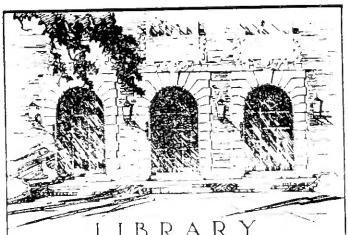

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# TERRITORIAL AND MATING BEHAVIOR OF THE HOUSE WREN

WITH 32 FIGURES

BY

S. CHARLES KENDEIGH

CONTRIBUTION FROM THE BALDWIN BIRD RESEARCH LABORATORY
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## ACKNOWLEDGMENT

THE WORK reported in this paper is by no means the contribution of any one person. The greatest credit is due to the late Dr. S. Prentiss Baldwin, who not only financed the entire undertaking but also had the early vision and energy to initiate this study and to direct its continuance. He personally made all the observations and notes through 1924, and he participated whole-heartedly in the work thereafter until his death in 1938.

My own attention to this problem covers the period from 1925 to 1939, inclusive. Many assistants and associates participated in collecting data, and I am pleased to list their names and the seasons when they worked at the Baldwin Bird Research Laboratory:

Rudyerd Boulton, 1926
W. Wedgwood Bowen, 1927
Ross B. Albaugh, 1928-1929
Leonard G. Worley, 1928-1930
Theodore C. Kramer, 1929-1934
Mae MacNab, 1929-1938
Delos Johnson, 1930
James Stevenson, 1930-1931
Francis Gilliland, 1931
Carl M. Johnson, 1931-1934
Roscoe W. Franks, 1932
Wilbur S. Long, 1935
James Bruce, 1935
Eugene P. Odum, 1936-1938
Russell A. Huggins, 1936-1938
Irene T. Rorimer, 1937
Sarah E. Huggins, 1937-1938
Frank A. Pitelka, 1939

I take pleasure in acknowledging the helpful comments and criticisms made by Dr. Ernst Mayr and Dr. A. L. Rand, both of the American Museum of Natural History, who read this paper in manuscript form. I am grateful also to Mr. J. Murray Speirs for suggesting the method used in the drawings to show territories each year.

# I. INTRODUCTION

The requirements and behavior of the house wren, *Troglodytes aedon,* in respect to territory are similar to those described by Howard (1920, 1929) for several passerine species. In the following discussion it will be apparent how the behavior of the house wren (Fig. 1) satisfies the definition given by Howard (1929, p. 63) that "when territory is imperative, a male isolates himself, makes himself conspicuous, becomes intolerant of other males, and exercises dominion over a definite area." Territory is generally considered as important in various ways: as a means by which birds become paired and mated, as an insurance of adequate nest-sites and food supply for adults and young, and as a safeguard against disturbance. The process of courtship and mating can scarcely be separated in the house wren from the phenomena of territory, as they are so vitally interwoven and intrinsically related.

There is considerable literature on the life-history and behavior of the house wren. A bibliography including every mention of information dealing with territory, mating, interrelations, and nesting in this species would run into dozens of references. As very few of them tend to tell the whole story, citations will be made only when they have a direct bearing on topics considered in the following pages, although for a general background the following references may be consulted: Wright (1909), Baldwin (1921), Sherman (1925), and Allen (1927). Likewise the study of territory in the St. Kilda wren, *Troglodytes t. hirtensis,* by Harrisson and Buchan (1934) has a direct relation, as does the recent life-history study of the European wren, *Troglodytes t. troglodytes,* by Kluijver *et al* (1940). References for comparative purposes will be made to these wrens and to the long-billed marsh wren, *Telmatodytes palustris,* that was studied by Welter (1935), but otherwise no attempt will be made at a monographic treatment of territorial and mating behavior as it applies to birds in general.

Since this paper was written, an article by Miller (1941) dealing with the Bewick wren, *Thryomanes bewickii,* has appeared. Items in the behavior of this wren of special interest for comparison with the other members of this family discussed in the following pages are here briefly summarized. This species of the southern United States has several subspecies, some being migratory, as *T. b. bewickii,* but others, as *T. b. spilurus* in California, which received major attention, being permanent residents. The latter, at least some more mature individuals, maintain a territory throughout the year, although less vigorously during the winter. Defense of territory appears to be entirely by song. Only the male sings, and the singing period lasts from early spring to late autumn. The female

takes no part in the territorial relations, although she appears to be cognizant of the boundaries of the territory belonging to her mate and does not venture outside. The territories average about an acre (0.4 hectare) in size. Mating occurs in early spring; the sexual status of paired birds frequently observed in winter is uncertain. Individuals recognize each other's sex by differences in call-notes and by the male's song. The female has special notes that serve as an invitation to the male for copulation. Two broods are raised during the season. Both sexes share in nest-building; the nests are placed in tree cavities; and pieces of snake skin are often incorporated in the nest-material. Although the male may start several nests, the possession of multiple nests is not a characteristic trait of this species as in some other members of this family. Although the male does not incubate, he is closely attentive, frequently feeding the female on the nest or elsewhere and sharing in the care of the young.

The study here reported covers the nineteen-year period from 1921 to 1939, inclusive, at the Baldwin Bird Research Laboratory, near Cleveland, Ohio. Perhaps the study actually began considerably earlier, for in Dr. S. Prentiss Baldwin's 1919 paper on the "marriage relations of the house wren," in which he reported on studies initiated in 1914, he tells how male birds sing and begin nest-building and compete with other males for the possession of nest-sites. Dr. Baldwin often stated that his notes were "full of territory," yet their significance as such did not appear until he had read Howard's classic study in 1920. Since 1921, detailed observations are available and are here summarized on the territorial behavior of 142 male and 147 female birds. Since many of these birds returned to the area year after year or had two broods in the same year, altogether some 331 matings between males and females are recorded, each mating the climax and goal of an individual territorial maneuver. This is the nineteen-year population on the "Hillcrest" area (Fig. 2). Altogether, the history of 215 individual male territories enter into this study. Many observations made in the "Outfield" area are also included as they bear on particular points.

The Hillcrest area (Fig. 3) included the fifteen acres immediately around the former home of Dr. and Mrs. Baldwin and at the top of the west bluff of the Chagrin River Valley. On the north the study area merged into hard maple-beech woods that extended fairly continuously for several miles beyond. The boundary on the east contacted several acres of cultivated land and pasture transversed by a wild rose lane and scattered trees and shrubs. Another estate of similar composition lay to the south, and extensive shrubby pastures adjoined to the west.

On the fifteen acres (six hectares) of the Hillcrest area itself, besides several buildings and long driveways, there were flower and vegetable

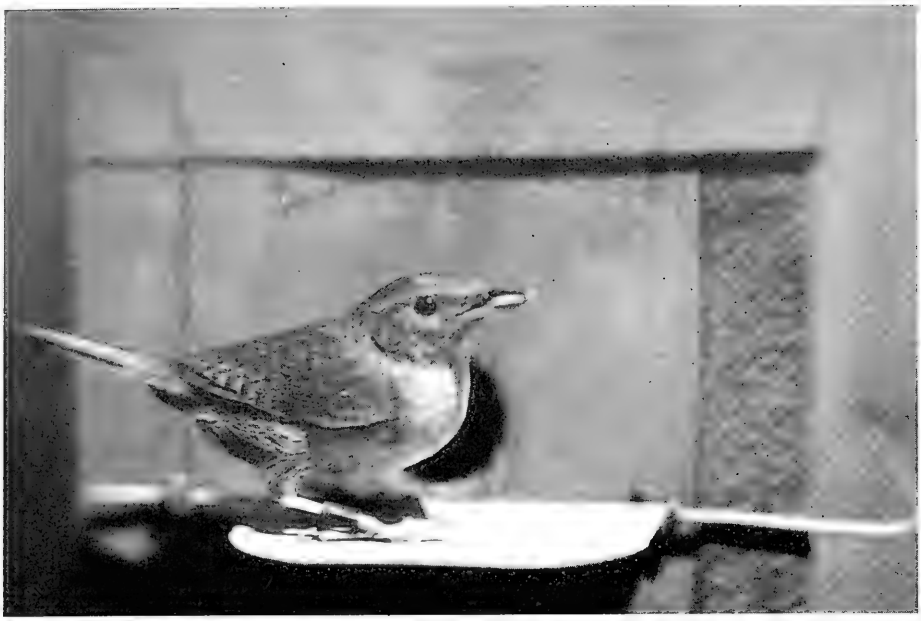

FIG. 1.—House wren standing on trap-door perch at nest-box. Note the celluloid band around the right leg of the bird.

FIG. 2.—Air-view of Hillcrest area looking west. Mayfield Road on the left marks the south boundary, and West Hill Drive, extending to the right near the top, marks the west boundary. The fence in the lower right corner is the eastern limit of the area. The hard maple grove is in the upper right corner. The barns and north edge of the area are not shown. Other features of the area may be identified from Fig. 3.

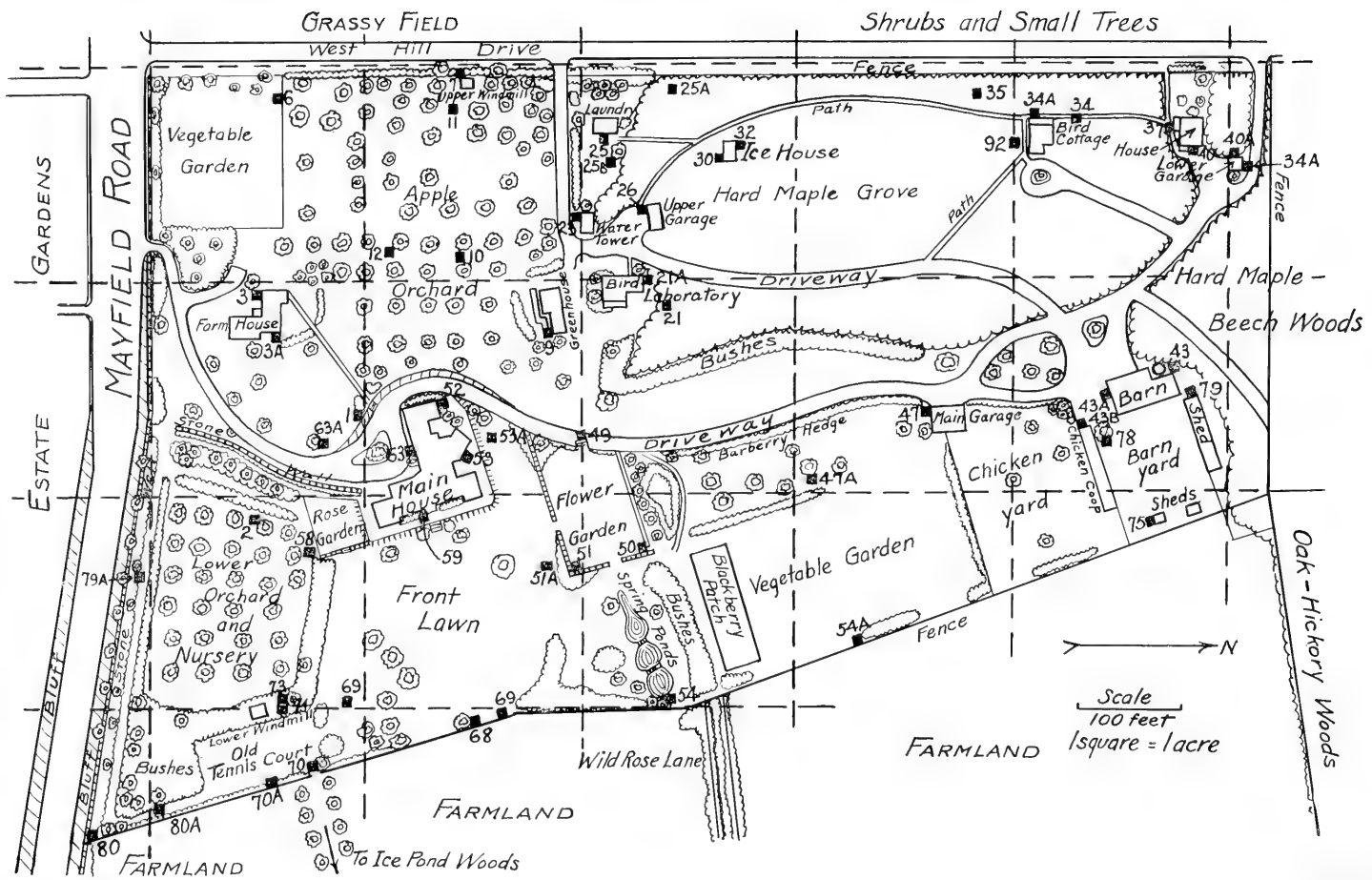


FIG. 3.—Generalized map of Hillcrest area, showing location of all boxes (numbered squares) used by house wrens from 1921 to 1939, inclusive. Minor changes from year to year in landscape and buildings are not indicated. Likewise slight changes in location of boxes are not shown here, although they are indicated on the year-by-year maps. The grid of squares, each equaling one acre, is for more accurate reference to this base map of the territories shown in the simplified maps, Figs. 7-32.

gardens, orchards, extensive lawns, a grove of tall hard maples with thick undergrowth, and many shade trees and cultivated shrubs of great variety. It was really a man-made forest-edge type of habitat, ideally favorable for the nesting of the house wren. Some forty boxes suitable for nesting were available, many more than were needed or ever used at any one time. These boxes were essentially permanent in location, as changes from year to year were slight. Rarely indeed did the wrens ever attempt to nest in natural cavities. In spite of abundance of nest-sites, strife between birds for possession of particular boxes was common. How behavior would be modified in areas where only natural nest-sites were available, needs to be studied, but doubtlessly the fundamental behavior would be the same.

