 1925. From a beginner in bird study. Audubon Bulletin, Summer, 1925:16-17.
- MOYER, E. B. 1924. Bird notes of a circle tour. Audubon Bulletin, Spring and Summer, 1924:34-37.
- MUSSELMAN, T. E. 1921. The birds of Illinois. Journal of the Illinois State Historical Society 14. 75 p.
- . 1932. The 1931 season at Quincy. Audubon Bulletin 22:48-51.
- . 1933. Quincy nature diary for 1932. Audubon Bulletin 23:50-54.
- . 1939. Bird notes at Quincy, 1938. Audubon Bulletin 29:14-15.
- . 1966. Purple martins face a difficult spring. Audubon Bulletin 139:14.
- NELSON, E. W. 1876-1877. Birds of north-eastern Illinois. Essex Institute Bulletin 8 (9-12):90-155.
- . 1877. Notes upon birds observed in southern Illinois, between July 17 and September 4, 1875. Essex Institute Bulletin 9:32-65.
- NOLAN, V., JR. 1955. Fall migration. Middlewestern prairie region. Audubon Field Notes 9 (1):28-31.
- . 1956. Spring migration. Middlewestern prairie region. Audubon Field Notes 10 (4):336-338.
- OBERHOLSER, H. C. 1917. The migration of North American birds. Bird-Lore 19 (6):320-329.
- . 1918. The migration of North American birds. Bird-Lore 20 (2):145-152.
- PETERSEN, P. C., JR. 1966. Spring migration. Middlewestern prairie region. Audubon Field Notes 20 (4):514.
- . 1967. Fall migration. Middlewestern prairie region. Audubon Field Notes 21 (1):45.
- . 1970. The nesting season. Middlewestern prairie region. Audubon Field Notes 24 (5):689-691.
- REISS, E. W. 1971. Green leaves . . . Purple Martin Capital News 6 (10):21.
- RIDGWAY, R. 1874. On local variations in the notes and nesting habits of birds. American Naturalist 8 (4):197-201.
- . 1887. List of birds found breeding within corporate limits of Mt. Carmel, Illinois. Ridgway Ornithological Club Bulletin 2:26-35.
- . 1889. The ornithology of Illinois. Volume 1. Illinois Natural History Survey Reprint, 1913. Pantagraph Printing Company, Bloomington, Ill. 520 p.
- . 1915. Bird-life in southern Illinois. Bird-Lore 17 (3):191-198.
- RIES, D. T., and F. G. WERNER. 1946. Checklist of the birds of Starved Rock State Park and surrounding territory. Illinois State Academy of Science Transactions 39:135-142.
- ROBERTSON, W., JR. 1941. Audubon Magazine's fifth breeding-bird census. Swampy prairie. Audubon Magazine 45 (5):485.
- . 1942. Audubon Magazine's sixth breeding-bird census. Swampy prairie. Audubon Magazine 44 (5):18-19 (supplement).
- . 1944. Audubon Magazine's eighth breeding-bird census. Swampy prairie. Audubon Magazine 46 (5):16 (supplement).
- SCHAEFER, J. J. 1916. Notes on the barn swallow. Wilson Bulletin 28 (2):88-90.
- . 1917-1918. The fall migration. Audubon Bulletin, Winter, 1917-1918:40-43.
- . 1920. Notes from Port Byron. Audubon Bulletin, Fall, 1920:21-22.
- . 1921. Port Byron. Audubon Bulletin, Fall, 1921:39-41.
- . 1922. Port Byron. Audubon Bulletin, Fall, 1922:41-43.
- . 1923. Notes from Port Byron. Audubon Bulletin, Fall, 1923:37.
- . 1932. Port Byron. Audubon Bulletin 22:52.
- . 1933. Port Byron. Audubon Bulletin 23:56.
- SCHANTZ, O. M. 1923. The charm of ravines. Audubon Bulletin, Fall, 1923:47-48.
- SILOWAY, P. M. 1906. A novice's note-book—No. 4. Oölogist 23 (6):89-91.
- . 1906. A novice's note-book—No. 5. Oölogist 23 (9):139-140.
- . 1922. Birds of the Peoria parks. Typescript in Peoria (Illinois) Public Library. 86 p.
- SMITH, E. T. 1942. The season. Chicago region. Audubon Magazine 44 (6):8-9 (supplement).
- . 1943. The season. Chicago region. Audubon Magazine 45 (4):8-9 (supplement).
- STROBE, W. S. 1892. A morning on Spoon River, Ill. Ornithologist and Oölogist 17 (3):34-36.
- STRONG, R. M. 1898. Bank swallow habits. Wilson Bulletin 10 (4):50.
- TANNER, C. H. 1933. Martins. Audubon Bulletin 23:36-37.
- TAVERNER, P. A. 1906. A purple martin roost. Wilson Bulletin 18 (3):87-92.
- WADE, J. L. 1968. Here are tips for success with martins. Purple Martin Capital News 3 (2):7.
- WEBER, A. J. 1954. Weaklings among young purple martins. Iowa Bird Life 24 (3):57.
- WHITE, J. S. 1933. Migrating martins. Chicago Academy of Sciences. Program of Activities 4 (4):n.p.
- WIDMANN, O. 1880. Notes on the birds of St. Louis. Mo. Bulletin of the Nuttall Ornithological Club 5 (3):191-192.
- . 1884. Where the martins roost. Forest and Stream 23:183-184.
- . 1884. How young birds are fed. Forest and Stream 22:484.
- . 1898. The great rooks on Gabbert Island, opposite North St. Louis. Mo. Auk 15 (1):22-27.
- . 1905. Nest-box notes. Bird-Lore 7:17-18.
- . 1907. A preliminary catalog of the birds of Missouri. Academy of Science of St. Louis Transactions 17 (1):288 p.
- . 1922. Extracts from the diary of Otto Widmann. Academy of Science of St. Louis Transactions 24 (8):1-8.
- WILHELM, C., JR. 1954. St. Louis area. Bluebird 21 (4):n.p.
- WOODRUFF, F. M. 1907. The birds of the Chicago area. Chicago Academy of Sciences Natural History Survey Bulletin 6:1-221.
- WRIGHT, E. G. 1939. Gathering of the martins. Audubon Bulletin 31:1-3.

