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## BARN SWALLOW LIFE HISTORY DATA BASED ON BANDING RECORDS\*

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Barn Swallow (*Hirundo rustica erythrogaster*) records totalling 2,469 nestlings and adults banded and 654 return records were accumulated by the Wharton Bird Banding Station, Groton, Mass., during the period 1929-1942. The technique of taking adults as initiated by Davis (1936) was used for the first time in 1933. It was obvious that this method of banding mature birds, and especially the possibilities opened up of subsequently catching as returns individuals banded as both adults and nestlings, would result in the acquisition of data previously impossible of attainment. Thus under the impetus of this new technique, greater efforts were also made to band nestlings in the hope of learning more about their distribution through their subsequent recapture.

The combined operations of the Wharton and Davis Stations during the years 1932-1936 resulted in the banding of birds in some 30 odd barns within about an 8-mile radius of Groton. The construction features of some barns are such that excellent coverage is possible, while in others the reverse is true. This applies to both the banding of young in the nest, and the taking of adults at night with flashlight and hand net. It was unfortunate that conditions arose which made it impossible for the Davis Station to continue beyond the period reported on by them (*loc. cit.*), for the total number of banded birds in the area was becoming such that return records could be expected with increasing frequency. The interchange of birds thus stopped in 1936, frustrating the hope of accumulating a volume of data on inter-barn movements in the large area covered cooperatively, although the value of other types of data increased as the study was continued by the Wharton Station alone.

### BROOD SIZES

The records of 1,939 nestlings banded are available to show brood sizes. Based as they are upon the numbers of nestlings in individual nests banded, corrected occasionally when an especially small nestling had to be left unbanded, they are referred to as "Viable nestlings per brood." The ideal time to band nestling Barn Swallows is when they are about 7 days old. Prior to that time tarsi and feet are so small as to make the operation difficult to perform, and there is some possibility that the band might slip off. Tarsi grow, then shrink as they harden off. Size 1 bands were used. There is the definite danger, if banding

\*Contribution from the Wharton Bird Banding Station, Groton, Mass. Acknowledgment is made by the author of the assistance and continued interest in this study by William P. Wharton.

is delayed beyond the point where the wing primaries have broken through the sheath, that the nestlings will not remain in the nest after being replaced subsequent to being banded. Therefore, to band all the reproduction of a given colony, several visits must be made. It was found extremely helpful to mark each occupied nest by chalking up a number nearby. With nests thus definitely identified, it was possible to leave undisturbed those broods already banded when subsequent visits were made.

Summarizing the data obtained on brood sizes during the period 1929-1942, we find they were distributed as follows:

TABLE 1

FIRST BROODS	VIALE NESTLINGS PER BROOD						TOTALS		AVER- AGE
	1	2	3	4	5	6	BROODS	NEST- LINGS	
No. of Broods	14	20	44	104	163	29	374		
No. of Nestlings	14	40	132	416	815	174		1,591	4.25
SECOND BROODS									
No. of Broods	7	11	28	40	15	0	101		
No. of Nestlings	7	22	84	160	75	0		348	3.34
TOTAL NO. OF BROODS	21	31	72	144	178	29	475		
TOTAL NO. OF NESTLINGS	21	62	216	576	890	174		1,939	OVER-ALL AVERAGE 4.08

First nestlings average 4.25 viable nestlings per brood. Second broods average 3.34. It is interesting to note that of the 1,591 first brood nestlings, 1,231 of them came from broods in the 4 and 5 categories. Forty-three per cent of the total of first broods contained 5 nestlings, while broods of 4 were 28% of the total. In second broods the 4 nestling category leads easily, being 40% of the total. Broods of six occur in greater proportion in some years than others. No second brood containing six was found. Bent (1942) states clutches of 7 eggs are rare, and Davis (*loc. cit.*) states he found one nest (out of about 400) containing seven nestlings. It would seem that in instances where more than 6 eggs or young are found, dual laying possibly occurred.

Infertile eggs and eggs with weak embryos were found during the course of this study. Occasionally complete clutches of infertile eggs would be found, the type and location of the nest indicating the possibility of immaturity in the nesting pair. Observations lead to the belief that older birds begin nesting activities with a greater sureness of purpose. Arriving at the chosen site, there is no hesitancy. They occupy the choicest sites, immediately refurbishing old nests in most cases, the complete cycle from nest building on being accomplished with a minimum of lost motion. Birds nesting for the first time, on the other

hand, have much to learn by experience. Failing to appropriate the most desirable nest sites, they are often forced to build completely new nests, the mating cycle in some instances probably being interfered with and its timing spoiled. Noting the distribution of nests in barns, it seems that sites receiving the most light are the preferred ones. The most intense light is usually near the places of ingress and exit, thus confusing the issue, but in one barn of considerable length the nests were located chiefly at both ends, at one of which there was no opening, but at which there was light coming in through a window.