The Outfield area (Fig. 4) included the Gates Mills village and vicinity. Its dimensions were approximately one and a half miles (2.4 kilometers) north and south, and one mile (1.6 kilometers) east and west. Hillcrest Farm lay near the center of this area, and the village itself lay in a deep valley, 300 feet below the surrounding upland. Much of the area was wooded, especially on the bluffs and to the north of Hillcrest. The western part of the area mapped was largely barren shrubby pastures of poor wren habitat and did not enter extensively into the study, the majority of the nest-boxes being in the southern and eastern parts. Work in the Outfield was started in 1926 (Baldwin and Bowen, 1928) and continued until 1938, although in decreasing amounts during the later years. During the period of main effort approximately 300 boxes were operated on some 70 different estates. An attempt was made to visit each box once a week, but some boxes were visited more frequently; others, only a couple of times each season. Record was made on each visit of progress of nesting, and a special effort was made to capture and band all adults and young. Identification of the entire wren population in the area was attempted. Where birds were found nesting in natural cavities, the nests were often transferred to boxes erected nearby so that the wrens could be caught and banded and their activities followed more easily. The purpose of this extensive study in the Outfield was to follow the movements of individual birds and to obtain ample data on mating and on nesting life.

For identification purposes the birds were trapped at their nest-boxes and banded with numbered government aluminum bands. The trapping was easily done by means of a movable perch that could, by means of a string, be closed over the entrance hole of the box after the bird had entered (Fig. 1). The bird was then induced to leave the box and enter a gathering net held over the entrance hole so that it could be more easily handled. During the early years of study, both adult birds were sometimes caught at about the same time or before they had become thoroughly

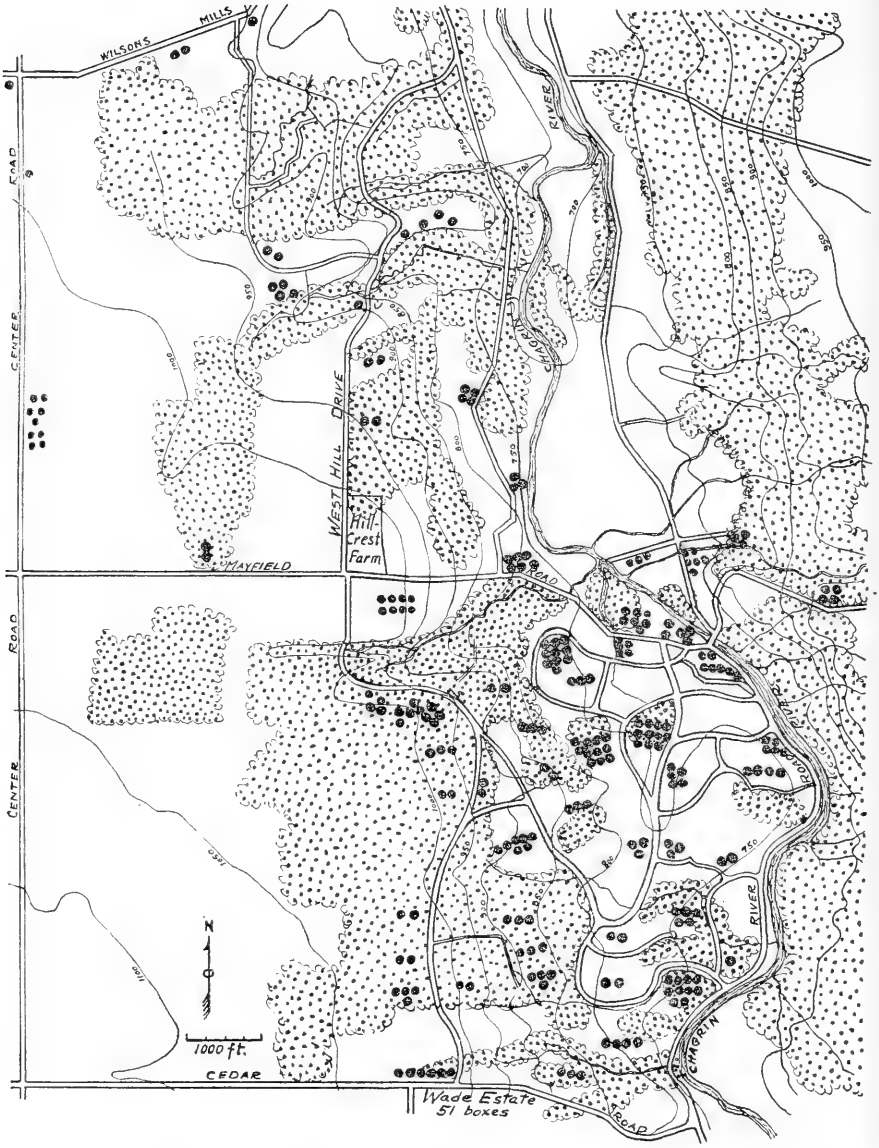


FIG. 4.—Map of the Outfield area, showing location of boxes by large dots. Contour lines are indicated. Stippled areas mark the location of forests or thick stands of trees. Areas not stippled are farmland and village. Gates Mills village lies mostly in the network of curving roads west of the river between Mayfield and Cedar roads.

established in nesting, so that disturbance of normal territorial behavior undoubtedly entered in to some extent and accounted for some undue shifting of birds from place to place. In later years the adult birds were not caught until the young had hatched and then usually on different days, so desertions were less common. Since the two sexes appear identical in the field and are separable only by behavior and by the male's song, colored celluloid bands for sex recognition were used as early as 1925, and consistently thereafter. In the hand, the sexes could quickly be distinguished during the breeding season by the presence of a brood patch only in the female. The sex bands were placed around the other leg than that which held the aluminum band (Fig. 1). Red was used for male and yellow for female. Usually the presence or absence of the sex band in connection with the location where observed gave also recognition of the bird as an individual. When a returning bird had been banded as a nestling, its age, of course, was accurately known. In an earlier paper (Kendeigh and Baldwin, 1937, p. 115) it was demonstrated that young birds are much more prone to wander into new regions than are adults, where the tendency to return in subsequent years to or near the place where they had previously nested is almost universal. All new unbanded birds of both sexes coming into the area were, therefore, considered birds in their first breeding season and to have hatched the preceding year or, rarely, two years before. Certainly this criterion is open to occasional exceptions, but it permitted logical explanations of various behavior phenomenon which otherwise would have remained obscure. This point is further considered on pages 17-19.

Since territory in this species is not large and since the adult birds return to their nest-box every few minutes, the limits of the territory and changes in its boundary were easily determined by observation. We were on the Hillcrest area daily from early June to September and less frequently through May and April. To visualize the dynamics of territorial behavior, a detailed map of the area was pinned on the laboratory wall. This map showed precise location of buildings, gardens, trees, and shrubs (Fig. 3). The territorial boundaries were marked, and changes through the season were followed as carefully as possible.

Nesting commonly began in early May and continued to middle or late August. This is the "breeding season" referred to in the following pages. The season is divided conveniently into two "breeding periods." The "first breeding period" terminates in late June when the majority of first broods are well on their way toward being independent individuals. The "second breeding period" begins in late June or early July and lasts to the end of the season. This is the period of second broods for those birds that nest twice. Not a few individuals, however, may nest for the first time in this second breeding period. These two periods are not

sharply distinct. Late arriving individuals may not start to nest until early or middle June, so that their first broods are not completed until the second breeding period is far along. Such a division is further complicated by birds starting again after the destruction of an early nest. However, the majority of nesting attempts fit in well with these two periods, and this division facilitates the analysis of territorial and mating relations. Within each period, nest-building by the female involves a period of 2-3 days, one egg is laid each day during the egg-laying period until the full complement of five to seven eggs is completed, and incubation lasts about 13 days. The young birds, after hatching, are cared for in the nest for 15 days, and after the young fly from the nest, their care by the parents continues for another 13 days, or until they become entirely independent.

For illustrating and supporting the various points brought out in the discussion and to put into available form for future reference or study of topics not here considered, case histories of each individual territory have been compiled (Section VIII). The identity of the male and female on each territory is given so far as it is known. The band number of the bird is given without parenthesis after the sex, both in the case histories and throughout the text. For the sake of completeness, work done from 1914 through 1920 is also indicated. Dr. Baldwin's notes first became complete and the study of house wren behavior took a serious form in 1921, so that beginning with that year, each territory is given a number. Maps were not made of the territories until 1925. During the early years, the boundaries of each territory were indicated during the progress of each summer's observations by means of pins and thread, and usually only the greatest extension of these boundaries were permanently recorded at the end of the season. During later years the territorial boundaries were marked in pencil and dated so that changes during the season would be permanently recorded. Thus the maps that are here reproduced (Figs. 7-32) show greater detail as the years progress. The history of each bird that returned one or more years is also compiled (Table 5), so that by cross-reference to the territorial accounts a complete story for each bird may be worked out for its entire life.

## II. SPRING ARRIVAL OF BIRDS

The first males that arrive on the area in early May are in song immediately. Occasionally at this time a bird may be observed moving through the Hillcrest area, not singing and keeping well hidden in the bushes, but most of the migrating individuals probably move northward through the Chagrin River Valley, 250 feet below. It is our impression, based on movements of newly arrived birds, that they have come up from lower down in the valley, frequently entering the study area (Fig. 3) at

the southeast corner and then spreading fanwise to the boxes that they select. A less common but regular point of entry is the northeast corner. The southwest and west sides are bordered by open fields, and while they contain scattered shrubs and clumps of briars they seem not to be important migration paths. The first males to come have the choice of territories. Most popular seem to be the areas around box 25 and around box 47; after that perhaps around boxes 37, 74, and 53, and then boxes 43A, 59, 3, and 49.

