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### BREEDING BIOLOGY OF BARN SWALLOWS IN WEST-CENTRAL KANSAS

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Nesting Barn Swallows (*Hirundo rustica*) were studied near Hays, Ellis County, Kansas from April to October 1968. The major objective was to observe and document Barn Swallow breeding biology in a prairie environment in Kansas where only one minor study has been done (Thompson 1961). Extensive breeding studies of Barn Swallows have been done in New York (Stoner 1935), Massachusetts (Mason 1953), West Virginia (Samuel 1971) and Illinois (Graber *et al.* 1972).

#### METHODS

Nests were visited from before the arrival of swallows through the breeding season. Each newly constructed or occupied nest was numbered and mapped, with two-thirds of the nests visited daily and the remainder visited on alternate days. Dates of egg-laying, incubation and fledging, general behavior of adults and young, and outcome of each nest were recorded. In 28 nests the eggs were marked with India ink and the nestlings were marked by clipping claws. These young were daily weighed on a triple beam balance and their tarsal and ulnar lengths were measured with dial calipers. As many birds from all nests were banded as possible, including nestlings at 7 or 8 days of age and adults which were mistnetted in the vicinity of their nests at night. Adults were sexed by brood patch (female), coloration (males were usually brighter throughout and darker below), and/or measurements, *i.e.*, tail over 78 mm (males) or 78 mm or less (female). Of the 143 adults captured for banding, 77 had tail lengths of 79-104 mm ( $\bar{x}$  86.5) and were considered males; 66 had tail lengths of 69-78 mm ( $\bar{x}$  74.0) and were considered females. (Wing length [flattened] overlapped completely but males averaged larger, *i.e.*, 112-121 [ $\bar{x}$  115.9] in males and 111-118 [ $\bar{x}$  113.5] in females.) This sex ratio of 63% males is exactly that found by Mason (1953) with 566 swallows over a period of eight years.

#### RESULTS AND DISCUSSION

**Arrival.**—Barn Swallows usually return to the Hays area in mid-April, and in 1968, the earliest was on 14 April; within 2 to 4 weeks swallows had increased greatly at all potential nesting areas. Numbers at some nest sites exceeded the eventual breeding population, and varying large numbers of birds roosted in certain buildings until at least May. These are presumed to be transients.

**Nests.**—In this study, only 16 of 199 nestings (8%) were under bridges or in culverts, the remainder being in farm buildings. Single nests were placed in 3 cement culverts, and under 3 concrete and 1 wooden bridges; 9 nests were under a single wooden bridge. Various buildings had from 1 to 14 active nests.

Old nests, when available, were always occupied before new nests were constructed and few of the latter were built in the buildings having old nests. If old nests had been destroyed over the winter, new nests were built rapidly; new nests built among old nests by later arrivals were constructed more leisurely. All of the 65 old nests occupied were renovated by at least the addition of fresh mud to the rim—a process usually taking from 2 to 5 days.

As found in previous studies, a high proportion of nestings were in old nests. Sixty-two% of the first clutches were laid in old nests, compared with the 70% reported by Kuzniak (1967) in Poland and 54% by Samuel (1971) in West Virginia. Sixty-one% of second brood nestings were in old nests. Mason (1953) found that the most desirable sites—often occupied by old nests—were used by older birds which arrived and began nesting before first-year birds. The somewhat higher nesting success in our study in old rather than new nests (92.9% compared to 85.2%) may therefore have been due to the age and experience of the birds, to the more favorable nest sites, or to both.

The duration of building for new nests ranged from 6 to 22 days and seemed to shorten as the season progressed. Nest building occurred in 3 stages: 1) construction of the shell from mud and rootlets; 2) addition of grass (or rootlet) lining; and 3) addition of a feather lining. Time for completion of these stages were respectively: 5-14, 2-5, and 2-3 days. Delays of up to 10 days duration between stages were common, especially after stage 2. Both sexes participated in nest building. Purchon (1948) observed both sexes contributing equally to nest construction but with the female only adding the lining.

