

It seems probable that if two or three trials for a successful nesting are made, the season is too far advanced for a second brood, but if the first brood is successfully raised, a second brood may follow.

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A STUDY OF NESTING EASTERN BLUEBIRDS

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This past season it has been my privilege to conduct the Bluebird (*Sialia sialis sialis*) nest-box project started in 1936 in Percy Warner Park in the suburbs of Nashville, Tennessee. This park consists of 2141 acres (see map), much of it wooded hills, with many miles of winding automobile roads, bridle paths, and hiking trails, interspersed with picnic grounds, shelter houses, and homes of park employes. On the outer boundaries are numerous meadows, bordered on one or two sides with narrow thickets of trees and undergrowth. These meadows provide excellent sites for the Bluebird nest-boxes that have been placed there.

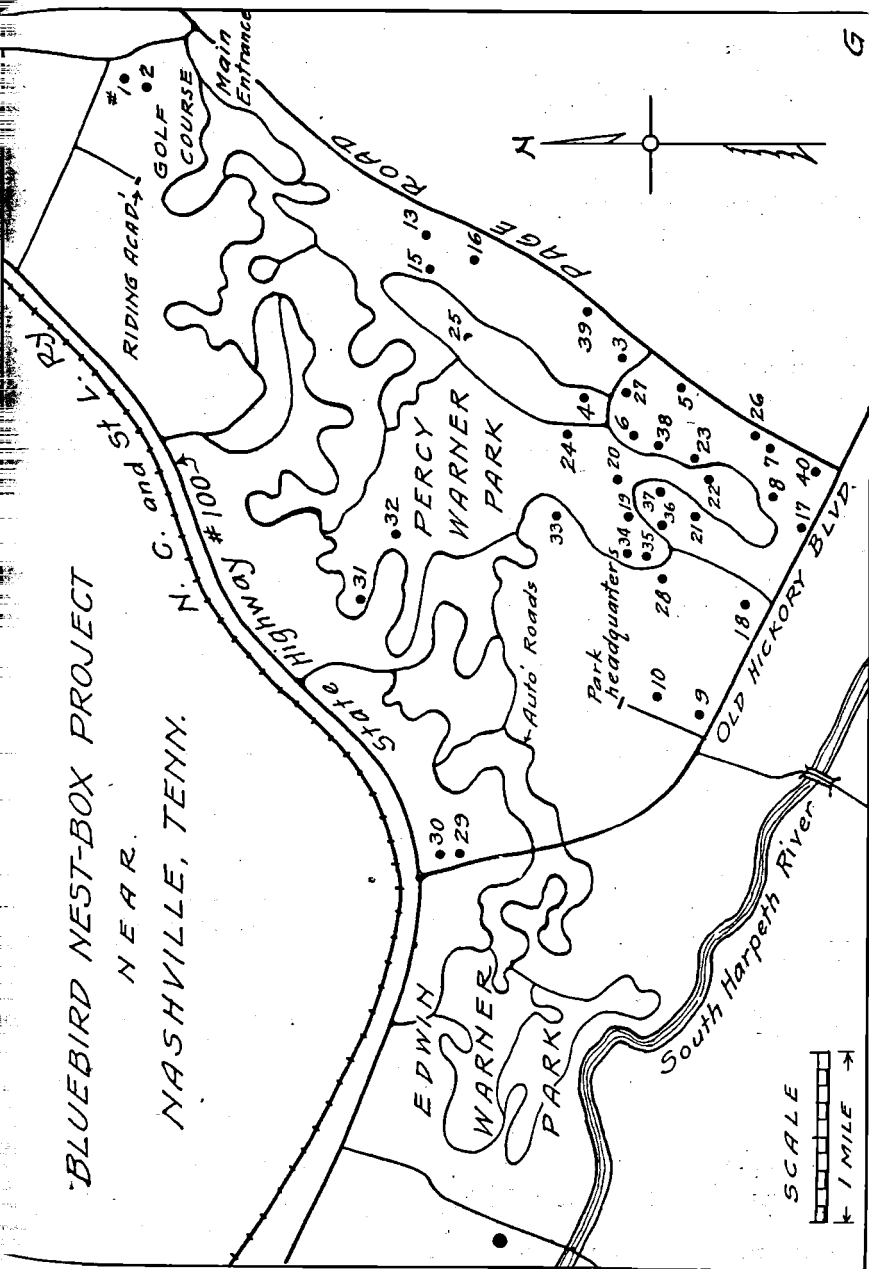
Although it is necessary to drive twelve miles in the park to visit these nest sites, most of the boxes are concentrated within an area of 1.1 by .7 miles in the southeastern section of the park adjacent to farm land. The majority of the boxes are placed from one to two tenths of a mile apart, facing the road, and in most cases they are screened from each other by the intervening vegetation.