*Integration of the Breeding Population.*—To give a better conception of the manner of first appearance and building up of a season's wren population, let us consider the year 1933 (Fig. 19). The first wren, a male, probably C68910, a return bird from the preceding year, was seen in the bushes by the laundry (Fig. 3) on April 14, the earliest record we have for any year. He was singing to some extent and scolding. Later he was down near the laboratory and established territory No. 129. The next day, another male, probably F45946, also a return, was singing near the garage; he later established territory No. 130. The following day, a third male, probably H18577, appeared around the main house; he later laid ownership to territory No. 125. This bird as well as all others not indicated as returns were very likely first-year birds. No new birds arrived for ten days. On April 26, an unidentified male was in the ice pond woods. On April 27, male, H18582, came to the laundry and established territory No. 128. On the 28th, a non-singing bird was seen in the bushes east of the barns, possibly a migrant or possibly a female, as the first female, H18566, came in on April 29 and inspected boxes 21A, 21, and 49 (129). The same day a new male, unidentified, was at box 80 (131).* On April 30, male, H18570, began setting up territory No. 132 near box 74. Another slack period ensued, although a return male, F58648, came to box 40A (136) and female, F58248, came to box 49 (129) some time during the first nine days of May. On May 12, two males arrived, H18588 at box 72 (133) and F45987, a return, at box 54A (134), and one female, F45942, a return, who went to box 25 (128). On May 16, an unidentified female came to box 80 (131), and about this time female, F58493, was at box 70 (132). On May 20, three more males came in, H18580 at box 10 (126), H18600 at box 11 (127), and L24102 at box 43 (135), and also three females, H18583 to box 10 (126), F58955 to box 11 (127), and H18587 to box 54A (134). It is quite possible that these six birds migrated more or less together. The last two females arrived on May 24, H18581 going to box 63 (125) and H18584 to box 43 (136).

*Numbers in parenthesis following box numbers and not otherwise identified refer to history of individual territories; see Section VIII.

Although the actual date of arrival in the area could not always be determined with certainty, the time for beginning of nesting activities was approximately determined in 186 instances for males and 165 instances for females for the period 1921 to 1938 inclusive. The median date for *all* the males to begin nesting activities is May 11, although the median date for the *first* male activity is May 1, and for the *latest* male to begin activity, at least on Hillcrest, is June 22. Females average later, the corresponding three dates being May 20, May 11, and July 1. When the first activity of males and females is analyzed respective to age and combined into half-month intervals, the results shown in Fig. 5 are obtained. Although for the season as a whole, records for first-year males were 1.5 times as numerous and for first-year females 3.2 times as numerous as for older birds, as many old males as first-year males arrived between middle April and middle May, and there were almost as many older females as younger ones. From middle May to middle June the picture is different. Males two or more years old were outnumbered by one year

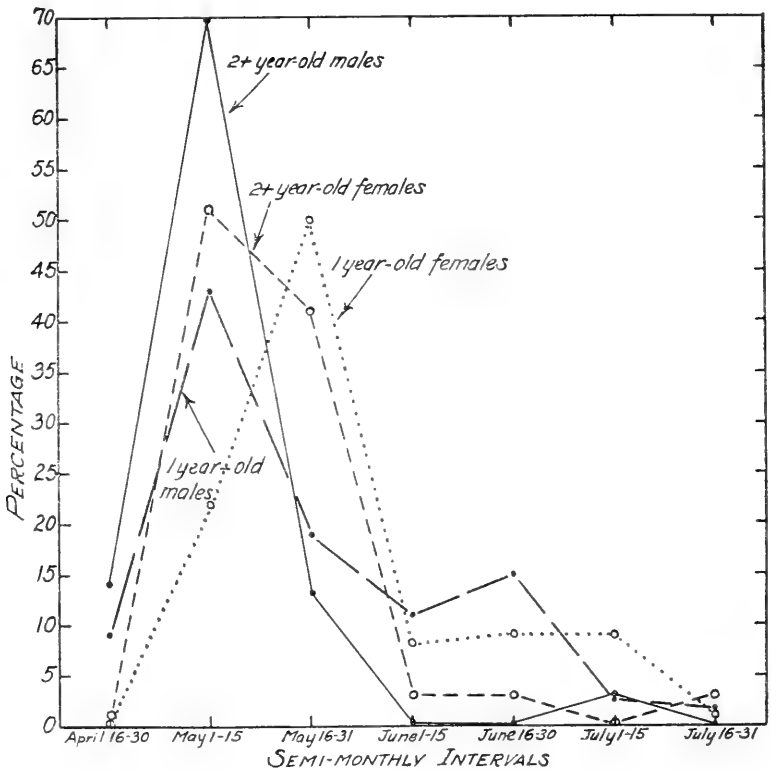


FIG. 5.—Graph showing percentage of all birds in each age and sex class arriving in spring migration on Hillcrest at semi-monthly intervals.

olds almost six to one, while the older females were outnumbered over four to one. Although the peak of arrival for males belonging to both age groups came during the first half of May, this peak was made up of 70 per cent of all the older males that returned to breed and only 43 per cent of the first-year males. The peak for the older females, constituting 51 per cent of all, came during the first half of May, while the peak for the one-year-olds, 50 per cent of all, came during the latter half of the month. Nearly all the new birds that arrived in time only for the second breeding period were young birds.

The above information shows definitely that while one-year-old birds of either sex may arrive along with the first birds of the season, older and more experienced birds constitute a great proportion of early arrivals, and younger birds predominate by far among the last to arrive and begin nesting activities. This order of arrival holds true also for the long-billed marsh wren, but in contrast the European wren is a permanent resident. The tendency to advance the time of beginning to breed with increasing age is shown further when arrival dates of individual birds in a series of years are compared. For 14 male house wrens that returned to breed for three to five years, the median dates of arrival in subsequent years are: May 13, May 9, May 4, May 4, and May 2. Similar information for six females that returned three or four years are: May 27, May 15, May 14, and May 11.

*Return to Former Territories.*—From Table 1, a strong tendency is evident for both adult males and females to return to their former territories, or at least to territories that overlapped in area territories occupied the preceding year. As example, note how the territories of male, A38398, in 1929 (89—Fig. 12) and 1930 (98—Fig. 14) overlapped part of his territory in 1928 (78—Fig. 11), and the territory of male, C68252,

TABLE 1.—RETURN OF ADULTS TO TERRITORIES USED THE PRECEDING YEAR

| Comparisons Involving 30 Males and 24 Females | Males | | Females | |
|---|---|---|---|---|
| | Number | Percentage | Number | Percentage |
| New territories overlapping former territories | 30 | 58 | 17 | 52 |
| New territories adjacent to former territories | 6 | 12 | 1 | 3 |
| New territories elsewhere on Hillcrest | 10 | 20 | 9 | 27 |
| New territories in Outfield | 5 | 10 | 6 | 18 |
| *Total* | 51 | 100 | 33 | 100 |

in 1931 (111—Fig. 15) and 1932 (122—Fig. 17) overlapped his territory in 1930 (101—Fig. 14). Further illustrations include male, C68910, whose territories in 1932 (119—Fig. 17) and 1933 (129—Fig. 19) overlapped his territory in 1931 (108—Fig. 15); also male, F58648, whose territories in 1933 (136—Fig. 19) and in 1934 (142—Fig. 21) overlapped his territory in 1932 (116—Fig. 17).

Often if the territories do not overlap they are adjacent to the area formerly occupied. Especially interesting is the sequence of territories of male, F45987, who nested six consecutive years on Hillcrest, alternating in such a way that three times his territories overlapped those of the preceding year, while two times they were adjacent, but not overlapping. The numbers of his territories in consecutive years are as follows: 1932 (118—Fig. 17), 1933 (134—Fig. 19), 1934 (144—Fig. 21), 1935 (157—Fig. 23), 1936 (169—Fig. 25), 1937 (177—Fig. 27).

In cases where males set up territories on Hillcrest having no evident relation to those of the preceding year, one might suppose that they went elsewhere because their previous year's territory was already occupied. In only two doubtful instances could this have been true. Information on the first arrival and beginning of activity in individual males of known identity is not always well established, but circumstantial evidence indicated that in eight and possibly all ten cases their former territories could have been taken over. No reason can be given for the males nesting in the Outfield rather than on Hillcrest, aside from a lack of a precise homing behavior. There are no records of adult birds being recovered in other localities away from this vicinity. In general, then, the odds are nearly three to one for male birds to return and set up territories on the same spot or immediately adjacent to where their territories were located the year before, and for those that do not do so to establish territories in other areas not far removed. The European wren likewise retains the same territory from one year to another and insures its retention by defending it against intruders at all seasons of the year.

The percentages of return for female house wrens do not differ greatly from the males, but there appears a slightly greater tendency for the females to wander (Table 1). The tendency to return to former nesting areas is further shown, however, in that out of 49 instances when comparisons are possible the females 33 per cent of the time selected for nest-sites some time during the breeding season the same box that they used at least once the year before.

In the Outfield, numerous records are available on birds that returned to nest in succeeding years. Although their territories were not mapped, the amount of shift from one year to another was readily determined from the distances between boxes that the birds occupied. There are 278 records for old return males and 279 for old return females. There are

likewise 182 records, males and females inclusive, showing the distance that young birds first nest from their place of birth; these birds were all banded as nestlings, so that their exact age is known. In a surprising number of instances, actually 22 per cent of all the records, these return nestlings skipped at least one year, and in four instances two years, before they were recorded as nesting. This could hardly be due to inefficiency in trapping operations as, in the case of adult birds, skipping a year occurred in only 7 per cent of all the records. Those birds that skipped one or two years before beginning to nest did not wander farther from their birthplace than did the others. Actually, of the four nestling birds in the Outfield that returned to nest in the box where they were born, one skipped a year before doing so. Skipping a year is therefore disregarded, as all records are compiled together in Table 2.

Approximately three-fourths of all the adult birds return to nest within 1000 feet (305 meters) of where they nested the previous season. A high percentage return to the same box where they previously nested. A higher percentage of males than of females return to the same place or the immediate vicinity. With males, only one per cent wander to a distance greater than a mile (5280 feet, or 1.6 kilometers), while six per cent of the females do so. The tendency for the female to shift around to a somewhat but not decidedly greater extent than the males has already been noted for the Hillcrest population.

The situation is quite different with nestling birds that return in later years. Of those where definite records are available, only 15 per cent

TABLE 2.—CHANGES IN LOCATION OF NESTS FROM ONE YEAR TO ANOTHER*

| Distance between Nests in Feet (1,000 feet = 305 meters) | Return Males | | Return Females | | Return Nestlings | |
|---|---|---|---|---|---|---|
| | Number | Per-centage | Number | Per-centage | Number | Per-centage |
| Same box both years.. | 85 | 31 | 72 | 26 | 4 | 2 |
| Less than 1,000..... | 146 | 53 | 123 | 44 | 23 | 13 |
| 1,000–2,000..... | 17 | 6 | 30 | 11 | 34 | 19 |
| 2,000–3,000..... | 9 | 3 | 17 | 6 | 21 | 12 |
| 3,000–4,000..... | 10 | 4 | 8 | 3 | 24 | 13 |
| 4,000–5,000..... | 1 | + | 6 | 2 | 12 | 7 |
| 5,000–6,000..... | 6 | 2 | 4 | 1 | 19 | 10 |
| 6,000–7,000..... | 4 | 1 | 6 | 2 | 3 | 2 |
| 7,000–8,000..... | 0 | 0 | 8 | 3 | 7 | 4 |
| 8,000–9,000..... | 0 | 0 | 1 | + | 4 | 2 |
| 9,000–10,000..... | 0 | 0 | 1 | + | 1 | + |
| 10,000–11,000..... | 0 | 0 | 0 | 0 | 2 | 1 |
| *Total*..... | 278 | 100 | 276* | 99* | 154* | 85* |

*In addition to the changes shown in the table, 31 wrens changed the location of their nests more than two miles. The record of these changes, in miles (1.6 kilometers), is as follows: no return males; 3 return females (1%)—2¼, 5, 6 miles; and 28 return nestlings (15%)—2½, 3, 3, 4, 4½, 4½, 5, 5½, 6, 6, 6½, 6½, 7, 7, 7, 7, 7, 7, 7½, 8, 8, 9, 9, 10, 20, 35, 50, 700 miles.

return to within 1000 feet (0.3 kilometer) of their birthplace. The distribution of returns for each additional 1000 feet in radius is fairly uniform up to a mile. Between one and two miles (1.6 and 3.2 kilometers) the distribution becomes greatly reduced, and beyond two miles, records of recovery are very spotty. The reason for this is that the distance goes beyond the study area of the Outfield. One recovery is of special interest, that of 34-3901, banded as a nestling, June 14, 1934, at a box in the Outfield and caught by a cat on August 10, 1935, at Lexington, Missouri, where supposedly it had been nesting. Its sex is not known. Thus, a bird that hatched as *Troglodytes aedon baldwini* (Oberholser, 1934), when it became adult, nested well inside the range of *Troglodytes aedon parkmani*. Riddle—to what subspecies does it belong?