**Egg-laying and incubation.**—Laying of the first egg followed completion of the feather lining by 1 or 2 (rarely 3) days. The first egg recorded in 1968 was laid on 11 May, 2 weeks after the pair had arrived at that nest site and nearly one month after the first swallows had arrived in the area. The latest recorded date for initiation of a first clutch was 18 June, 3 days later than the first second clutch was started. The last second clutch was begun on 6 August, although single eggs were dropped in an unused nest on 2 and 3 September. Eggs were laid daily (typically between 05:30 and 07:30) until the clutch was complete. Most incubation was done by the female, including in nests checked at night, during which time males perched nearby. Nests were commonly unattended for 10-25 minute periods during incubation.

Bent stated (1942) that the incubation period is either 15 or 16 days but some investigators place it as low as 13. In our study it was about 14 days (13.7) in 18 nests. This compares to 14.6 in Poland (Kuzniak 1967, for *H. r. rustica*) and 15 days (5 nests) in West Virginia (Samuel 1971). This apparent variation may occur because some individuals may incubate briefly during egg laying or may occasionally begin incubation with the laying of the first egg. For example, we found that in 2 nests (4 and 6 egg clutches), the last chick hatched 4 days after the first. In these nests incubation was by both sexes with the female doing the greater share.

Clutch size was greater for the first brood (4-7 eggs,  $\bar{x}$  4.6) than for the second brood (3-6 eggs,  $\bar{x}$  4.1) (Table 1). Almost identical means for first and second broods were recorded by Samuel (1971). Thompson (1961), with a smaller sample, found somewhat larger clutch sizes ( $\bar{x}$  4.75 for 12 nests; 4.55 for 9 nests) in south-central Kansas. In our study, 5 egg clutches were most common for the first brood; 4 egg clutches for the second.

When dates of clutch initiation are plotted, the resulting curve is bimodal for each brood (Fig. 1). For the first brood most clutches were initiated during late May and early June; 26 during the period 1-5 June with 9 on 2 June alone. An additional 13 clutches were initiated during 9-11 June. Most second brood clutches were initiated during early and mid-July, including 10 on 30 June and 1 July and 9 from 15-19 July.

**Nesting success.**—The 199 nestings studied involved 137 nests, 62 of which were used for 2 broods. Twenty-six nests were destroyed or abandoned before any eggs were laid. The remaining 111 nests involving 173 clutches provide the basis of this study. The first brood involved 105 clutches with 484 eggs. Of these, 375 (77.5%) hatched and 282 (58.3%) produced fledglings. The second brood involved 68 clutches with 277 eggs. Of these 211 hatched (76.2%) and 197 (71.1%) produced fledglings (Table 1).

Nesting success in both first and second broods and also total success were lower than those reported for comparable broods in 3 previous studies (Table 1). The reasons for this lower rate of success are not known but may be due in part to the larger number of nests studied and/or the more varied nest sites. Human activity in some farm buildings is probably another factor. Nesting success was reduced by 3 known factors: 1, adverse weather, 2, nest disturbance or usurpation by the

**TABLE 1****COMPARATIVE NESTING SUCCESS OF BARN SWALLOWS FROM FOUR STUDIES**

	This Study			Thompson (1961) #			Buxton (1946) #			Samuel (1971)		
	(Kansas)			(Kansas)			(Bavaria)			(W. Virginia)		
	1st	* 2nd	both	1st	2nd	both	1st	2nd	both	1st	2nd	both
No. clutches .....	105	68	173	12	9	21	19	11	30	94	33	127
No. eggs .....	484	277	761	57	41	98	77	45	122	430	134	564
$\bar{x}$ clutch size .....	4.60	4.07	4.39	4.75	4.55	4.70	4.05	4.09	4.07	4.57	4.06	4.44
No. hatched .....	375	211	586	51	31	82	69	44	113	358	115	473
% hatched .....	77.5	76.2	77.0	89.5	75.6	83.7	89.6	97.8	92.6	83.3	85.8	83.9
No. fledged .....	282	197	479	47	30	77	58	37	95	349	114	463
% fledged .....	75.2	93.4	81.4	92.2	96.8	93.9	84.1	84.1	84.1	97.5	99.1	97.9
% fledged of all eggs laid .....	58.3	71.1	62.9	82.5	73.2	78.6	75.3	82.2	77.9	81.2	85.0	82.1

# Data recalculated; \* First, second and combined broods, respectively.

NUMBER OF CLUTCHES

28  
26  
24  
22  
20  
18  
16  
14  
12  
10  
8  
6  
4  
2

— First brood  
- - - Second brood

6 11 16 21 26 31 5 10 15 20 25 30 5 10 15 20 25 30 4 9  
MAY JUNE JULY AUGUST

Figure 1. Number of Barn Swallow clutches started per five-day period.