All indications point to the facts that normally the Barn Swallow hatches a high percentage of eggs laid, and raises a large proportion of young hatched.

Due to several factors, it usually was found impossible to give as complete coverage to second broods as first. Therefore, the relationship between the figures for first and second broods in no way reflects the true ratio. A careful consideration of the records shows that only in the year 1938 was a degree of efficiency reached that makes the data on the ratio of second broods to first at all reliable. In that year 52 first broods and 35 second broods were banded, indicating that at least 67% of the total number of pairs present had second broods. This is believed to be a high ratio probably seldom exceeded. Bent (*loc. cit.*) refers to an observation made in New York State of a dozen nesting pairs, stating that almost exactly 50% raised a second brood. The same authority states the belief that pairs nesting in refurbished nests were the ones raising second broods. As will be shown later, nearly half of a breeding population would be over two years old, further confirmation of the fact that second broods are raised by the approximately 50% of the breeding population with previous nesting experience.

#### LIMITING EFFECTS OF WEATHER

On several occasions during the course of this study, the effects on Barn Swallow populations of extreme weather conditions were observed.

From time to time it was noticed that in some barns extremely high temperatures were built up during periods of hot weather. This condition was noticeable when carrying on the banding work near the peaks of the roofs. Also, there appeared to be a correlation between the high temperatures reached and the finding of dead nestlings beneath the nests.

Barn Swallows were purposely barred from nesting in the barn loft at the Wharton Station because no nestlings were raised there for several seasons. Reasons for the lack of nesting success were not clear at the time, but in the light of later experiences it seems quite likely that the high temperatures generated in the loft, due to the relatively modern (Mansard roof) type of construction, was the reason.

The possibility of parasitism by *Apaulina*, once known as *Protocaliphora*, was considered, but when note is taken of the fact that only two definite cases of parasitism of Barn Swallow nests by this fly came to light during a period of seven years during which 276 broods of this species were under study, it seems obvious that other factors were

the likely cause. Furthermore, in those instances when *Apaulina* larva were found in Barn Swallow nests, they were not considered present in lethal numbers (Mason 1942).

On several occasions it had been noted that the Horrax Barn in West Groton was the hottest one in which the banding work was carried on. Even so, the extremely high temperature found there on June 22, 1938 was an unusual experience. Also extremely unusual was the finding on that date of a total of 10 nestlings dead beneath the nests. Notes made at the time state "nests numbered 1 and 11 were responsible for most of the mortality." Lesser degrees of nestling mortality were found the same day in other barns. The total experience of dead young beneath the nests, and panting nestlings hanging their heads over the sides of nests in obvious discomfort, resulted in the opinion that the extremely high temperatures built up were responsible. It was noted that half-grown young were most affected. It should be repeated that high temperatures inducing nestling mortality are the result of a several-day-period of hot, clear weather, which builds up extremely high temperatures near the roof of the barn. The structure of the barn and its orientation are also factors, roof construction features of more modern barns being more likely than old ones to contribute to the building up of extreme temperatures.

The effects of a protracted rainy period were observed after a north-easterly storm which began on the afternoon of June 26, 1938, and ended during the night of June 28. The Station rain gage recorded a fall of 2.59 inches for the period.

Barn Swallow nests were visited on the 27th. While no dead nestlings were found, it was noted that the spark of life in some was so low that it was barely discernible. Nestlings were so cold and lifeless in many instances that the feeble turning of the head was the only indication of life.

The mean temperatures during this period are important. Although it was 64° on June 26, it dropped to 58° on the 27th. On the 28th and 29th, it was 63°. The average mean for the month of June at Groton is 68°. The minimum readings were 56° for June 26 and 27; 55° for the 28th; and 52° for the 29th.

The combination of low temperatures and continuing rainfall obviously must cause a lessened food supply for a species which garners its insect food entirely while on the wing. It thus happens that when nestlings require more food to combat lower temperatures, the available food supply is at low ebb.

Returning to a barn on July 2, 1938, where five nests containing 17 nestlings had been visited on June 27, it was found that only 6 of the 17 nestlings were still alive. Thus this nestling population had suffered a mortality rate of 64.7% during the period of low temperatures and continued rainfall.