From February 23, 1938 to mid-August, forty-five visits were made to examine the boxes, record data, band the nestlings and brooding birds, and recapture the latter for identification. This necessitated spending three or four hours in the field each trip after brooding started, as this year extraordinary efforts were made to trap the occupants during each nesting period. The object was to determine whether the same birds remained in their respective nest-boxes for the entire season or whether there had been any shifting in the population for the later nests. As the season advanced this part of the project became increasingly difficult and required patient, strategic stalking including many trips in the rain which experience taught was the only time many individuals could be captured. During the long, warm season Bluebirds spend much time away from the nest and their daytime brooding is often carried on with heads

protruding from the opening. Then, too, the dry, crackling stubble underfoot and the increased activities in the park add to the difficulties of the bander so that the inconvenience of a thorough wetting was more than offset by the achievement of capturing the elusive individuals. Fortunately a large percentage was trapped for banding or reading numbers on bands previously attached. The brief handling necessary to do this caused no desertions, broken eggs, or ill effects of any kind. Biological Survey numbered aluminum bands were placed on the left tarsus of all nestlings when about ten days old. Vacated nest boxes were immediately emptied of old material. About half of the trips were made by me alone and on other trips, several young bird students assisted. Acknowledgment is made to them for assistance rendered, particularly William Simpson.

Of the 37 nest-boxes available in 1938, 36 were used, at least once by Bluebirds, with a total of 104 sets or 460 eggs laid, an average of 4.42 per nest. In addition there was a nest of the Carolina Wren (*Thryothorus ludovicianus ludovicianus*), a nest of the Crested Flycatcher (*Myiarchus crinitus boreus* Bangs), both successful, and several attempted nestings by House Sparrows. None of the latter's eggs were permitted to hatch. The total number of Bluebird fledglings that left the nest successfully was 264 or 58.1 per cent. Comparing the results from the previous two years, it was found that this number from the 36 boxes of 1938 exceeded the combined totals of the first two seasons. Schreiber reported 74 from the 26 boxes available in 1936 and 183 from the 27 boxes of 1937. Statistics showed that the early nests were most successful; the sets of eggs were larger and the losses smaller. In 1938 there was one clutch of 7 eggs, a very unusual record, and especially remarkable because all of the nestlings were fledged safely. In the first nesting period of 1938, 72.3 per cent of the eggs laid developed to the fledgling stage successfully; from the second period, there were 55.2 per cent, and for the third period, still less, 42.6 per cent. Two nesting attempts were made in a fourth period but both failed. There were 6 sets of albino eggs laid by 3 females; of the 26 eggs, only one was infertile.

In 1936, only 5 brooding females had been banded. Two of them were retaken in 1937 in the boxes they had occupied the previous year. In 1937, 13 brooding females were banded and 7 of them were retaken in 1938, 6 in the same boxes they had used the previous year. In addition, one of the 1936 birds was recaptured for her third season and, among the brooding females, were found 3 that had been banded as nestlings in previous years. There were 27 unbanded females caught on the nest and banded on the right tarsus. Thus with the previously mentioned returns from other years, there was a total of 38 brooding females tagged for identification. In the 33 repeat records of this group can be found ample proof that faithfulness to the chosen box was the rule throughout the three nesting periods of the season. Although it was not possible to cap-



Map Showing Percy Warner Park with the adjoining smaller Edwyn Warner Park. Lines indicate paved roads. Dots indicate Bluebird nest-boxes. Boxes numbered from 29 to 40 were placed in February 1938.

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ture each female in every nesting period, there are 19 records of individuals rearing two and three broods in the same box this season. In a few cases different birds were found in the later nests. However, in the five boxes in which this situation is known to have occurred, the history of four of them showed that fatalities or interferences by enemies were responsible. In one case the previous occupant had been killed by a cat; in another she was found injured and died; in a third case there were depredations by a chicken snake; and in a fourth the nest was repeatedly robbed by unknown predators.