House Sparrow (*Passer domesticus*), 3, infertile eggs (including possible nest desertion).

Adverse weather, especially extreme temperatures during a short period, may cause a sudden increase in nestling mortality. In Massachusetts, Mason (1953) observed considerable mortality among half-grown young as a result of very warm temperatures. During our study extreme readings of 5°C and 41.5°C occurred within a 36 hour period beginning on 27 June. The resulting heat killed 2 swallow broods (9 nestlings) under a metal roof and a third brood (4 nestlings) in a hay loft. Eight nests were taken over by House Sparrows and at other sites their presence seemed to affect swallow activity and possibly nesting success even though nests were not actually usurped. Boyd (1936) reported an active nest actually pulled down and destroyed by sparrows. Although we never actually observed predation or destruction of eggs or chicks, eggs in 2 nests were punctured by an unknown agent and both eggs and chicks disappeared from other nests.

Overall, 175 eggs (23% of the total) were destroyed or failed to hatch; some were found to be infertile. About 62% of this mortality occurred within first clutches. In 2 nests, 2 attempted clutches, and in a third, 3 attempted clutches all failed to hatch. In each case the second clutch was laid 34 to 37 days after the first, on a thin lining of grass and feathers covering the previous clutch. The third attempted clutch (2 eggs) was not preceded by a relining and may have been an example of egg dropping. Third clutches, following favorable conditions and early nesting have been reported in England (Hosking and Newberry 1946) and some have been successful.

In our study, second broods were more successful than first broods. Hatching success remained about the same in both broods but fledging success was considerably higher in the second (Table 1). Even though clutch size was smaller in second broods, the number fledged per clutch was slightly higher (2.9) for second than for first broods (2.7). The second brood with 37 fewer nestlings accounted for about 41% of the total production.

**Growth and development of the young.**—Daily measurements of the weights and of the lengths of right ulna and right tibiotarsus were taken from 29 young of 7 nests from date of hatching to 16 days of age or until the young died or disappeared from the nest. Growth curves (weight and ulna length) of the 19 young which survived through day 15 are shown in Figure 2. On hatching day their weights averaged  $2.2 \pm .46$  g, and their ulnas and tibiotarsi  $5.2 \pm .62$  mm and  $4.6 \pm .47$  mm respectively. Chicks weighed slightly less at hatching than the 2.39 g reported by Smith (1933) and growth was slower than reported by Stoner (1935) and Smith (1933). Weight increased most rapidly between the 4th and 9th days, reached a maximum on the 15th day and then declined until fledging. Ulna and tarsal curves were very similar. The average age for attainment of maximum tarsal length was the 13th day; for ulna length, the 15th day. Comparable ages reported by Smith (1933) were 13 and 12 days respectively.

At hatching young were naked except for pale smoke gray natal down on the forehead, scapulars, occiput and mid-dorsal region. On day 2 the skin of the femoral, alar and dorsal tracts began darkening. The bill, cream color at hatching, darkened on the 4th day and the primaries first became noticeable. The eyes opened gradually from the 5th to the 8th day. Rectrices appeared on the 5th or 6th day and emerged from the sheath on the 9th as did the primaries (8 days for one bird).

The average fledgling periods for the first and second broods were 20.4 and 20.7 days respectively (extremes of 15 and 24 days). This compares to 19 days reported by Wood (1937), 19-21 days observed by Hosking and Newberry (1946), 20.7 days by Samuel (1971) and 19-23 days observed by Kuzniak (1967). Both parents fed the young. Little brooding occurred after the nestlings were 5 days old. By the 12th day nestlings would turn around, back up to the nest rim and void over the rim. Until this time fecal sacs had been carried from the nest by the adults.