Barn Swallow nestling mortality during this same period was reported from Harvard, Massachusetts, by James L. Peters. At Harvard the age of the birds was said to be up to practically fully fledged nestlings. The group of nestlings at Groton were not much more than half grown.

RETURNS

The bird banding literature contains many instances showing the greater proportion of returns that result from banding adults as compared to nestlings and juveniles. The same is true in this instance. Using the material gathered in the years 1933-41 we find 80% of the returns were adults when banded, while only 20% came from the much larger nestling group. During the period 381 adults were banded, 34% subsequently returning. Nestlings banded numbered 1,718, only about 2% subsequently being retaken as returns.

The sex ratios of these returning age groups are compiled in the following table. The years 1935-41 are used, prior years being discarded because of less efficient sex determinations.

TABLE 2

YEAR BANDIED	SEX RATIOS OF RETURNING AGE GROUPS		ALL AGE GROUPS			TOTAL
	BANDED AS		MALE	FEMALE	SEX ?	
	ADS.	NESTS.				
	♂ : ♀	♂ : ♀				
1935	17:11	4:0	21	11	4	36
1936	4:5	4:0	8	5	1	14
1937	9:7	6:1	15	8	3	26
1938	11:13	—	11	13	1	25
1939	3:5	1:0	4	5	2	11
1940	7:10	—	7	10	—	17
1941	3:7	5:0	8	7	—	15
	54:58	20:1	74	59	11	144
SCALE OF 100	93:100	2,000:100	125:100			

Before discussing the astounding ratios unearthed by Table 2, the following table shows the sex ratios of breeding populations, including unbanded birds which arrived to nest as well as birds returning which had been banded in previous years either as adults or nestlings.

TABLE 3

SEX RATIOS OF BREEDING POPULATIONS  
INCLUDING NEWLY BANDED ADULTS

	AGE								RATIO OF ♂ ♂ PER 100 ♀ ♀
	1*	2	3	4	5	6	7	8	
	♂ : ♀	♂ : ♀	♂ : ♀	♂ : ♀	♂ : ♀	♂ : ♀	♂ : ♀	♂ : ♀	
1935	33:24	1:3	2:0						133:100
1936	27:21	19:7	2:2	1:0					166:100
1937	38:23	4:3	6:5	0:3	2:0				147:100
1938	31:27	5:5	4:2	1:2	0:2	—			108:100
1939	21:21	15:12	7:5	1:0	1:0	—	—		115:100
1940	19:22	2:4	8:4	2:0	1:0	0:1	—	—	103:100
1941	11:16	7:8	2:3	3:2	3:0	0:0	0:1	—	87:100
1942	17:16	3:7	3:5	0:2	1:1	2:0	1:0	0:1	84:100
SCALE OF 100	116:100	114:100	131:100	88:100	200:100	200:100	100:100	0:100	117:100

\*All newly banded adults were assumed to be one year old.

Any discrepancies between the figures in Tables 2 and 3, and those in Tables 4 and 5, are due to some birds being "Sex?"

The ratio of 117 males to 100 females for the entire breeding population as shown in Table 3 seems like a fairly normal relationship. It is perhaps significant that the 1 year group has about the same ratio; i.e., 116:100. As shown by Daley (1929) and Smith (1937), and borne out frequently by observations made during the course of this study, both parents normally spend the night in close proximity to the nest during the period when the young are in it. Thus if the night operation of catching adults is carried out without any great number escaping, a fair sample of the adult population can be expected to be taken. If it is assumed the males have a possibly slightly less attachment to the young than the females, if anything a preponderantly female ratio could even be expected.

The year by year variations in the ratios given under the heading "All Age Groups Present", given in Table 2, are puzzling in view of the above statements. However, a clue may be found in the fact that on occasions when an adult population has been caught twice in one year, once during the first brood period and once during the second, individuals have been taken during the second operation that were not present at the first one. Davis (*loc. cit.*) refers to this phenomenon. It is believed, however, that variables in the data due to this factor would tend to cancel each other out over the seven year period treated. It may be that a further clue is contained in the 2,000:100 ratio given in the same table for returns which were banded as nestlings. If a segment of the adult population is not tied by any bonds to a particular barn territory, might not this segment be composed of one-year-old unmated, unattached males? Even considering the ratio for the average adult population of 117:100, given in Table 3, we are confronted with a surplus of males, and it seems reasonable to suppose that this surplus would continue its efforts throughout the breeding season to find mates, and would constantly be on the move from barn to barn in its endeavors to find empty territories and unmated females.