The bird using Box 17 furnished a remarkable example of constancy, for in spite of continuous raids by a Starling (*Sturnus vulgaris vulgaris Linnaeus*), she occupied the box from early March to mid-July, making five unsuccessful attempts to raise a brood. The Starling was able to enter the box and even laid an egg among those of the Bluebird. (Boxes made by W. P. A. labor.)

Another incident showed the attachment of a bird to her box. When her second nest had been completed, she suffered an accident (cause unknown) and was found on the nest with both legs broken above the tarsus joint. She was removed to the car to be brought home for care; the nest was also taken out. However, before leaving the park, she escaped, flying out of the car window. Two days later, when the boxes were again examined, she was found in her own nest-box. When touched, she gave a warning cry which brought her mate swooping at the heads of the observers. Therefore, thinking she was being fed by him, she was replaced. However, on the following visit, she was found dead in the box in an emaciated condition.

These experiences with the Warner Park group of brooding females differ from that of Musselman of Quincy, Illinois, who has sponsored a Bluebird nest-box project for several years involving 22 to 150 boxes. He says: "During the first period in 1935, I banded 18 mothers. During the second nesting, I found none of these birds were in my nests which leads me to believe the mother Bluebirds probably travel a number of miles between the first and second nesting. . . . The second nesting is carried on by stray mothers which formerly have nested elsewhere."

No data is available to show the relative constancy of the males of the Warner Park group because no male was ever found brooding, and it was not possible to trap them as they went into the box to feed the young without specially equipped boxes. However, with binoculars, it was possible occasionally to see one wearing a band on the left tarsus indicating he had been banded previously as a nestling.

The only Nashville record of a brooding male Bluebird is that of Simpson in April and May of 1937 when one individual was captured twice in a mail box on a nest containing eggs. Smith, of Wells River, Vermont, reports a male assisting in incubation and in the course of

a three-hour observation period, he was seen taking the place of his mate on the eggs three times.

A few of the males breeding at Nashville displayed considerable pugnacity in defending nests by snapping their mandibles as they swooped with great speed almost striking the heads of persons at the nest. Other males merely gave warning cries from trees near the boxes which in several instances added to the difficulties of trapping the female as some individuals responded immediately by flying to the trees and joining in the little warning carols. Herrick, in his "Home Life of the Birds," mentions this difference in behavior of male Bluebirds.

At the home banding station, boxes are placed for Bluebirds and there are several records of returns for nesting in the same box. A female, C109406 banded in 1932, was retaken in 1933; another female, 34-172784 banded in 1936, returned in 1937 and 1938. Other females moved to boxes a few yards away for later nestings. A male used the same box for three consecutive years. The identity of his mate was not learned for each brood but for each of the four nestings when his mate was known, she was found to be a different individual. What happened to these mates was not determined for none was ever found later. Another pair stayed together for at least two nestings of a season but moved to a different box when noisy workmen caused them to desert their nestlings.

Broderick has records of a pair of Bluebirds in Washington's Birthplace, Virginia, that used the same nest-box for two broods in 1934, returned in 1935 to the same box, raising another brood, and attempting the second brood for that year when the female was killed by a snake. Smith found a female banded in 1932, returning to the same box in 1933. Mrs. Nice lists one pair that remained together throughout the season and another pair that changed mates for the second brood but returned to the first mate for the third. Holcombe of Zion, Illinois, banded a nesting pair of Bluebirds in 1927. The female returned in 1928 to the same box but with a different mate and they raised two broods. She again returned in 1929 with her third mate, but, for that season, her two nests were built in a new box that had been placed the previous winter.

Some surprising details of Bluebird life have been observed at nest-boxes placed in yards of my neighbors. On April 25, 1938, when banding four nestlings, they were found resting on the dried flattened body of a female Bluebird that had been banded the previous September at the home banding station about 150 yards away. The parents of the nestlings scolded from a nearby tree. It was probable that the dead bird had been the previous mate that had come to a tragic end after the building of the nest but before laying eggs. There was evidence that she had been in a desperate fight for one wing was broken, one leg missing, and her skull was bare. Pettingill describes a fierce fight between a female with a

crippled leg and another female while the mate of the former perched nearby apparently indifferent to it all, although the head of the cripple was featherless and bleeding. The fighting females were so engrossed they did not fly until Mr. Pettingill touched them. Although the mated pair had worked several days on their nest in an old Woodpecker cavity, the marauding female was found there the following day and remained to rear a brood successfully.