**Behavior of adults and young.**—At the beginning of the nesting season, adults left the nests as we closely approached them. As the season progressed birds would give alarm calls and depart as soon as our vehicle approached the nest area and were quite hesitant to return to their nests. In some barns, swallows would remain

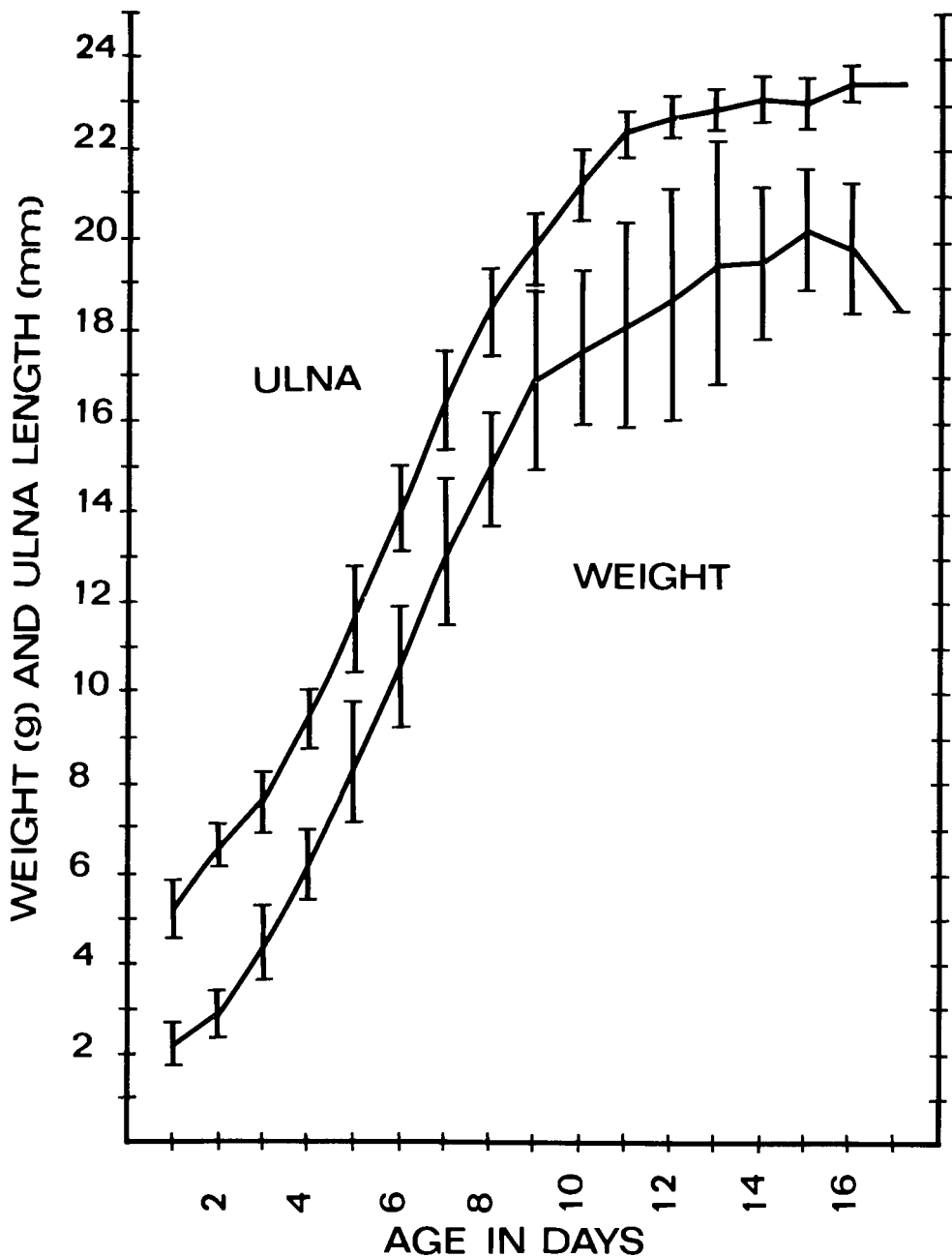


Figure 2. Growth curves for nestling Barn Swallows from hatching to day 17. Upper curve is length of ulna; lower curve is weight. Points plotted are means with standard deviation. (N=19 for days 1-16; 6 for day 17; 2 for day 17.)

on their nest while the farmer did chores but would depart immediately if we entered.

