Breeding biology of a Pennsylvania Tree Swallow colony: Effects of the parasitic blowfly on growth rates

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Introduction and objectives

The study of the Tree Swallows *(Iridoprocne bicolor)* nesting at Montour Preserve, Montour County, Pennsylvania, was begun in 1975, and has continued every breeding season since then. A major part of the study was carried out in 1976. Except as noted, the data which will be presented here were compiled during that breeding season.

The main objective of the study was to determine, based on data collected by taking weights and measurements each day, the growth rate of the Tree Swallow nestlings, and to examine some of the factors that influenced it. Those factors included weather conditions, quality of parental care, and the influence of the parasitic blowfly *Protocalliphora splendida*..

The larvae of *Protocalliphora* parasitize young birds, attaching themselves to the feet, legs, and abdomens of the nestlings and feeding on their blood (Johnson, 1930; Mason, 1944; Pettingill, 1970). The larvae feed throughout the nestling period (usually at night), gradually increasing in size from 2 mm to about 12 mm. They then crawl beneath the nest and pupate, emerging in two weeks as adult flies.

A second objective was to determine if Tree Swallows reared two broods in this study area. Earlier studies by Austin and Low (1932) and Gullion (1947) have yielded conflicting results.

Study site and procedures

Montour Preserve is owned by the Pennsylvania Power and Light Company. In 1975, the swallow study area consisted of 18 artificial nest sites placed at various locations surrounding a 165-acre man-made lake. Presently there are 41 nest sites (Figure 1).

Weather recording instruments were used to measure temperature (thermograph) and relative humidity (hygrograph) throughout the study period.

Young birds were weighed to the nearest 0.1 gm daily from the hatching date until the final day they remained in the nest. Birds were placed in a pre-weighed plastic container lined with paper towels. Older nestlings were placed in a cloth sack before weighing. Weights were determined in the field with a triple beam balance attached to a modified camera tripod, and were recorded between 0600 and 0800 (EDT).

Nestlings also were measured to the nearest 0.1 cm daily for overall length and length of wing chord. Measurements were taken with a metric ruler and calipers.

Four days after the young had departed the nest site, the contents of the nest boxes were carefully collected and analyzed for the presence of *Protocalliphora* pupae.

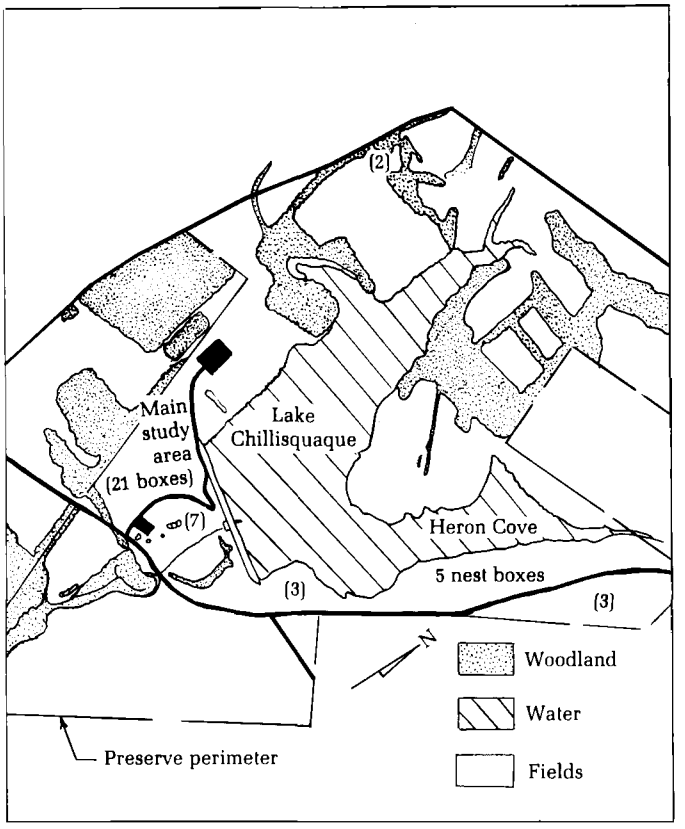

Figure 1. Montour Preserve (Scale: 1 inch equals 2545 feet; 1 cm equals 775 m)

Results

Nestling period

Factors influencing the duration of the nestling period.