It is astonishing that the 21 nestling returns (Table 2) give the ratio of 2,000:100. This ratio counterbalances the 93:100 ratio derived from the adult-when-banded group totaling 112 individuals. Considering the small percentage of birds banded as nestlings which return at all, the only inference possible, even after taking into account an expected heavy juvenile mortality, is that nestlings disperse widely to find nesting territories, but that nestling males return to the region of their birth more faithfully than females.

In Table 3 the downward trend in the numbers of females returning in age classes 3, 5, and 6, is striking, and their dominant position in age class 4 puzzling. It should be noted, however, that the figures for the years 5, 6, 7, and 8 are weighted by one female which ultimately returned for the seventh time when she was at least 8 years old. If it had not been for this lone record, there would be no females recorded as present in age classes 6, 7, and 8, and instead of the data showing

longevity as a female attribute, it would on the contrary indicate males in the ratio of 2 to 1 outliving females.

From the foregoing it can be inferred that the birds arrive on the nesting grounds mated, males bringing in new females in most instances. Females show up poorly in survival data, as indicated in Table 3, for two reasons: (1) Some are attracted to new territory; (2) some are more than 1 year old when appearing in records for the first time.

#### RECORD OF NESTING PAIR

The two Barn Swallows nesting at Five Oaks Farm, Groton, in 1943, were captured on the night of June 19. Because of the layout it was possible to enter before the birds were disturbed. When the lights were switched on, they were found sitting side by side on a cleat about six feet from the nest. Their young were quite large, and probably would leave the nest in about four days, which may be the reason neither adult roosted actually at the nest. Both birds were returns. The male, 37-95213, had been banded as an adult on July 1, 1937, and was therefore at least seven years old. The female, 140-49439, had been banded as an adult on July 3, 1940. In 1943 this pair was again occupying a nest they had used in 1940 and 1941, but which had been usurped by Phobes (*Sayornis phoebe*) in 1942. The records show that the female was not caught in 1942, otherwise the pair of Barn Swallows using this location were known to be the same from 1940 to 1943, inclusive. The same pair were definitely mated, and used the same nest site for three of the four years. It should be pointed out that the location was so small that it offered only one nesting territory, although, as indicated, two Barn Swallow nests had been built at the location.

#### BREEDING POPULATION OF ONE BARN

The breeding population of an individual barn was measured on June 19, 1943. This was the colony at the Clough Barn, situated about 2 miles S.S.E. from Groton. This barn's colony of swallows, both adults and young, had been banded annually in the period 1934-1942. Only the adults were trapped in 1943. Based on plumage and the presence or absence of brood spots, the adult population was determined to fall into the following categories:

TABLE 5

	OLD	1 YR.	ADULT	ADULT	TOTALS	
	MALE #	MALE	MALE*	FEMALE	MALE	FEMALE
RETURNS	—	—	8	8	8	8
NEW	3	4	4	6	11	6
TOTALS	3	4	12	14	19	14
SCALE OF 100					135	: 100

#Two or more years old, based on plumage.

\*No age determination possible.

The first thing of note is the even sex ratio among the returns. The preponderance of males in the totals (135:100) upset the picture of balance, but is offset by the 15:14 ratio obtained by totaling the adult males and old males, (i.e., ones believed to be over one year old), and comparing that figure to the number of adult females. This is 107:100, a ratio arrived at by leaving out the 4 birds classified as one-year-old males. This is another item of evidence pointing to the possible fact that one-year males may not always find mates.

#### AGE COMPOSITION OF BREEDING POPULATION

It was hoped it would be possible to show survival as indicated by returns, as was done by Wharton (1941) for wintering finches in South Carolina. A study of the data, however, indicated that in this case no satisfactory base was present to start from. With so few nestling females returning, and with annual turnovers in the adult female population, any attempt to show survival on the basis of returns alone was impossible.

The following table was compiled as a substitute. Showing as it does the known age groups present, it does give some idea of the survival of this species.

TABLE 4  
AGE COMPOSITION OF BREEDING POPULATION\*  
(ASSUMING NEW BANDINGS TO BE 1 YEAR OLD)

	1	2	3	4	5	6	7	8	TOTAL TAKES
1933	18								18
1934	27	5							32
1935	62	4	2						68
1936	58	34	4	1					97
1937	62	9	12	3	2				88
1938	60	10	6	3	3				82
1939	44	29	12	1	2	—	—		88
1940	42	7	12	2	1	1	—	—	65
1941	27	15	5	5	3	0	1	—	56
1942	33	10	8	2	2	2	1	1	59
TOTAL RECORDS	433	123	61	17	13	3	2	1	653
Av.	43	14	8	2	2	1	½	0	65
SCALE OF 100	66	19	9	3	2	0.50	0.30	—	

\*Going downward diagonally to the right in table 4 shows the survival of birds banded in a particular year.