Young nestlings visited daily exhibited little fear or agitation (other than occasionally crouching or hiding in the nest) until the 16th or 17th day and all han-

dling was stopped at this time to avoid premature fledging. Nestlings visited on alternate days showed a fear response earlier (by the 11th day) and some fledged prematurely when handled on the 14th day.

Young left the nesting area within a few days of fledging and on only a few occasions were young recaptured in the nesting area. As the season progressed it was not unusual to capture unbanded juveniles that must have moved into the area from outside; a phenomenon also observed by Boyd (1936).

**First-year banding results.**—A total of 1,095 Barn Swallows was banded during the summer of 1968. Of these, 255 were banded in feeding flocks over quiet portions of Big Creek during May. As only 4 of these birds were later found nesting within the study area, most were presumably transient birds. The remaining 840 birds (161 adults and 679 fledglings) were banded at nest sites. Twenty-two adults were identified with specific nests and mates.

One nestling banded on 19 August was recaptured in a migrating flock at Cheyenne Bottoms (115 km SE) 41 days later. During early autumn an influx of migrating swallows was noted within buildings in the study area. Four of these were beginning molt in the ventral neck region. Of 13 adults in such a group banded on 21 August, one was recovered near Quetzaltenango, Guatemala in October 1968.

Only 3 of the banded nestlings and 2 fledglings (source unknown) were subsequently recaptured in Ellis Co. despite the banding of over 400 adults since 1968. Forty-four adults (21%) were subsequently recaptured within the study area, usually in the barn where originally banded. Most (28) were recaptured only during the following season (1969) but 3 were still present as late as 1972. Unfortunately, banding has been sporadic since 1968.

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**Unusual nesting of Eastern and Say's Phoebes in an area of sympatry.**—I studied the nesting ecology of the Eastern Phoebe (*Sayornis phoebe*) and Say's Phoebe (*Sayornis saya*) in Ellis County, Kansas during the 1973 and 1974 breeding seasons. Both phoebes returned in late March and early April and in most in-

stances nest building began within a week. Nest building behavior was generally as described by Klass (A population study of the Eastern Phoebe, *Sayornis phoebe*, and its social relationships with the Brown-headed Cowbird, *Molothrus ater*, Ph.D. Dissertation, Univ. Kansas, 148 pp., 1970). However, I noticed several differences between the two species and observed a number of unusual nests.

Both Eastern and Say's Phoebes relined and utilized nests from previous years as reported by Klass (1970) for the Eastern Phoebe and by Ohlendorf (Wilson Bull., 88:255-271, 1976) for the Say's Phoebe. Generally, Eastern Phoebes relined old nests of their own species (20 of 21 instances). Say's Phoebes, however, utilized nests of Barn Swallows (*Hirundo rustica*) in nine of 14 instances. They are also known to use old nests of Eastern and Black Phoebes (*S. nigricans*), (Ohlendorf, 1976). The Say's Phoebe does not build an adherent nest and such a nest (e.g., Barn Swallow) therefore provides a better base for support and also helps protect the nest from destructive gusts of wind. Wind gusts destroyed four of the 13 nests (of a total of 29) which were constructed on the flat portions of I-beams of bridges. A fifth such nest was blown down shortly after the young fledged.

Eastern Phoebes occasionally build more than one nest simultaneously (Cuthbert, The Jack-Pine Warbler 40:68-83), 1962; Ashmole, Wilson Bull., 80:332-333, 1968; and Klass, 1970). I observed this activity in both species. One pair of Eastern Phoebes completed two nests under a bridge and laid two eggs in one and a third in the other. Another pair built four partial nests on adjacent I-beams and made a continuous band of mud pellets along another single beam. In a more unusual instance, a pair of Eastern Phoebes built two rather small nests side by side on an I-beam under a bridge. The two eggs in one of the nests were crushed and the site was abandoned. The following year a Say's Phoebe selected the same nest site and relined the nests, nearly covering them in the process. The nest complex was later destroyed and nesting was unsuccessful. Certain nest sites in this area of sympatry appear to be highly desirable to both Eastern and Say's Phoebes.

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