Table 1 shows the date of hatching, date of fledging, the duration of the nestling period, the number of young fledged (or found dead), the total number of *Protocalliphora* larvae, and the average number of larvae per young, for each of the 14 nests studied in 1976. All the young in 2 of the nests died. The average number of young in the 12 successful nests was 4.3±1.3. The 2 failed nests and 2 of the successful nests were not analyzed for *Protocalliphora* pupae.

Brood size:

The nestling period, that is, the length of time that the young birds remained in the nest, ranged from 18 to 22 days, and averaged 19.8 days. There appears to be a lack of correlation between brood size and the length of the nestling period. Such correlation might be expected and, indeed, was found to be the case in the study by Austin and Low (1932).

At Montour, the shortest nestling period, 18 days, occurred in the nest box which contained the smallest brood (box 1). The average brood size for those nestlings which departed on Day 19 was 4.3 birds, although the 3 broods which fledged on that day varied in size from 3 to 6 birds. Similarly, broods which departed on Day 20 averaged 4.6 birds per brood, and varied in size from 3 to 6 birds. None of the young fledged on Day 21, but the 1 brood (box 13) which fledged on Day 22 contained only 4 birds. This brood will be discussed in detail below.

Weather:

During the study period, the average weekly temperature ranged from 11.9°C (23 May 29 May) to 24.2°C (20 June - 26 June). Precipitation amounts were moderate, and during the period when nestlings were being fed (23 May - 24 July), averaged 27.7 mm of rainfall per week. The lowest weekly average for this period was 4.6 mm (6 June - 12 June); the highest average for any 1 week was 71.7 mm (20 June - 26 June).

Parental care:

Both parents were involved in caring for their young. At Montour, parental behavior was observed at each of the nests, but my efforts were concentrated on boxes 1, 5, 13 and 17. More than 25 hours of observation were made at these nests. The average number of feeding stops per hour was 11 for the first 5 days of the nestling period. For Days 6 to 10, the average was 15 stops per hour; for Days 11 through 15, the adults averaged 22 stops per hour. During the final days of the nestling period, the swallows averaged 17 stops per hour. On the last day, only a few stops were made to actually feed the young; most of the brief visits seemed only for the purpose of enticing the nestlings to leave.

Table 1. Relationship between duration of the nestling period and the brood size and blowfly parasite data.

Box no.	Date hatched	Date fledged	Days in nest	Number of young	Number of larvae	Avg no. of larvae/young
15	24 May	12 Jun	20	3	0	0.0
18	28 May	16 Jun	20	5	0	0.0
5	30 May	18 Jun	20	5	15	3.0
19	30 May	18 Jun	20	6	NA	NA
12	31 May	18 Jun	19	6	NA	NA
11	03 Jun	Died	—	(6)	NA	NA
14	03 Jun	Died	—	(6)	NA	NA
7	07 Jun	25 Jun	19	3	39	13.0
C	07 Jun	26 Jun	20	5	74	14.8
20	13 Jun	02 Jul	20	5	51	10.2
1	18 Jun	05 Jul	18	2	12	6.0
13	18 Jun	09 Jul	22	4	108	27.0
9	22 Jun	11 Jul	20	3	44	14.7
17	06 Jul	24 Jul	19	4	11	2.8
	Averages		19.8	4.3	35.4	9.2
	Standard Deviation			1.3	11.3	8.5

Parasitism:

In the 10 nests analyzed for the presence of *Protocalliphora* in 1976, the number of pupae collected varied from 0 to 108 (Table 1). The 2 earliest nests (15 and 18) contained no pupae, probably because the adult flies were not yet active. The total number of pupae collected in each nest was divided by the number of nestlings in order to determine the average number of larvae per young. Where *Protocalliphora* were present, the average number of larvae per young varied from 2.8 to 27.0. The birds in nest box 13 were especially affected, as noted below.