A previous study (Kendeigh and Baldwin, 1937, p. 116) found that 92.5 per cent of all living adult birds can be accounted for by those known definitely to return to the general locality where previously they had nested, but this is true for only 11.5 per cent of former nestlings that are believed to be still alive. The other 88.5 per cent of the former nestlings drift away into unknown regions. In this group females outnumber males about five to three. In Table 2, it is permissible to think of the percentage of returns as approximately equivalent to the percentage of the total living population in the case of adult birds, but not for return nestlings. Approximately 10 per cent of the young birds probably still alive returned and nested within two miles of their place of birth; the other 90 per cent went elsewhere.

In 15 out of 18 records of birds banded as nestlings that have returned and nested for two or more seasons, the amount of shifting between breeding seasons has definitely decreased with increasing age. The record of B96357, a male in the Outfield, is an example:

1929, June 22—Banded as a nestling.
1930, July 7—4000 feet (1220 meters) away from place of birth.
1931, June 11—1000 feet (305 meters) away from nest-site of previous year.
1932, June 8—100 feet (30.5 meters) away from nest-site of previous year.

The tendency appears to exist for young birds to scatter out for their first breeding season anywhere from the box in which they were born to potentially the limits of the species' range, but with the return nestling population being thickest in the general locality of their birthplace, and the maximum possible dispersal rarely if ever actually realized. Furthermore, after once having nested they are thereafter faithful in their return to the same location year after year. There is no evidence that juvenile house wrens establish a temporary territory before they leave for the south to which they return the following spring, although in the European wren young males may sometimes select a territory their first autumn. Juvenile wrens of *Troglodytes aedon* leave the territory of their parents within a few days after they become fledged, remaining there-

after, until they are ready to journey southward, in shrubby fields, forest edges, or dense thickets, often in small loose groups.

*Homing Tendency in Nesting Birds.*—Fifty-three experiments, mostly with males, were performed over the course of several years to test the homing ability of nesting birds (Table 3). Individuals were captured at their nest-box and transported various distances away before being released. Up to about a half-mile distance (0.8 kilometer) most male birds returned to their nest, but beyond that the percentage of returns fluctuated, although it was sufficiently high, even up to two and one-half miles (4.0 kilometers), to indicate that a tendency to return is present. This is presupposing that if such a tendency exists the birds are able to find

TABLE 3.—HOMING BEHAVIOR OR RETURN TO THE SAME BOX OR VICINITY WITHIN A FEW DAYS AFTER REMOVAL

| Distance Removed in Miles (1 mile = 1.6 kilometers) | Males | | Females | |
|---|---|---|---|---|
| | Number Returning | Number Not Returning | Number Returning | Number Not Returning |
| Less than ½ | 9 | 2 | 1 | 1 |
| ½–1 | 8 | 9 | 0 | 2 |
| 1–1½ | 5 | 3 | 1 | 4 |
| 1½–2 | 4 | 0 | 1 | 0 |
| 2–2½ | 1 | 1 | .. | .. |
| 11 | .. | .. | 0 | 1 |
| *Total* | 27 | 15 | 3 | 8 |

their way back successfully. In three cases when males did not return to the place of capture they stayed and nested within one-quarter mile (0.4 kilometer) of where they were released. In two other instances they renested one and one-quarter and two miles respectively (2.0 and 3.2 kilometers) from their first place of capture, after traveling in one instance two miles and in the other one-half mile (3.2 and 0.8 kilometers) from their point of release. Some attempt was made to study homing at various stages of nesting life, but the results are only suggestive. In half the cases where the males were taken away before they had nests and mates fully established, they returned to or near their old territories. That homing behavior is better developed after nesting is well along is indicated by seven out of nine males returning to nests containing young.

As for the females (Table 3), the proportion of returns in these homing experiments is very much less. However, in eight out of the eleven experiments they had not begun egg-laying and were newly arrived at the box. Of these eight birds, five stayed and nested within one-third

of a mile (0.5 kilometer) of the point of release, two returned to the box where they were first captured, and one went elsewhere. One bird in the process of egg-laying did not return. The only bird with young at the time of capture returned to them. If a larger number of females could have been removed while they were with eggs or young, very possibly a larger proportion would have returned, as the incentive to do so would then have been greater. The males had this incentive better developed in having their territories already well established or their nests begun.

## III. ESTABLISHMENT AND DEFENSE OF TERRITORIES

With the establishment of a territory a male becomes intolerant of other males of the same or of competing species. He becomes a despot over the area that he claims possession. This despotism and defense of territory is exhibited in definite ways that can be analyzed.

*Song.*—Territory is established and defended chiefly by song (103, 106, 124, 178, 199, 208). Only the male sings, as is true also with the European wren and the long-billed marsh wren. The "territory song" of the house wren is but little different from the "nesting song," and both songs announce to other birds that the territory is occupied. The character of the "territory song" is difficult to describe, not only because of its intrinsic nature, but also because of its great variability. A representation may be diagrammed as follows:

The song is characteristically composed of a series of rich, bubbling, rapidly repeated notes, given with three or four or more changes of pitch. Sometimes the different pitch levels are not so distinct as the diagram indicates, but are slurred together in an ascending or descending manner. Commonly the song lasts two to three seconds. The song often begins with churring, guttural or sharp staccato notes or squeaks differing from the main body of the song, and occasionally the song is preceded by notes made by clicking the mandibles together. Sometimes the song also ends with squeaks or gutteral notes. Outside the normal range of intensity and pitch, even the main part of the song may become shrill and squeaky. This is especially true when the male becomes highly excited by the presence of a new female inspecting his nest. This series of high-pitched,

shrill, squeaky notes, which may properly be called the "mating song," is almost invariably indicative of a female's presence, and very likely stimulates her towards coition. The variation from the territory song that we call the "nesting song" is given after mating is accomplished and persists throughout the progress of nesting activities and to a small extent even until the bird leaves for the south. Not infrequently the two songs are nearly indistinguishable, but usually the nesting song is not so loud, not so long, not so high-pitched, and is not repeated at so rapid a rate. Occasionally the pitch changes as many as four times, but more often there are only two or three major variations in pitch level, and not infrequently the variability may be still further reduced to a single shift in pitch or none at all. Often the song is given in a listless or subdued manner, but at other times it is uttered with more spirit, especially in the presence of the female. It is seldom shrill or squeaky. This song serves in part to coordinate and regulate male and female activities at the nest.

The male gives other songs and call-notes. When mildly disturbed or annoyed he may utter a long series of slow sharp staccato notes nearly on the same pitch level. When more seriously disturbed, he has a scold: "*zzz-zzz-zzz-zzz-zzz-zzz.*" His scolding against intruders around the nest is often not so vigorous or so energetically given as is the scold of the female. Both male and female have other notes that serve for intercommunication throughout the nesting period. Especially important is a "*churrr,*" given most often by the female, to which the male often responds by song or change in behavior. Sometimes this note is shorter and repeated as "*chur-chur-chur*" or "*urrr-urrr-urrr.*" Occasionally it is a "*cherr-ee*" or "*kerr-dee.*" All these variations seem to serve the same general purpose of notifying the male of the female's presence. The female has a series of squeaky notes that she gives when excited, as when inspecting a new box for the first time in the male's presence. She also has a short low whine that she gives on occasion inside the box, as when the male comes near at the end of a period of attentiveness while she is incubating the eggs. The male European wren, in contrast, troubles himself little with the brood nest and has less contact with the female after the incubation begins.

Both male and female quiver their wings when excited. This is most pronounced during the mating process, but is also practiced when the birds are disturbed or scolding. The male may also quiver his wings when defending or advertising his territory by song. Another index of the male's degree of excitement is the position of the tail. During ordinary singing it is kept lowered, but may be raised to various degrees when the singing becomes very intense or in scolding. The tail is held quite vertical or even to an acute angle with the back during the mating activities.

Perhaps these wing and tail movements serve in addition to song and call-notes to convey meanings from one individual bird to another. Similar use of wings and tail occurs in the long-billed marsh wren and European wren.

The territory song is usually given on some conspicuous post, wire, shrub, or tree, often within ten feet (3 meters) of the ground but sometimes up to fifty feet (15 meters) above the ground. The frequency of singing may be some measure of the vigor of the male and of his chance for success. On June 16, 1939, two males (208, 210—Fig. 31) on opposite sides of a large elm on the front lawn were competing for territory. One bird sang seven times a minute, the other eight to nine. The latter bird seemed the more vigorous of the two, and he later won out. Eleven to twelve songs per minute is near the maximum. On June 4, 1929 (Fig. 12), male, B97018, had to defend his territory (90) against male, B56491, invading from box 3A (88). In a tree near box 9 the "two males became perched opposite and facing each other about 18 inches (0.46 meter) apart. Each took his turn singing his territory song, beginning as soon as the other stopped, and giving it with all his might. They appeared to be trying to out-do each other, although apparently no female was around. After a couple of minutes of this, one chased the other away and remained apparently to claim this as his territory henceforth."

Birds in migration seem not to sing so vigorously or so continually as on their territory, but the closer they get to their final destination, the more they are apt to do so. It is probable that while enroute during migration, they may discover likely breeding places, sing, and then disappear. For instance, on April 21 and 22, 1932 (Fig. 3), a singing male came to the evergreens on the front lawn, then wandered over to the flower garden near box 51, passed up to the trees in front of the laboratory, and finally flew off in the direction of the laundry and disappeared. The next day, another bird was first noticed singing in the ice pond woods, later came up to the rose garden south of the main house, then went over to the north side of the house, but on the following day was back at the ice pond woods and soon disappeared.

The song of the first males to arrive in the spring is imperfect and incomplete. This is especially true if the weather is not too favorable and there is little stimulation from rivals. In 1926, male, 57759 (58), did not reach full vigor of song until eleven days after arrival, and A34236 (59) not for seven days. They would sing sporadically for a day or two, then become silent and not even be seen, only to appear again for another burst of activity. By the time the females were due their songs were being given more vigorously. This imperfection in early singing is not due to immaturity, for 57759 was at least four years old. It seems more a

characteristic of early recrudescence each year and may be effected by periods of unfavorable weather. In other years the songs of males have reached perfection much quicker, due probably to stimulation from a larger population of competing males and to the earlier arrival of females.

The presence of a female is a distinct incentive to song. The male will give his territory song over and over again, day after day, in a purely mechanical manner until a female comes into view. Not really until then does he show any emotional excitement. The song is given more energetically, the mating song is interspersed, and males from adjoining territories may tune in. Competition between two males in adjoining territories becomes most vigorous when an unattached female enters the area (44, 52, 59, 64, 103, 105). The ideal of song perfection for the female bird or the manner in which the song may be most stimulating to her is difficult to judge. Nevertheless it appears there is at this point an opportunity for the factor of sexual selection, advocated by Darwin and in recent times by Huxley, to become exerted, for the female must make some choice as to which territory first to enter. The male whose song is most stimulating to her ears would seem to have the advantage.

The apparent purposes fulfilled by the territory song are that of notification to other males that the territory is occupied, of advertisement of the male's presence to females, and of inducement to the female to enter a particular male's territory in preference to the territory of some other male.