In late May and early June of 1930, a rare occurrence in Bluebird life was observed at the home of another neighbor. Five birds of the first brood, less than two months old, diligently cared for the four nestlings of the second brood. This group of immature birds began bringing food into the box when the young were three days old. From the windows of Mrs. Dismukes' home, one could observe them easily. They could be watched daily as they brought food, one awaiting the exit of the other to enter with the next offering. They also assisted in removing the faecal sacs. In "The Birds of Oklahoma" Mrs. Nice describes her experience of 1920 saying "the young of the first brood returned with the parents and two of them helped feed their younger brothers and sisters in the nest, also carrying off excreta." Mrs. Wetherbee of Pomfret, Connecticut reports a similar experience in 1933 and Mills published an account of young Mountain Bluebirds (*Sialia curruoides*) in Colorado also feeding young of the second brood. In all the foregoing cases there was at least five weeks difference in the ages of the older and the younger broods. However, Miller published a record and a photograph of two young hand-reared Bluebirds in which one individual, only two weeks older than his companion, persistently fed the younger over a period of two weeks.

Near Warner Park this summer, a brood of week-old nestlings was found in a tin newspaper box almost dead and apparently deserted by the parents after an accident had occurred which spilled the small birds out of the nest onto the tin which was heated uncomfortably by the blazing noonday sun. There was hope for the life of only one, so it was taken to a nest-box in Warner Park and added to a brood of three that was only slightly younger. The foster parents accepted the foundling readily and raised it. It left a day or two ahead of the original family.

Another interesting detail noted was the relative length of time consumed by the various individuals in completing the cycle of three nesting periods. The occupants of Boxes 37 and 32 furnished an outstanding example for comparison. Both began building their first nests between the dates of March 3 and March 5. They both had three successful nests and each raised 14 young. In one case the last brood left the box on July 10 but the last brood of the other pair did not leave until a month later, August 10th. The first bird allowed only a week to elapse between the flying of one brood to egg-laying in the next nesting period. The occupant of Box 32 waited two weeks or longer.

The following tables give the details of the first nesting period; the second nesting period; the third nesting and the fourth nesting period; brooding females in Warner Park retaken in following years; nestling females retaken in following years; and females using same box for two or three nests in 1938.

Table 1

First nesting period began February 23 to March 23, 1938.

Total number of available boxes		37
Unused boxes	4	
Monopolized by House Sparrows	2	
Occupied by Bluebirds	31 or 83.78 per cent	
Sets of eggs laid in the	31 boxes	34
1 nest had 3 eggs	3	
3 nests " 4 eggs each	12	
26 " " 5 " "	130 (2 albino sets)	
3 " " 6 " "	18	
1 nest " 7 " "	7	
Total number Bluebird eggs		170
" " Birds matured		123 or 72.3 per cent
Average eggs per nest		5
" birds per nest		3.61

Entirely unsuccessful: 6 nests in 4 boxes, 29 eggs.

SUMMARY

Infertile eggs	13 or 7.6 per cent
Disappeared from nest (eggs and nestlings)	24 or 14.1 per cent
Unhatched fertile eggs	1 or .6 per cent
Large nestlings dead	4 or 2.4 per cent
Eggs deserted after depredations	5 or 3 per cent
Birds matured	123 or 72.3 per cent
	100 per cent

Table 2

Second nesting period began April 19 to May 19, 1938.

Total number of available boxes		37
Unused boxes	6	
Occupied by Carolina Wren	1	
" " Bluebirds	30 or 81.8 per cent	
Sets of eggs laid in the	30 boxes	35
2 boxes had 2 eggs each	4	
1 box " 3 " "	3	
5 boxes " 4 " " each	20	
26 " " 5 " " "	130 (2 albino sets)	
1 box " 6 " "	6	
Total number of Bluebird eggs		163
" " birds matured		90 or 55.2 per cent
Average eggs per nest		4.65
" birds " "		2.57

Entirely unsuccessful: 12 nests in 8 boxes, 53 eggs.

SUMMARY

Infertile eggs	7 or 4.3 per cent
Disappeared from next (eggs and nestlings)	45 or 27.6 per cent
Unhatched fertile egg	1 or .7 per cent
Nestlings found dead	2 or 1.2 per cent
Eggs deserted after depredations	8 or 4.9 per cent
Destroyed by Starling	10 or 6.1 per cent
Birds matured	90 or 55.2 per cent
	100 per cent

Table 3

Third nesting period began May 25 to July 4, 1938.