In 1981, a record number of 196 *Protocalliphora* pupae were removed from a single nest box (box 26). 6 young were hatched in the box, but 1 died about halfway through the nestling period. The presence of such a large number of parasites may have contributed to the death of that nestling. The 5 nestlings which remained were, of course, heavily parasitized (an average of 39.2 larvae per bird), and they grew at a markedly slower rate. The exact day of departure is not known, although they remained in the nest at least 21 days.

Growth rate of nestlings

Weights:

Figure 2 shows the mean weight curve for the nestlings in 5 typical nests (boxes 1, 5, 12, 17, 18). For the first 15 days, the young gained an average of 1.4 gm per day. Then the weights fluctuated, the nestlings gradually losing weight until they left the nest. All except the young in nest box 13 showed a fairly uniform pattern of weight gain. Those heavily parasitized birds showed a substantially *slower* rate for the first 15 days, and they did not begin to lose weight until after Day 17. On the average, from Day 9 through 15, the birds in nest box 13 weighed 23% less than the normal nestlings.

Overall length:

The young swallows from nest boxes 1, 7, 17, and 20 measured an average of 3.42 cm soon after hatching (Figure 3). They grew an average of 0.46 cm per day. The average length on the day of departure was 11.61 cm. The nestlings in nest box 13 again showed a slower growth rate. As expected, the length was about the same in the early stages of growth in all nests. However, starting at about Day 7, the nestlings in box 13 showed a decrease in the rate of growth. They never quite caught up to the other nestlings, although they remained in the nest at least 2 days longer than any of the others. The birds in nest box 13 averaged only 11.07 cm on the last day. From Day 7 through 19, the birds in box 13 measured an average of 17% shorter than the normal nestlings.

Wing chord:

The average wing chord measured 0.64 cm on Day 1 of the nestling period and increased to an average of 8.17 cm on Day 19 (Figure 4). The wing chord lengthened each day, with the greatest period of increase in the first 10 days. The wings of the nestlings in nest box 13 grew at a significantly slower rate. From Day 7 to 19, the wing chord of the nestlings in box 13 measured an average of 29% less than the wing chord of the other nestlings.

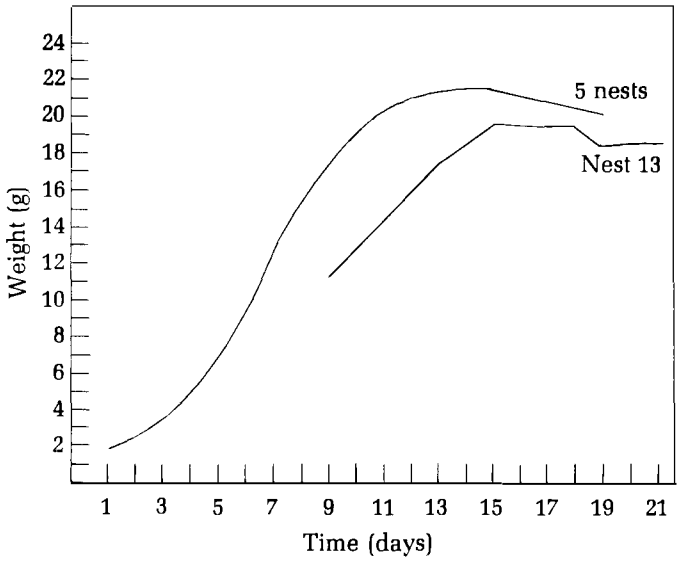

Figure 2. Comparison of the average fledgling weights for nest 13 with the average fledgling weights for 5 typical nests (1, 5, 12, 17, 18)