*Nest-sites.*—Since house wrens nest in cavities, the number of suitable nest-sites may be definitely limited, and their establishment and protection is an important function of territory and necessary in the acquiring of mates. The acquiring of nest-sites often involved the destruction and ejection of eggs or young of other birds already nesting there. The destructive tendencies of the house wren are analyzed in detail in a later section (p. 28). These nest-sites help to outline the shape and size of the territory, and usually two or three such nest-sites are available. The term "nest-site" is here used in a broad sense to include also the nest begun by the male. In the 214 territories studied, the number of nest-sites claimed by males for their territories at some time during the season was as follows: 38 territories had 1 nest-site, 64 had 2 nest-sites, 60 had 3, 34 had 4, 13 had 5, 5 had 6, and 1 territory had 7. In those territories with unusually large numbers of nest-sites (59, 78, 115, 136, 158, 168), the nest-boxes were situated fairly close together, there was very little competition with other males, or the males simply were restless and aggressive. Although apartment houses intended for purple martins, *Progne subis,* were available in certain territories, they were seldom used. To have but one nest-site in a territory definitely showed subnormal activity. Often in such cases it was a young bird coming to breed during

the second period, so that he was compelled to force his way in and carve out a territory. Several territories have been indicated where a bird, again a first-year breeder, had a temporary splurge of activity at a single box for a period of several days to a few weeks and then disappeared. Then again where suitable nest-sites were isolated, the bird got along with a single one. There are no known instances on Hillcrest of a bird nesting in a box and having extra nests in natural cavities, although such surplus nest-sites could easily have been overlooked. These extra nests are not utilized by the male for night roosting, but any one of them may be used for a second brood later in the season or for two simultaneous nestings with different females.

The house wren is surpassed by the European wren in possessing a surplus of nests. Twenty-five males over three years built 155 nests in that species, or an average of 6.2 nests per male. In both the European and house wrens the male builds the basal part of the nests, principally of small sticks, while the female inserts the nest-lining. In the long-billed marsh wren the male builds several nests, but these are not usually used by the female for nesting as she makes one of her own with only incidental aid from the male. Welter (1935) gives five as the average number of male nests per bird, while the number may run as high as ten; these numbers are in addition to the nests built and used by the females. In the European wren the fledged young sometimes use these extra nests for night roosts, and in cold weather males and females may roost together in old cocknests.

Possession of nest-sites is indicated in the house wren by the insertion of nesting material, usually sticks. A very few sticks will do, in some cases only a single stick has appeared sufficient to lay claim to a box. The male is by no means equally active at all his nest-sites. His activity usually centers around a single box to which he first attracts female visitors. At this box his nest foundation is usually best formed and has the largest number of sticks present. His other nest-sites contain stick nests built to a varying degree of perfection. An active male holding possession of these extra "dummy" nests visits them at intervals, sometimes once a day, sometimes days apart. A main purpose of these extra nests is to give an incoming female a choice of various sites for nesting, thereby insuring her retention, where otherwise she would more likely seek the territory of some other male. Baskett (1896) appreciated some such function for these extra nests in the house wren many years ago, and apparently they serve the same purpose in the European wren, but not in the long-billed marsh wren. It very often happens during the course of the nesting season that the male house wren's activity becomes so centered at other parts of his territory that he loses contact with certain boxes where he had previously been active. In such instances,

too numerous to mention in particular, another male bird has come in and taken possession. Occasionally the male will make a contest for retention, but usually the new male simply assumes possession without a struggle.

The insertion of sticks into a nest-cavity seems to be a regular act in the behavior pattern of establishing a territory, second in importance only to singing. This nest-building activity begins simultaneously with initiation of singing on the male's first arrival in an area. Either activity at times takes pre-eminence. Sometimes the male is so active inserting sticks that his singing is interspersed only at intervals. Then again he may sing continuously and insistently all day long, visiting the box frequently, picking up sticks and straws, but then often dropping them without taking them to the box. Where the two processes are more evenly balanced, the male, when stimulated by a female's presence in the neighborhood, may carry two or three sticks into the box every minute, singing in the air each time he leaves. A single male may show all three degrees of activity at different times, showing the variability of his emotional behavior.

New nesting-sites may be included in the territory at any stage in the nesting cycle. If a male is not soon successful in obtaining a mate, he may shift his activities to other boxes. When the female is incubating, the male may wander to another box and add it to his territory, as his time is not otherwise fully occupied. Number 57759 in 1926 (58—Fig. 9) alternated between two types of behavior and song, giving his nesting song for a time at box 11 where his mate was incubating, then going over to box 6 and giving his territory song. The male usually takes an active part in feeding young, so during this phase of nesting his activity at other boxes may be limited. Not uncommonly, however, the male may early desert his task of feeding, leaving it mostly or entirely to the female, in order to get started that much sooner with a second brood at another box with another female (27, 41, 59, 114, 170, 171, 183, 202).

*Chasing and Fighting.*—Competition for territory through singing involves outbluffing the other bird. Competition may also involve actual combat, as through chasing (59) and fighting (77). Kluijver *et al* (1940) state that the European wren defends his territory by song and posturing. Welter (1935) describes not only song and posturing but also chasing in the defense of territories by the long-billed marsh wren. Actual physical combat and destruction of nests, as will later be described, appears much more prevalent in the house wren than in either of these other two species. Chasing in the house wren is less strenuous than fighting, and in many cases may be sufficient. Chasing of one bird by another implies fighting if the other bird is caught. Thus chasing in itself is threatening to a greater degree than is singing or posturing. Posturing in a

threatening attitude may precede the chase, and sometimes is sufficient in itself. When assuming a threatening posture, the male intently watches every movement of the other, flattens himself out on a branch, erects his back feathers, lowers his tail almost vertically and fans it out, and partially spreads or droops his wings. When actually chasing, the two birds become oblivious of their surroundings. They circle round and round, sometimes flying to within three feet of the observer. On one such occasion they flew against the window pane of an open garage door. In intervals between chases sometimes, but not always, excited singing occurs. Usually in such chases the invader leaves the territory, and when the pursuer reaches the boundaries of his territory, he turns back. Sometimes the invader may endure this chasing or may chase in turn so that he is successful in wresting away ownership over the area in dispute. If one bird catches the other in such flights, pecking occurs and the competition may change into physical combat.

The following account taken directly from the recorded notes at the time (July 25, 1931, Outfield) describes what takes place. This pair of wrens had young birds twelve days old, and another male attempted to wrest away part of their territory even though it was late in the season. "Both males were singing quite rapidly as we approached the box. They were chasing each other in short rapid flights. Between flights one male would alight in a tree and sing a very elaborate territory song as rapidly as possible. It seemed to take the other male several minutes before he was able to sing his full territory song. The female was a very interested onlooker, and we believe she entered the chase, as three birds were seen circling when the female was not feeding the young. The nestlings scolded continuously. The songs of the two males were very different. After thirty minutes one male was driven from the territory. The victorious male then flew fifty feet (15 meters) north and then fifty feet south of the box singing his territory song. He then flew to a wire in front of the box where the female was. She entered the box, and the male scolded and next flew to the northern limit of his territory. Soon after the other male left, the nestlings quieted down, although the male did not enter the box for one and one-half hours."

The above represents a defense of a territory already well established. The following description of an actual physical combat is between two males for the possession of a territory and a female early in the season, May 10, 1931. "As we approached the box, two singing wrens were seen flying around the front lawn in circles, one apparently doing all the chasing. They flew around in circles about ten times, the flight becoming slower and slower as if they were tiring. One flew to the foundation of the porch, followed by the other. They clasped each other with their feet and fought. Kramer approached to within two feet of both birds

and tried to catch them but with no success. While this was going on, a third wren, probably a female, came to the box carrying nest material. The two males stayed at opposite ends of the porch, and every time one came near the other he was chased away."

The following description is of the encounter between the two males indicated in the description of territory 77 where a new male came in and dispossessed a male already partially established at box 59. "They were piling and tumbling around, much as two boys in a scrap. One was bouncing on the other, which was turned on its back. The female of box 59 was nearby, more or less hidden in the bushes, and seemingly unaware of what was going on. After a few seconds of this struggle, which, however, may have gone on much longer previously, the two separated, and one drove the other down the lawn. Neither male sang during the struggle, but they gave some shorter notes."

Fighting between wrens had been recorded by many other observers, but particularly by Miss Sherman (1925). She gives some graphic accounts of such combats but describes them as occurring between females. In our experience, a female is very often nearby and may sometimes be involved, but the fighting is entirely between males. She further states that these duels may end in the death of one of the combatants and occasionally this has been witnessed, but she does not give details of the evidence. In our experience, one bird usually becomes exhausted before the other and flees. If death occurs, as it infrequently does in the wren's conflict with other species (pp. 29-30), it is probably due to a chance blow on the back of the head.

*Evolution of Territorial Defense.*—If the various actions involved in competition between house wrens for territory are arranged in order of decreasing strenuousness, they would rank as follows: physical combat, chasing, threatening postures sometimes with scolding, competitive singing, establishing nest-sites combined with advertising song. This may well represent a natural order of events in a psychological series as well as in an evolutionary one. Observations in territory No. 209 (Fig. 31) bear this out. On June 13 another male invaded the vicinity of box 74, and the owner chased it into the rose garden. For a short interval preceding the chase, however, he assumed a serious threatening posture, which the invading male appeared to disregard. On June 14 he again invaded and was again chased out. Perhaps this happened more times than was observed. At any rate, on June 18, when the same male invaded to approximately the same spot as five days before, the male, who owned the territory, scolded him from a foot away and assumed a threatening posture as before. The invading male behaved as if he expected a chase. He hopped out to the edge of the bushes and with a final threatening posture from the owner he left, although there was no chase. It looked

like a conditioned reflex type of behavior, the postures and chase being at first associated to produce a response which after some repetition was produced by the posturing alone.

In an evolutionary way, territorial behavior may have progressed in a similar manner. Physical combat represents the most primitive manner of competition but is associated with the chase, although song is usually absent. After a time the chase alone is sufficient to drive an invader away as it is a prelude to fighting. The chase is usually interspersed with excited singing or threatening postures, and one can well imagine that later in evolution competitive singing in turn would be sufficient warning. Finally, song of the same character, although not given in an excited competitive manner, but more in a mechanical manner for self-advertisement may be ample notification of possession so that wandering males will avoid the territory. The behavior patterns of the males have become conditioned in a permanent manner, doubtlessly ingrained by process of evolution in the nervous makeup itself, so that at their present high state of development the simple territory song serves the same purpose for which in ages past more frequent physical combats were required. Certainly it is of distinct advantage to the welfare of the species not to waste energy in combats needlessly when the same purpose may be fulfilled by less strenuous behavior responses. That energy is needed for other duties such as are involved in reproduction and self-preservation.

*Destructive Tendencies.*—Conflict between house wrens for possession of territory and especially for nest-sites may involve the destruction of nests of other birds already begun. Strange unmated males are frequently about. If a breeding male deserts his territory or leaves it unguarded, these males may come in, court the female, and even attempt copulation (59). The female may object in some cases (126), but often does not. The advantage to the male in assiduous defense of his territory is in the prevention of such adultery (116) and breakup of nesting. Unguarded nests not infrequently have the eggs removed (53) or even the young killed and carried out of the box (136, 150) by new males or males from neighboring territories. It would seem that this is a natural consequence of the normal tendency of the male to add other boxes to his territory during the course of his nesting cycle, which becomes especially pronounced when unattached females are about. It is the regular act of the male, when his brood of young has flown, to clean out the nest of lining, debris, and other foreign material exclusive of the stick foundation which he himself had inserted. Eggs or young, if present in desired boxes, would be removed in the same way as any other excess material, as the goal is possession of a clean stick nest foundation to show to incoming unattached females.

Destruction of eggs (11, 15, 59, 61, 64, 77, 137, 156, 160, 175, 182, 201) and young (29, 134, 137, 150) may occur even when the nest is defended, as invading males try to wrest away ownership. It is seldom that one can obtain direct evidence of destruction (134), although circumstantial facts often warrant accusations, as when a new male is observed in the area or later building at the box where destruction has occurred. In some instances (29, 59, 61, 64, 201) one even wonders if the male might not have destroyed his own nest in the excitement of competition with a new male or for a new female, but there is no positive evidence of this (see also Wright, 1909). The extent of this destructive tendency within the species is not great, considering that, out of 331 matings, eggs were destroyed in only 13 instances and young in 5. This degree of destruction is only 6 per cent.

There is no reason to believe that the house wren must compete for a food supply with other species, although that may be one factor for competition within the species itself. The wren finds its food in crannies, crevices, corners, under bushes, in the grass, and elsewhere, often in places that other species do not frequent. However, nesting-cavities are often scarce, and, as the wren practices multiple nesting, they must often be fought for. Since other species may use similar cavities, competition for them may be keen and destructive. On this area the bluebird, *Sialia sialis,* and house sparrow, *Passer domesticus,* were most important in this regard.