Total number of available boxes	37
Unused boxes	6
Occupied by Crested Flycatcher	1
Monopolized by House Sparrows	2
Occupied by Bluebirds	28
Sets of eggs laid in 28 boxes	33
1 nest had 1 egg	1
1 " " 2 eggs	2
10 nests " 3 eggs	30 (2 albino sets)
16 " " 4 " in	64
5 " " 5 " "	25
Total number of Bluebird eggs	122
" " birds matured	52 or 42.6 per cent
Average eggs per nest	3.69
" birds " "	1.57

Entirely unsuccessful: 17 nests in 13 boxes, 61 eggs.

SUMMARY

Infertile eggs	13 or 10 per cent
Disappeared from nest (eggs and nestlings)	32 or 26.2 per cent
Unhatched fertile eggs	2 or 1.6 per cent
Dead nestlings	15 or 12.3 per cent
Eggs deserted after depredations	4 or 3.3 per cent
Nestlings killed by Starling	4 or 3.3 per cent
Birds matured	52 or 42.6 per cent
	100 per cent

Fourth Nesting Period

July 23, 1938 Box 37, 1 egg laid, deserted.

July 25, 1938 Box 21, 4 eggs. On August 8, 1 newly hatched, dead nestling and 1 sterile egg remained.

SUMMARY OF ENTIRE SEASON

Number of boxes available	37
Boxes used at least once	36
Sets of Bluebird eggs	104
Number of eggs laid	460
Average eggs per nest	4.42
Number of birds leaving nest	265 or 57.6 per cent

Table 4

Brooding Females in Warner Park Retaken in Following Years.

Band No.	Date Banded	Box	Retaken	Box	Retaken	Box
36-118842	June 3, 1936	18	April 10, 1937	18	May 21, 1938	27
36-146456	July 29, 1936	24	April 3, 1937	24		
36-146550	April 10, 1937	15	June 19, 1937	13	June 27, 1938	13
36-146594	April 24, 1937	9	April 5, 1938	9		
37-135454	May 8, 1937	10	April 2, 1938	10		
37-135482	May 15, 1937	16	March 26, 1938	16		
37-135509	May 22, 1937	8	June 27, 1938	8		
37-135510	May 22, 1937	25	June 23, 1938	6		
37-135553	June 5, 1937	22	March 26, 1938	22		

Table 5

Nesting Females Retaken Brooding in Following Years.

Band No.	Date Banded	Box	Retaken Brooding	Box
34-172764	April 25, 1936	4	April 3, 1937	3
34-172782	April 25, 1936	9	June 25, 1938	23
36-118865	June 10, 1936	16	April 10, 1937	25
36-146557	April 17, 1937	18	April 2, 1938	26
36-146573	April 24, 1937	17	April 2, 1938	36

Table 6

Females Using Same Box for Two or Three Nests in 1938.

Box	Band No.	First Period	Second Period	Third Period
1	38-106455	Yes	Yes	Yes
3	38-106453	Yes	Vacant	Yes
7	38-144726	Yes	Yes	Not caught
9	36-146594	Yes	Yes	Yes
10	37-135454	Yes	Yes	Yes
17	37-144790	Yes	Yes	Yes
21	38-120786	Not caught	Not caught	Yes also Fourth Period
22	37-135553	Yes	Not caught	Yes
24	38-106452	Yes	Yes	Vacant
25	38-106451	Yes	Yes	Yes
26	36-146557	Yes	Yes	Yes
27	36-118842	Not caught	Yes	Yes
32	38-106454	Yes	Not caught	Yes
33	38-106449	Yes	Not caught	Yes
34	38-120732	Not caught	Yes	Yes
35	38-120648	Not caught	Yes	Yes (Died)
35	38-120649	(Replacing above bird)		Two nests, unsuccessful
36	36-146573	Yes	Not caught	Yes
37	36-106450	Yes	Not caught	Yes

CONCLUSIONS

1. Bluebirds, permanent residents in Tennessee, have long nesting seasons which are divided into three nesting periods. Each year there may be a few nests in a fourth period.

2. The early nests have a higher percentage of success than later nests.

3. Boxes placed for them in suitable open situations are quickly taken.

4. Faithfulness to the chosen nest site proved to be a dominant trait of females and further investigation will probably reveal the same tendency in males. The same site may be used for the entire season and from year to year unless depredations or other disturbances occur.

5. Nest-boxes placed at a distance from human habitation are more successful than those nearby.

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