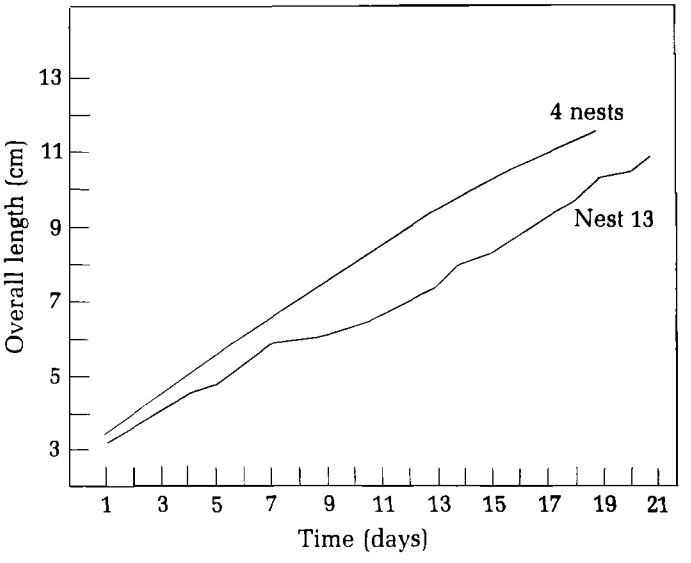

Figure 3. Comparison of the average fledgling length for nest 13 with the average length for fledglings in 4 typical nests (1, 7, 17, 20)

Second broods

In eight seasons, only one female was able to raise 2 broods in the same year. This occurred in 1976. She laid the first egg of the colony on 3 May in box 15, and 3 young fledged on 12 June. The first egg of the second clutch was laid in box 17 on 20 June, and 4 young were fledged on 24 July.

Banding returns

Since 1976, the overall rate of return for adult female swallows was 51.3%. Most birds banded as *adults* that returned to breed returned for only 1 year (Table 2). 2 adults returned for 2 consecutive years. Some adults skipped a year, then returned to breed. In the years they were not seen, perhaps they found natural nest sites, went to other areas to breed, or did not breed at all.

For birds banded as nestlings, the overall rate of return was 5.4%. Of the nestlings that returned to breed, most returned for only 1 year. One returned for 3 consecutive years, another for 2 years, and still another skipped a year and then returned. One nestling return is particularly interesting. Number 860-83152 was banded as a

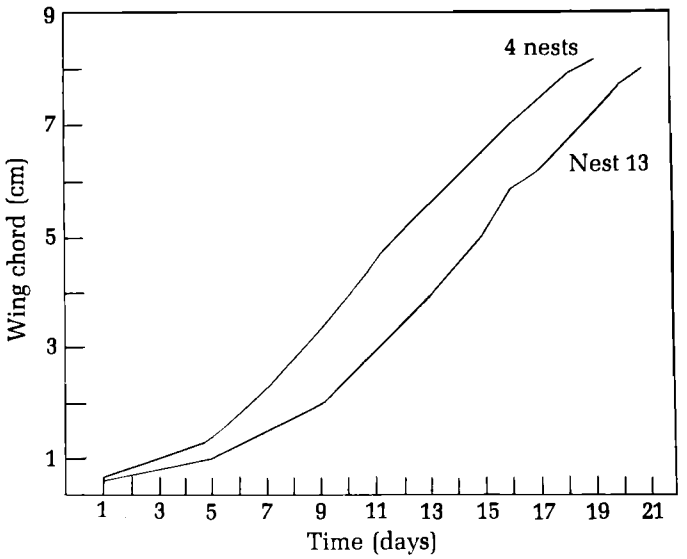

Figure 4. Comparison of the average wing chord measurements from nest 13 with the average wing chord measurements for 4 typical nests (1, 7, 17, 20)

nestling in box 18 in 1975. She returned in 1976 to raise the heavily parasitized brood in nest box 13. In 1977 and 1978, she raised broods in boxes 15 and 17. The next 2 years she raised her broods in box 18, the same nest site from which she herself had fledged. She did not return in 1981. In all, she successfully fledged 26 young.

Also, one "foreign" return has been encountered. Number 860-48711 was banded as a local bird at Conneaut, Ohio in 1976. The next year she nested, though unsuccessfully, at Montour.

Discussion

Nestling period

Factors influencing the duration of the nestling period.