Bluebirds are often successful in the defense of their nest-sites (64, 84, 92, 190), and in frequent instances a bluebird's nest in or near a wren's territory will not be molested by the wren until the bluebird brood has left (60, 90, 106, 147, 190, 193, 210). The conflict between these two species is sometimes very vicious, however. The wrens may terminate the bluebird's nesting in a box very early (59, 62, 89, 195) or may throw out eggs (86, 99, 103, 137, 192) or young. The destruction of bluebird young has not been recorded on Hillcrest, but the following observations were made, May 31, 1932, in the Outfield. In this case the young were between 11 and 14 days of age. "At 4:00 P.M. a *pair* of wrens were going in and out of the box trying to carry out a dead bluebird. When found, the bird's head was on the perch and the body in the nest below the opening. The nest was all torn to shreds. The other three young in the nest were also dead, with their necks torn badly and some viscera torn out. Neither adult bluebird was about. The next day a wren's nest was begun on top of the bluebird's nest and the dead young, and on June 6 the first egg was laid."

The bluebird-wren feud does not stop with destruction of eggs or young but may involve death of the adults. In two instances (59, 137) adult bluebirds have been found dead in their nests. One was a male,

one a female. One was badly bruised on the back of the head and neck. The other had the feathers on the rump matted with blood which were still wet when discovered. The injury did not appear severe on the surface, but autopsy showed an internal hemorrhage in the abdomen. Within an hour a new male wren was seen and heard singing its territory song near the box. In neither case was the deed actually observed, but the circumstantial evidence is indicative. One wonders how the attack took place. Was the injury inflicted during flight, on the ground, or was the bluebird cornered inside the box? In both cases the dead bird was found inside the box, and here it would seem that the smaller agile wren would be at an advantage. An observation of Beckwith (1913) of a fight between a house wren and a house sparrow has a bearing here. He noticed that the house wren was much more agile and quick than the sparrow. The wren would fly directly above the sparrow and then pounce on it and sink its sharp beak into the sparrow's head and back while in flight. The sparrow would sometimes fall more than 18 inches (0.46 meter) in the air after being struck by the wren. Possibly the bluebirds were first attacked in flight, and then the wren pursued them into the box for the final blows. In the nineteen years of observation, there have been 150 attempts of bluebirds at nesting. Ten of these were unsuccessful due to wrens, which gives a percentage of seven. We have no record of bluebirds actually destroying either eggs, young, or adult house wrens.

The house sparrow and house wren are more evenly matched. Twice, according to our records, wrens were able to stop sparrows from nesting in boxes before eggs were laid. Once they threw out eggs (210), and once they were probably responsible for the killing and ejection of young sparrows from a natural cavity. On the other hand, there are at least thirteen instances where wrens did not start nesting in boxes until sparrows were through or had their nests removed by us. Three times sparrows destroyed wren eggs, and possibly once they destroyed a brood of young. These four instances constitute only about one per cent of wren nesting attempts. On one or two occasions extra nest boxes of the wren have had their entrances so clogged with sticks and wires that no bird larger than a wren could possibly have entered. It seemed this was primarily a protection against sparrows. There is an observation recorded (Smith, 1911) of a house sparrow entering a house wren's box, pulling an adult bird out, and dropping it exhausted to the ground. Wrens and sparrows did not come into conflict as frequently as wrens and bluebirds. Sparrow nesting was well along before wrens were well started, and an additional factor was our own efforts in destroying sparrow nests and favoring wrens by making the entrances of many boxes too small for sparrows to use.

Although the sparrow is a larger bird than the wren, the wren is

frequently successful in defending his nest. One observation in the Outfield, June 4, 1926, is worth recording. The wrens had only the fifth egg of their set. "Two male house sparrows were perched within a foot or two of the box. Every minute or so they would raise the feathers of their back and lower their heads and open their wings slightly as if to make a dash for the box. The male wren, which was scolding excitedly, would then dive at the one which apparently was contemplating a sally toward the entrance of the box, and on two occasions he succeeded in dislodging him, possibly with his wings, but I think also with his bill." Barrows (1889) describes several observations of conflict between wrens and sparrows. He mentions 180 records of sparrows molesting wrens and 39 cases where wrens resisted the sparrow, but he does not list instances where wrens had interfered with the nesting of sparrows.

Any species that nests in holes in the same habitat as the house wren is not immune from the destruction of their nests. Once I observed a wren enter a nest of a black-capped chickadee, *Penthestes atricapillus,* in a natural cavity, carry out an egg in its bill and drop it about ten feet (3 meters) away, thereby breaking it. Usually, I believe, the wren punctures the eggs with its bill and carries them that way, or the eggs may be left in the nest. While carrying on these destructive activities the wren does not sing but slips around slyly and unobtrusively. In this case the adult chickadees were absent until after the eggs were destroyed. Later in the season a wren, probably this same one, succeeded in getting a female here and they raised a brood of young (72).

Among non-avian species using holes, the white-footed mouse, *Peromyscus leucopus,* is most important in competition with the wren. When a mouse gets started with a nest in a box, the wren rarely dislodges it (36, 84, 92, 102, 158). The mouse is active chiefly at night, and during the day is buried in its nest inside the box, so the two have actually little chance for physical combat. Only twice has evidence been available that mice possibly destroyed a wren nesting already begun. In one case (36) during egg-laying, the first three eggs were found gone the day the fourth was laid. The female wren deserted, and when the nest was next examined three days later, a mouse was found to have appropriated it. In another case (158) a family of mice was found in a nest on the same day that the absence of the eggs was discovered. After nesting has started, the female bird is almost always in the box at night, and usually this is sufficient to keep the mice away. On one other occasion a dead mumified wren was found as part of a mouse's nest. It is rare that one knows certainly just what happens, but in this instance the bird may easily have become entangled in the nesting material and died. Prescott (1916), Pierce (1925), and Frost (1925) have described similar cases of wrens

dying after getting their feet caught in nesting materials. Hancock (1911) tells of other instances of finding house wrens made into the nests of white-footed mice and states one case where the mouse, about ready to give birth to young, actually killed the wren.

Squirrels, particularly the red squirrel, *Sciurus hudsonicus,* not infrequently enlarge the entrance hole of empty boxes and build nests therein. Chipmunks, *Tamias striatus,* are small enough to enter boxes with bluebird-size entrances and are sometimes found within. Neither species is a serious competitor with the house wren for nest-sites—the red squirrel because it is not sufficiently abundant and generally uses larger cavities higher in the trees, and the chipmunk because it is chiefly a terrestrial animal. In no certain instance can destruction of eggs or young wrens be ascribed to either of these two species, although there is one suspicious case (132).

Wasps, *Polistes fuscatus,* and less frequently bumblebees, *Bombus* sp., also use similar cavities for their nests. Both seem effective in keeping the wrens away (158, 172) but not frequently enough to be important. In no case are they known to have forced the birds to vacate but must get established first to be successful in competition.

Aside from strife for nest-sites, the house wren competes with some other species, as far as I can tell, chiefly from annoyance at their too close proximity. Our first record of purple finches, *Carpodacus purpureus,* nesting in the region was spoiled by having the eggs punctured, probably by a wren. Robins, *Turdus migratorious,* occasionally build their nests on top of the wren boxes early in the season before the wrens arrive from the south. This may prevent the wren from occupying the box until the robins are through (54). In two instances, the destruction of robin eggs in such a location I have thought due to wrens (27, 178). There is considerable difference between birds as to their tolerance. In 1933, wrens started to nest in a box about ten feet (3 meters) away from an active robin's nest (130). There was constant conflict, and in spite of the robin's apparently greater clumsiness and the protection the wren had in its box, it soon became apparent that the robins were getting the better of the competition. The female wren laid only three eggs, then deserted. In 1939, a robin nested in a rose arbor less than three feet away (1 meter) from a wren's nest (box 49, 208). There was never any sign of conflict. The robin brood flew successfully on July 4 and the wren brood left six days later. I also recall an observation made many years ago where a pair of robins and a pair of wrens both brought forth their young successfully, although the robin's nest was directly on top of the wren box. Metcalf (1919) reports a similar situation for a robin's nest, with nesting of both species successful. There is no basic conflict between these species.

On at least two occasions song sparrows, *Melospiza melodia,* nesting in bushes near a wren's nest and sometimes feeding directly below, have resented the wrens' presence and chased them whenever they left the box. Other birds may accidentally affect a wren's behavior. Once a catbird, *Dumetella carolinensis,* perched on top of a wren box, kept the adult wrens away from their newly-hatched young for several minutes. Another time a male redstart, *Setophaga ruticilla,* hovered in front of the entrance to the box peering inside, and in spite of loud protestations from the wrens did not leave, it seemed, until his curiosity was thoroughly satisfied.

Other species than those already mentioned with which the house wren has been reported in conflict are:

Mourning dove—*Zenaidura macroura*
Flicker—*Colaptes auratus*
Crested flycatcher—*Myiarchus crinitus*
Eastern phoebe—*Sayornis phoebe*
Tree swallow—*Iridoprocne bicolor*
Barn swallow—*Hirundo erythrogaster*
Purple martin—*Progne subis*
Carolina chickadee—*Penthestes carolinensis*
Tufted titmouse—*Baeolophus bicolor*
Bewick wren—*Thryomanes bewicki*
Starling—*Sturnus vulgaris*
Maryland yellow-throat—*Geothlypis trichas*
Scarlet tanager—*Piranga erythromelas*
Cardinal—*Richmondena cardinalis*
Chipping sparrow—*Spizella passerina*

Doubtlessly the list could be extended. Of the twenty species mentioned as suffering from the attacks of house wrens, eleven species nest in holes, and the conflict may be for nest-sites. Reasons for conflict with the other nine species is less obvious, unless it be simply annoyance at their occurrence within the wren's territories. The house wren is not always the aggressor but is sometimes the victim in these inter-specific encounters.

Some individual wrens are more aggressive than others in the defense of territories. Male, H18586, is a marked example of an individual with a behavior pattern of destruction and killing (137). In 1933, in our interpretation of the evidence is correct, he killed one adult bluebird, threw out two sets of bluebird eggs and one set of wren eggs, and destroyed three broods of nestling wrens, the latter all on the same day. Although individual differences in degree do exist, the same tendencies are inherent in all, and under proper conditions may become expressed. Destruction by wrens of nestlings of other wrens, bluebirds, and house sparrows is especially prevalent under conditions of high population or perhaps overpopulation. In the six years when no destruction occurred or where it might have been of a bird's own nest in the heat of sexual excitement, the average population of males was 10, with a range from 9 to 11.

During thirteen years when destruction of other nestings did occur, the average population of male wrens was 13, and ranged from 11 to 16, except for a not-too-certain case (59) in 1926 when the population was only 4. This is further evidence that it is inherently a problem of territory establishment and a desire for nest-sites for carrying on reproduction.

As there are individual house wrens that are especially aggressive, so also are there individual birds that have a lower competitive spirit. Instances of this sort will be noted in this paper, but such extreme cases as the two following accounts we have never observed. Taylor (1905) tells of a three-room apartment house, where during one year house sparrows occupied one compartment and house wrens the other two. During the next year the house sparrows' place was taken by bluebirds. All lived in peace and raised their families.

Another account is given by Smith (1911) of where house wrens found a half-built house sparrows' nest in a box placed on a barn. The wrens built the foundation of their own nest on top of it, but the house sparrows put in the feather lining. There was no fighting. The wren laid the first egg but the next day the sparrow also laid one, until finally there were four wren's eggs and five sparrow's eggs all in the same nest, with the eggs of the sparrow arranged on the outside. The sparrow did the incubating. All the eggs of both species hatched at about the same time, but the young wrens very soon disappeared. The sparrows were not seen killing or removing the young wrens, so the manner of their disappearance is a mystery. Although this incident is an amazing one, I believe it within the realm of possibility. Differences in the behavior of individual birds are often apt to be great.