From the data thus far presented, it is possible to construct a hypothetical barn swallow breeding population. This breeding population is composed of unbanded birds and returns. The unbanded birds have come to the colony from elsewhere. They have a sex ratio of 116:100, and include in their numbers, presumably, both one-year-old birds and older, the one-year-olds predominating. The return group, banded at



the colony in previous years, is composed of 20% one-year-olds, and 80% two years old or older. The 20% banded the previous year as nestlings has a sex ratio of 2,000:100. The remaining 80% has a sex ratio of 93:100.

Because the returns banded as nestlings come back to breed for the first time in the disproportionate sex ratio of 2,000:100, it might be expected that unbanded new arrivals would be preponderantly female. Such appears not to be the case, for we find a sex ratio of 116:100 in this group. Thus the facts all seem to point to the probability that the surplus of young males is not strictly speaking a part of the breeding population, either because they cannot find mates, or because in all instances they have not arrived at physiological maturity.

Combining all the data enables us to construct a barn swallow population from the time of its arrival in spring through the nesting season to its departure in fall. (Incidentally, through the kindness of Austen Fox Riggs, the outside dates of arrival and departure can be given for the Groton region. They are: arrival, April 17; departure, October 2. The arrival in force of the species occurs during the first week of May. Normally the exodus of the major portion of the breeding population occurs in late August.)

Arriving to nest in the spring would come 117 males to each 100 females. Of this breeding population 66% would be nesting for the first time, 19% would be 2 years old, 9% three, 3% four, and 2% five years old. There might or might not be a bird present which was 6, 7 or 8 years old.

This adult population would produce 100 first broods, including renestings, with a total of 425 viable nestlings. It would produce 50 second broods with a total of 172 nestlings.

Thus, by the end of the nesting season, the 217 adults are potentially augmented by 597 young birds, making a total population of 814.

Assuming the breeding population which arrived to nest the following year was exactly the same size, it would be 26.66% of the total reached, including reproduction, by the end of the previous nesting season. In terms of annual mortality suffered by a barn swallow population, we have the indicated figure of 73.44% per annum.

#### SUMMARY

The Wharton Bird Banding Station, Groton, Mass., banded 2,469 nestling and adult Barn Swallows in a 14 year period.

From records of 1,939 nestlings, it was learned that 374 first broods averaged 4.25 viable nestlings per brood, 101 second broods, 3.34. Of first broods, 43% contained 5 nestlings, 28%, 4. Four-nestling broods comprised 40% of second broods. About 50% of the breeding population raised second broods. Twenty-nine broods contained 6 nestlings. The species hatches a high percentage of eggs laid, and raises a large proportion of young hatched.

It was noted that extremes of both hot and cold weather had adverse effects upon the nestling population. A population of 17 nestlings in

one barn suffered a mortality rate of 64.7% during a cold, wet period.

Eighty per cent of the returns were adult when banded, 20% were nestlings.

From 381 adults banded, 34% returned with a sex ratio of 93:100. Only 2% of the nestlings banded returned, with a sex ratio of 2,000:100.

The entire adult population gave a sex ratio of 117:100.

An annual mortality of 73.44% is indicated for the species.

Three birds lived to at least 6 years, 2 to 7, and one to 8 years.

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## HOME LIFE OF THE VEERY

KATHARINE C. DAY

From 1926 to 1932 I made a special study of the habits of the Veery (*Hylocichla fuscescens fuscescens*) observed nesting in Holderness, New Hampshire. The material in this article is based on the records of thirty-two nests.

**Banding Record.** During the past fifteen years I have banded one hundred and five fledglings and one adult. The adult was banded by placing two of its young in a chardonneret trap as decoys the day they left the nest. So far I have not had a record of a return Veery.

**Location of Nests.** A hillside of about three acres sloping gradually to Lake Asquam was the nesting area used each year by the Veeries. It was heavily wooded with deciduous trees, principally beeches, maples and oaks, with large pines occurring at intervals. Beneath the trees was a continuous growth of mountain laurel (*Kalmia latifolia*) averaging from eighteen inches to five or six feet in height.

Seven nests were built on the ground, one without any shelter, four between stems of moose maple saplings, and two protected by large ferns.

Three were built on stumps from eleven to twelve inches from the