Brood size:

Although perhaps due in part to the small sample size, no significant correlation was detected between brood size and the length of the nestling period. This suggests

Table 2. Analysis of banding returns (1976-1982)

Band number	Banded	Age (box)		Years returned (box)			
860-83140	1975	AD (13)	1976 (18)				
860-83145	1975	AD (17)	1976 (15, 17)	'77 (09)			
860-83152	1975	LU (18)	1976 (13)	'77 (15)	'78(17)	'79 (18)	'80 (18)
860-83156	1975	LU (18)	1976 (10)				
870-07935	1976	AD (12)	1977 (12)				
870-07936	1976	AD (01)	1977 (10)				
870-07940	1976	AD (05)	1977 (05)				
870-07944	1976	AD (07)	1977 (01)				
870-07949	1976	AD (19)	—	'78 (19)	'79 (16)		
880-53302	1976	AD (09)	1977 (14)				
880-53304	1976	LU (15)	1977 (20)				
880-53306	1976	LU (15)	1977 (13)				
880-53333	1976	LU (C)	1977 (16)	'78 (13)			
890-73763	1977	AD (19)	1978 (16)				
920-41975	1979	AD (15)	1980 (15)				
920-41976	1979	AD (13)	—	'81 (19)			
920-41979	1979	AD (12)	1980 (13)				
920-41990	1979	AD (C)	1980 (19)				
920-41991	1979	LU (18)	1980 (D)				
920-41992	1979	LU (18)	1980 (06)				
920-93218	1979	LU (07)	1980 (07)				
m920-93219	1979	LU (12)	—	'81 (17)			
920-93225	1979	LU (D)	1980 (C)				
920-93226	1979	LU (D)	1980 (10)	'81 (16)	'82 (31)		
920-93367	1980	AD (17)	1981 (17)	'82 (16)			
920-93372	1980	AD (A)	1981 (09)				
m930-53409	1980	LU (17)	1981 (34)				
m930-53428	1980	LU (09)	1981 (17)				
950-98503	1981	AD (C)	1982 (C)				
950-98504	1981	AD (34)	1982 (24)				
950-98505	1981	AD (26)	1982 (26)				
950-98523	1981	AD (D)	1982 (39)				
950-98518	1981	LU (07)	1982 (09)				
950-98553	1981	LU (15)	1982 (42)				

Note: all birds are females except as noted (m)
AD females were taken when incubating eggs.
LU birds were banded as nestlings, then returned later to breed.

that the variation in the duration of the nestling period may be influenced by some other factors such as weather, the quality of parental care, and the presence of parasitic larvae.

Weather:

Tree Swallows depend on flying insects (mainly dipterans) to feed their young. The food supply during the nestling period is directly related to weather conditions for that period, because insects are not abundant on cool and rainy days (Austin and Low, 1932). In the study of Montour, the weather was fairly consistent throughout the nestling period. There were no prolonged unseasonably cool periods, and temperatures generally averaged near or above normal levels. The weather, therefore, was not considered to have a major bearing on the variation in the amount of time that the young spent in the nest. This is especially important in view of the nestlings in nest box 13, which grew at a markedly slower rate.

Parental care:

Another factor which may influence growth rates of nestlings and thus the duration of the nestling period is the quality of parental care. The frequency of feeding stops by adults was about equal in all nests observed. It can only be assumed that the amount of food procured by the parents was approximately equal in all of the nests (Austin and Low, 1932). There was nothing unusual about parental behavior at nest box 13 (the site at which the nestlings grew at a slower rate). The parents stopped frequently to feed their young, and their activities were not interfered with in any way.

Parasitism:

Based on the results obtained in this study, it seems likely that the parasitic larva of the blowfly *Protocalliphora splendida* was the major factor which influenced the amount of time that the nestlings remained in the nest. The deleterious effects of the parasite are evident from the growth results obtained. The nest (box 13) which contained an overwhelming number of blowflies (Table 1) showed a much slower growth rate. The young were noticeably smaller in size and weighed less than the other birds of the same age. They remained in the nest a longer period of time, and even when they departed, their size and weight did not quite equal that of the other nestlings. The abnormal growth rates experienced by these birds, therefore, was probably due to the heavy infestation of *Protocalliphora* larvae.

Second broods

Austin and Low (1932), working on Cape Cod, Massachusetts, reported that the "only cases of second laying occurred when the eggs of the first clutch were either destroyed or deserted. In no instance did one adult rear two broods of young." In contrast, Gullion (1947) determined that Tree Swallows in his Eugene, Oregon study area "frequently reared two broods a year". As reported, only 1 female raised 2 broods in the same year at Montour (1976), and the Tree Swallow should be considered a one-brood species for this area.