There has been considerable discussion in print (Bird-Lore, Wilson Bulletin, 1925-1927) concerning the destructive habits of the house wren on other species. This even went so far as to induce some (Sherman, 1925) to advocate removing all nest-boxes and other encouragement for wrens around human habitation when other species of birds are also desired. Although many of the accusations made against this species were based on circumstantial evidence, they were generally well within the realms of possibility. Even if all accusations could be verified, nevertheless there is very little evidence that the house wren affects the established population of any species over a period of years, unless it be with the Bewick wren. The northward dispersal of this species appears to be hindered by the house wren, which in turn is probably limited in its southward distribution by the Bewick wren (Butler, 1891; Jones, 1903; Christy, 1924; Sutton, 1930). After 25 years of having a high population of house wrens nesting each year on Hillcrest, there is no sign of diminution of other species. However, to lessen the competition between species for nest-sites, there should always be a surplus of boxes available.

*The Female's Role.*—Territorial relations in this species are strictly for the male to perform and function primarily for the obtaining of mates. Other advantages of the territorial system are the avoidance by the female of distracting attentions from other males and a ready source of food supply for both adults and young. I am not sure that I have ever seen a female take an active part in the defense of a territory.

The female will act, however, in the defense of the nest itself. She is often more quick and vigorous in her scolding at intruders near the nest than is the male. On at least one occasion (126) she was observed to drive off another male wren that came too close to the nest-box.

Possibly the presence of pieces of snake skin or other similar shining material may be protective, and as these pieces are usually conspicuously placed in the nest-lining or on top or between the eggs, they are probably inserted by the female rather than by the male, since only the female has ever been observed to insert the nest-lining material. Pieces of snake skin are regularly present in nests of the house wren. Accurate statistics are not available, but in 1939 they were found in at least 12 per cent of the nests. The most conspicuous use of a snake skin was in box 54A (212) during 1939 when a large nearly entire piece was inserted three days before the eggs hatched. One end was wound around the eggs and the other end stretched over the rim of the nest toward the entrance of the box. Its conspicuousness appeared too well done to be without some definite function. As numerous house sparrows were continually about and not infrequently perched at the entrance and looked in, the skin may have served a real defensive function, although there is no evidence that the bird deliberately intended it for this purpose.

The female appears to have very little knowledge of the limits of the territory established by her male mate, and she goes pretty much where she pleases. For instance in 1930, the female at box 53 was seen to go for food into apple trees north of the farmhouse outside of the territory of her mate (97—Fig. 14). When a female goes into the territory of another male, she may be chased out if the male there espies her (121). When she goes into unclaimed areas, she is safe from molestation (59, 208). After a female by repeated excursions into unclaimed areas forms a persistent habit of going there, the male often follows, and by giving his territory song adds this area to his possessions. The gradual extension of territory No. 203 in 1939 (Figs. 31, 32) was partly brought about in this way. I have no record of where an established female by repeated excursions into occupied territories of other males has induced her mate to usurp such areas for her benefit. If an unmated female seems interested in a box where previously the male had been present only occasionally, he may turn his major attention to it for a period of days, even if the female does not stay. A female may even induce the male to

add entirely new outside boxes or nest-sites to his domain, and Welter (1935) describes a similar instance in the long-billed marsh wren. Sometimes a female may inspect nest-sites (169) outside of any male's active territory and without any male around at the time.

The appearance of an unattached female seeking a mate and a nest-site is a potent stimulation for male activity (15, 44, 52, 59, 65, 72, 75, 103, 105, 108, 168, 209) and often causes intense song outbursts or combats between males of neighboring territories. There is one record for the Outfield where three different males were caught within a few minutes one after another in the same box where they had been competing for the attentions of a new female for a couple of days. Apparently this box had not been definitely incorporated into any one male's territory. My observations tend to support Tinbergen's (1936) contention that much of the rivalry between males is not just for territory, as has sometimes been maintained, but also for the attention and attraction of the female.

It seems that any tendency of the female to be confined to her own mate's territory is due to (1) the nest being centrally located so that she does not need to go far for food, (2) the female being chased out of neighboring territories, and (3) the male varying the boundaries of his territory to follow her movements.

## IV. CHARACTERISTICS OF THE TERRITORY

A WREN's territory is by no means a uniform area static throughout the season. One can never be certain that the territories as first established and mapped in the spring will be maintained through the year. Frequent observations show that the boundaries of a territory are definitely recognized by the male, but these boundaries, nevertheless, are frequently in a state of flux and change. The concept of territorial relations in this species should be a dynamic one with individuals often in strife to adjust their space relations best to meet the prevailing demands. There is very little time during the season that the male can afford to relax his attention, although after the young hatch perhaps changes are less frequent than at other times. The way territories fluctuate in size is best shown in the maps for 1931, 1932, 1933, 1936, and 1939 (Figs. 15-20, 25, 26, 31, 32). The territories established by the European wren likewise vary in shape and extent with the progress of the season, as Kluijver *et al* (1940) show in a series of maps, and probably a similar condition is true for the long-billed marsh wren.

*Variability in Territorial Boundaries.*—The time of arrival of a bird in spring migration affects the size and stableness of the territory over which it claims possession. The first arrivals may often wander over a considerable area before settling down at any one box. Male, A34236, in

1926 (59—Fig. 9; see also 64, 78) at various times during May sang his territory song over the area from the greenhouse to the main garage and from there to the southeast corner and may have even crossed Mayfield road for an inspection tour of the adjoining estate. Finally he returned to the point near where he was first seen on May 6 and settled at box 49, the choice of his female. As new birds came into the area, he gave up parts of his vast estate only after vigorous defense. While this may be an extreme case, still the first males that arrive investigate and attempt to claim a larger area than they are later able to hold. The wanderings of male, A34236, were probably so great because that year the number of birds attempting to establish territories in the area was unusually small. In ordinary years with normal populations the first males' wandering around must be limited to a very few days, as very soon a new influx of migrants occurs, and then to insure possession, each male cannot occupy a larger area than it is possible for him to defend with vigor.

Males that arrive late in the season must usually squeeze in their territories by usurping parts of established territories of other males and by taking advantage of unoccupied areas. A typical case is that of male, 36-38466, at box 1 in 1939 (203—Figs. 31, 32). These late arriving males are almost always first-breeders (p. 39), and they begin their territories by including a small area around a single box. After this is fully established they then expand in various directions and add new nest-sites, the amount and extent of the expansion depending on the favorableness of the habitat and the competition they meet from neighboring males. They may progress in certain directions by making only small additions on successive days. Of 17 attempts recorded of late arriving males to usurp the whole or part of another male's active territory, 11 were successful and 6 were not. In the latter case the males disappeared. The fact that nearly twice as many attempts were successful as failed indicates that the boundaries of the territories are adjustable and subject to pressure from competitors. In year-by-year maps of territories, where territories overlap, the portions relinquished by the one male are shown by broken lines.

*Changes in Territories between Breeding Periods.*—The greatest factor causing change in territorial limits is remating for second broods. Most of the males that renested, or actually 89 per cent, retained their old territories for the second breeding period, changing them only to meet pressure from incoming males or to accommodate their new mates. When a female chooses another box in which to raise a second brood, the male often becomes inactive in parts of his territory which he formerly held. In such instances, which are very numerous, new males coming in estab-

lish territories without difficulty, or neighboring males expand their territories in that direction without meeting serious, if any, competition. The amount of singing necessary to establish a new addition to a territory depends on the amount of competition. When there is no contest involved, part of a day to a day and a half is sufficient, but when there is dispute, two or three or more days are required.

About 11 per cent of the males that nested on Hillcrest during both breeding periods established disconnected territories at various times (42, 66, 67, 70, 125, 133, 148, 158, 162, 166, 168, 169, 173, 183, 185, 186, 212). They may have been unsuccessful in one locality and then suddenly shifted to a different place and established an entirely new territory. In many of these cases the male while caring for young wandered off into other regions and found a new female there, and so established a territory around the box selected by the female, forsaking his old area entirely. In one instance, partly to be explained by such a happening (168, 169—Figs. 25, 26), two males actually exchanged territories, but not their mates, for second broods. In other cases, the male has found his former territory usurped by another male when he became free from caring for his young, and so was compelled to set up a new territory, usually nearby. In the long-billed marsh wren new territories for rearing second broods are usually established in more open areas, but this may be associated with changes in the marsh habitat such as do not occur in the forest-edge.

Not all house wrens remain on Hillcrest to nest during both breeding periods. At the end of the first breeding period 23 per cent of the 173 males that nested on Hillcrest disappeared, and 24 per cent of the 176 males present during the second breeding period were new males that had appeared. Very often males disappear while caring for their young out of the nest. This exchange of males between breeding periods obviously upsets the spatial balance between the various territories.

Females likewise shift considerably from one territory to another as rematings occur for second broods. Of 144 females with first nestings on Hillcrest, 41, or 28 per cent, disappeared at the end of the first breeding period. Of 141 females present on Hillcrest during the second breeding period, 38, or 27 per cent, were new for the season. The percentages of females exchanged between breeding periods are slightly greater than those for the male.

Of birds that left Hillcrest at the end of the first period, 59 per cent of the males and 68 per cent of the females were birds presumably in their first breeding season, the rest being return birds that are known to have nested before. As the percentage of first-breeders in the total population was 65 for the males and 78 for the females, there was a slight tendency for first-breeders not to leave as frequently as adult birds, but

the differential was small and of questionable significance. However, of the new birds appearing for the first time to nest during the second period, 95 per cent of the males and 92 per cent of the females were in their first breeding season. These percentages are high enough to be worthy of notice. It is known from trapping operations that 12 per cent of the birds that disappeared and 12 per cent of those that appeared as new for the second breeding period nested in surrounding nearby estates in the Outfield for the other period. Certainly the very high percentage of young birds making their first appearance on Hillcrest during the second period must include many nesting actually for the first time. It is possible that the slowness of young birds in starting to nest is due to this being their first attempt, and the various physiological and psychological processes involved have not reached complete efficiency.

Trapping of adult birds at the Outfield boxes during both breeding periods furnishes much information as to the extent that males and females shift around between first and second broods. Out of a total of 115 records for males, 47, or 41 per cent, renested in the same box a second time, and 56 others, or 49 per cent, did not move over 1000 feet (305 meters). This distance is about that of the greatest diameter of Hillcrest, although nearly twice its short diameter. This total of 103, or 90 percent, shows rather close restriction of movement. Another 10 birds were scattered to distances up to 4000 feet (1220 meters); one bird shifted a mile (1.6 kilometers) away, and another a mile and a quarter (2.0 kilometers). The females showed the same reluctance for moving very far. Out of 206 records for this sex, 94, or 46 per cent, renested in the same box, 83 others, or 40 per cent, stayed within 1000 feet (305 meters); thus 177, or 86 per cent, can be said to have stayed on the same territories or to have merely shifted over to adjacent ones. Nineteen birds moved up to 2000 feet (610 meters) away, 9 birds up to a mile (1.6 kilometers), and, as in the case of the males, one bird moved as far as one and a quarter miles (2.0 kilometers). The amount of shifting between periods in general is not related to the age of the birds. Individuals known to have nested in previous years shifted to distances beyond 1000 feet to about equal extent as did birds in their first breeding season.

*Size of Territories.*—Males come to know the general area surrounding their territories, even when they make no attempt to include all this area under their control. To obtain this knowledge they go on scouting expeditions (58, 60, 203). When they are beyond the boundaries of their territories they do not sing, but move furtively through the bushes as inconspicuously as they are able. On these trips they often find other nest-sites, and they investigate boxes and plant cover in a very thorough manner. Often they enter the territory of other males, and ordinarily, if

seen, are chased by the owner to the limits of his possession. The invaders do not offer resistance, but as soon as they return to their own areas they proclaim their authority there by song. Probably the expansion of territory in any direction is preceded by preliminary trips of reconnaisance.