Banding returns

Studies by Low (1933), Shapman (1939), Kuerzi (1941), and Gullion (1947) have indicated similar results regarding the rather low return rate of nestlings. Percentage of returns for nestlings ranged from 0% for Gullion's Oregon study area to 12.0% for Low's Cape Cod colony. The return rate at Montour over 7 years was 5.3%.

The return rate for adults at Montour was 41.3%. This compares to 0% for Gullion; 26.7% for Kuerzi (Kent, Connecticut); 34.0% for Low; and 48.5% for Chapman (Princeton, Massachusetts).

Summary

The growth rates of Tree Swallow nestlings were studied by taking weights and measurements each day.

The duration of the nestling period (the amount of time that the young birds remained in the nest) varied from 18 to 22 days, and averaged 19.8 days.

There seems to be little correlation between brood size and the duration of the nestling period. The latter seems to be influenced to a greater extent by some extrinsic factors.

The blowfly parasite *(Protocalliphora splendida)* seems to be an important factor adversely affecting the rate of growth of the nestlings. The young from the one nest which contained an overwhelming number of parasites grew at a significantly slower rate than any of the others. By affecting growth rates, the blowfly also affected the amount of time that the young remained in the nest.

Both adults took part in caring for the young. This included such duties as feeding the nestlings, removing waste material from the nest, and guarding the nest.

While the Tree Swallow is predominately a one-brood species, the possibility of a second brood does exist in this locale.

Acknowledgments

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Notes on the banding of Emberizidae: Parulinae Seiurus species in southeastern Arizona

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The three members of the genus *Seiurus* are unusual in Arizona. Monson and Phillips (1981. Annotated Checklist of the Birds of Arizona. Second Edition. The University of Arizona Press) state that the Louisiana Waterthrush *(S. motacilla)* is "a very sparse transient and winter resident from the Huachuca Mountains west to the Pajaritos Mountains" and that the Northern Waterthrush *(S. novaboracensis)* a "rather uncommon transient throughout state, along streams and in areas of damp ground." They report "About 35 records, all for May-June, Sept.-Oct., and Dec.-Jan." for the Ovenbird *(S. aurocapillus)*.

For the period of 1977-1981, the total banded in the Arizona-New Mexico region of each of these species recorded in the Annual Reports of the Western Bird Banding Association, (1978-1982, *No. Am. Bird Bander 2)*, was: Ovenbird: 2, Northern Waterthrush: 14, and Louisiana Waterthrush: 1.

It then seems an unusual coincidence to mist-net and band a different member of this genus in each of the summers of 1980, 1981, and 1982 at the same banding station. This station is at the Tanque Verde Guest Ranch in the foothills of the Rincon Mountains east of Tucson. The habitat does not seem particularly conducive for attracting these species. The banding station is in the saguaro belt with mesquite, acacia, and prickly pear common. It includes a pond with an adjacent growth of mature cottonwoods. It is also bordered by the Tanque Verde Wash which is dry except for short periods following heavy rains or melting snow in the nearby mountains.

The rarest of the genus in southeastern Arizona, the Louisiana Waterthrush (930-92134), was banded on 31 July 1980. (Monson and Phillips, 1981); (Walters, 1981. *No. Am. Bird Bander* 4:169). This individual was the first to be banded in the Western Bird Banding Association area.

On 10 September 1981, a Northern Waterthrush (930-92466) was mist-netted and banded. Age: HY (by skulling). Sex: unknown. Weight: 18.4 g. Wing chord: 74 mm. Tail: 54 mm. Exposed culmen: 13 mm. Tarsus: 22 mm.

The final member of the genus, the Ovenbird (930-92705), was banded on 24 June 1982. Age: AHY (by skulling). Sex: unknown. Weight: 18.9 g. Wing chord: 71 mm. Tail: 52 mm.

None of these 3 individuals was recaptured, nor its recovery recorded. None was seen, or heard calling, after being released. In the case of the Ovenbird, a concerted search in the immediate area by two skilled observers on 25 and 26 June 1982, using taped calls of the Ovenbird, failed.

I presume that all 3 of the banded individuals were transients.

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