With the territories mapped, their areas were easily determined through the use of a planimeter. The maximum area occupied during each breeding period or breeding season was determined, even though in some cases parts of territories originally staked out by the birds were later lost to competitors. During eleven years when the territories were mapped separately for each breeding period, the average total size was one acre (0.4 hectare), the same each period, although actually the greatest number of territories fall in the size class of one-half to three-quarters acre (0.2-0.3 hectare). Of 178 territories measured, the distribution of different-sized territories is as follows:

| *Number of Territories* | *Size of Territories* | |
|---|---|---|
| | *Acres* | *Hectares* |
| 4 | –0.25 | –0.1 |
| 13 | 0.25–0.50 | 0.1–0.2 |
| 59 | 0.50–0.75 | 0.2–0.3 |
| 36 | 0.75–1.00 | 0.3–0.4 |
| 33 | 1.00–1.25 | 0.4–0.5 |
| 18 | 1.25–1.50 | 0.5–0.6 |
| 5 | 1.50–1.75 | 0.6–0.7 |
| 3 | 1.75–2.00 | 0.7–0.8 |
| 2 | 2.00–2.25 | 0.8–0.9 |
| 3 | 2.25–2.50 | 0.9–1.0 |
| 2 | 2.50–2.75 | 1.0–1.1 |

During the course of an entire season, the territory covers more area at one time or another than it does during any separate breeding period. During four years when territories were mapped only for the season as a whole, the average size was 1.4 acres (0.56 hectare). Harrisson and Buchan (1934) found the size of territories in the St. Kilda wren to measure 0.6 to 1.0 acre (0.24-0.40 hectare). Kluijver *et al* (1940) found that territories in the European wren vary in size between 0.75 and 3.0 acres (0.3-1.2 hectares); while Welter (1935) estimates their size in the long-billed marsh wren at about 0.3 acre (0.12 hectare) for monogamous males and double this for polygamous ones.

The largest territory of which we have record is No. 58 (Fig. 9) which was for the entire season of 1926, and in its broadest extent covered 3.6 acres (1.44 hectares). Some very small territories were also observed, such as No. 179 and 215 (Figs. 28, 31), each 0.18 acre (0.07 hectare), and No. 204 (Fig. 31) which was 0.08 acre (0.03 hectare). Territory 179 was that of a bachelor male during the second breeding period. Territory 215, if accurately mapped, was small during the first

breeding season, but when the female deserted her eggs on June 20, the male quickly expanded it. Territory 204 was of a bachelor male who did not get a mate until late in June. Although frequently watched, he was never seen to go beyond the four or five trees immediately around his box during the ten days previous to his obtaining a mate.

When the average size of the territories during each breeding period (Table 4) is plotted against the number of territories established during those periods (Fig. 6), it becomes apparent that with an increase in number of males setting up territories there is a proportional decrease in the average size of these territories. When the number of males present is of intermediate size, that is, eight or nine, the size of their territories in different periods varies greatly, 0.65 to 1.5 acres (0.26-0.60 hectare). However, a line may be drawn through this wide scattering of spots to show the general trend. With populations of males varying between six or seven and eleven, a straight line relation appears to hold. During 1926 (Fig. 9) there was a lower population than any shown in the figure, and with only three males establishing territories, their average size was 2.0 acres (0.8 hectare). This high average, however, is due to the one bird in territory 59 covering 3.6 acres (1.4 hectares); the other two territories, 58 and 60, covered 1.2 and 1.1 acres respectively (0.48 and 0.44 hectare). There is very probably a maximum limit to the size of a territory de-

TABLE 4.—NUMBER AND AVERAGE SIZE OF TERRITORIES EACH YEAR*
(1 acre = 0.4 hectare)

| Year | First Breeding Period | | Second Breeding Period | | Season as a Whole | |
|---|---|---|---|---|---|---|
| | Number of Territories | Size in Acres | Number of Territories | Size in Acres | Number in Territories | Size in Acres |
| 1925 | 8 | 1.0 | 7 | 1.6 | .. | ... |
| 1926 | .. | ... | .. | ... | 3 | 2.0 |
| 1927 | .. | ... | .. | ... | 8 | 1.4 |
| 1928 | .. | ... | .. | ... | 10 | 1.2 |
| 1929 | 11 | 0.9 | 10 | 1.0 | .. | ... |
| 1930 | .. | ... | .. | ... | 11 | 1.0 |
| 1931 | 8 | 1.5 | 8 | 1.2 | .. | ... |
| 1932 | 9 | 1.4 | 6 | 1.2 | .. | ... |
| 1933 | 13 | 0.9 | 8 | 0.9 | .. | ... |
| 1934 | 9 | 0.9 | 9 | 1.0 | .. | ... |
| 1935 | 8 | 1.2 | 9 | 1.0 | .. | ... |
| 1936 | 9 | 0.9 | 8 | 0.65 | .. | ... |
| 1937 | 10 | 0.7 | 11 | 0.6 | .. | ... |
| 1938 | 10 | 0.6 | 11 | 0.65 | .. | ... |
| 1939 | 12 | 0.6 | 10 | 0.8 | .. | ... |
| *Average* | 9.7 | 0.96 | 8.8 | 0.96 | 8.0 | 1.4 |

*Number of territories is total for study area even though parts of some territories extend outside. The average size is determined from only those territories whose entire boundaries are known.

termined by the distance practicable for the wren to leave the box for feeding and to exert dominance without undue expenditure of energy. This maximum limit is not very definite, but from the numerical distribution of different-sized territories given above, one and a half acres (0.6 hectare) would appear normal, as would a minimum size of about one-half acre (0.2 hectare). In five breeding periods out of twenty-two the average size of the territories got as low as 0.6 or 0.65 acre (0.24 or 0.26 hectare), but no lower. Perhaps this represents a size of territory below which only exceptional individuals can tolerate nesting conditions.

The size of a territory maintained by a species may exert an influence on the population density of that species in the habitat, but the reverse is also true. The size of the house wren's territory is compressible with increasing number of birds present, at least down to a minimum. When the territories are reduced on an average to that minimum, resistance to invasion by more individuals becomes exceptionally increased (p. 33) and the population tends to be thereby limited. Similar observations on the influence of territory on size of population have been made for certain water-birds by Huxley (1934). Moreau and Moreau (1938) found that size of territory was indefinitely compressible in one species of Euplectes

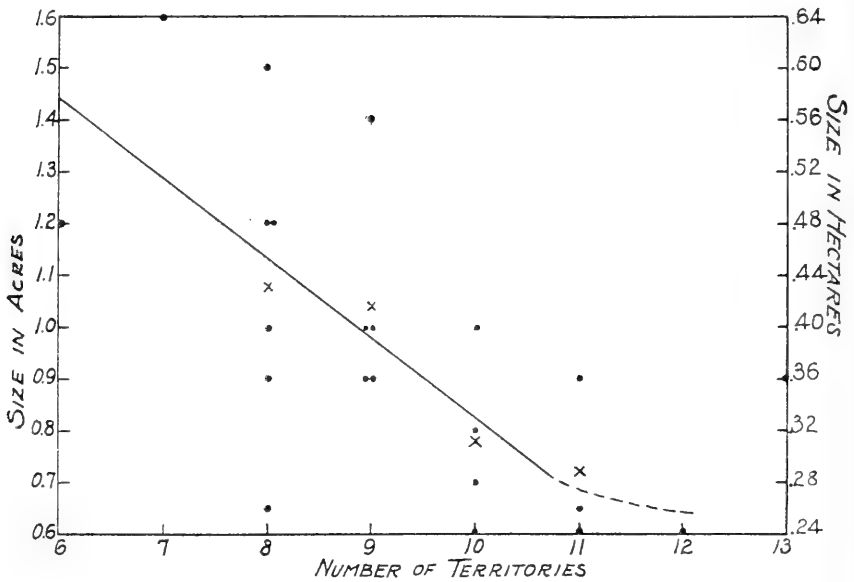


FIG. 6.—Graph showing relation between size and number of territories on Hillcrest. Each dot represents the average size for one breeding period, and each cross represents the average size for all breeding periods with the same number of territories.

but not in another, and therefore had different effects on regulating the size of the bird population.

On Hillcrest, 10 to 13 territories tend to reduce the territory size to near this incompressible limit and to represent a habitat saturated with this species. Even then many territories extended outside the limits of the fifteen acres. This does not mean that the entire area was included within the territories of different birds. Every year there were blank areas that remained unoccupied. These most commonly consisted of parts of the two apple orchards, the hard maple grove, the hard maple-beech woods, the vegetable gardens, and the front lawn. They represent less favorable habitats. The fact that the average size of the territories were not at the minimum (i.e. 1929, 1933, Figs. 12, 13, 19, 20) during some breeding periods with high populations is due to some territories when under pressure expanding into these less favorable habitats.

It is very difficult, however, to make any hard and fast rule, due to the individuality inherent in each bird. During some years with low populations and presumably reduced territorial pressure, some birds nested in those areas that we had labeled as less favorable. Likewise in some years with high populations, areas remained unoccupied that were normally filled. Actually the total area included in all the territories shows no consistent correlation with the number of active territories present but tends to remain constant. For example, in the second period of 1932, with only six territories, the total area included within territories was 7.2 acres (2.9 hectares), exactly the same as in the first period of 1939 when there were twice as many territories. Then again in the second period of 1925, seven territories covered 11.2 acres (4.5 hectares), while in the first period of 1933 thirteen territories covered nearly the same or only 11.7 acres (4.7 hectares). The point is clear that the size of the territory is flexible and, within limits, varies inversely with the size of the population present.

Observations show that a bird is not uniformly active every day in all parts of his territory. Parts of the territory may be forsaken for long periods of time and may or may not later be defended from the intrusion of another male. The wren is very much a creature of habit in much of its behavior. If food has been successfully procured in some one location, he is very apt to return again and again for hours or sometimes days at a time. This active portion of his territory, probably equivalent to the "sub-territories" or "food areas" described by Harrisson and Buchan (1934) for the St. Kilda wren, normally shifts gradually around from one side of the territory to another, so that the entire territory may be covered sooner or later. These active "food" areas are not always the same for both sexes, although some relation often exists between them.

## V. REPRODUCTIVE VIGOR

The urge or drive for reproduction is a variable phenomenon. Normally the urge is non-existent during the autumn and winter months and reaches its height during late spring and summer. Some evidence has already been presented indicating that it develops more slowly in first-year breeders than in those that have nested before. Individual differences in reproductive vigor must play a part in the competition for territory and for mates.

*Physiological Readiness.*—Physiological readiness for breeding depends on the maturing of the gonads in both male and female. The time when this development begins each year has not been studied in this species, but if similar to other species, may begin in early spring while the bird is still in its winter quarters and may be nearly completed by the time the bird arrives in May. Aside from the maturation processes of the sex cells, there is the release of the hormones that exert a conditioning influence over the body as a whole and initiate the nervous processes that regulate the various steps in the reproductive cycle. It may well be true that these hormonal factors do not act in a complete manner until the birds arrive on the mating grounds. They may require for final effective action direct stimulation from the opposite sex. Perhaps this nervous and hormonal stimulation varies from day to day in a cycle manner, as Allen (1934) suggests, so that for consummation of the sexual act the cycles of two individuals must be in tune with each other. We have made no study of this subject. Often a female will accept a male and a nest-site after apparently a single inspection and begin carrying in nest-lining at once (25, 54). There is reason to believe, however, that a longer time usually is required to attain the requisite emotional or physiological pitch at which copulation occurs, both for a first mating early in the season (25, 41, 58, 102, 109) and for a later mating in July (90, 108, 176, 178). A female may persist in the neighborhood of a nest-site for several days and make several inspection trips or visits to the box, or she may visit different boxes before actually beginning her duties concerned with the initiation of reproduction and nesting. The female long-billed marsh wren appears similarly to require a period after arrival in the spring to work into the necessary readiness for copulation.

*Non-Breeders.*—Elsewhere (Kendeigh and Baldwin, 1937) we have analyzed the size and composition of the non-breeding (non-nesting) population of the house wren during the years 1920 to 1934, inclusive, and including both the Hillcrest and Outfield areas. For the first breeding period this was calculated to lie between 18 and 36 per cent and for the second period between 36 and 51 per cent of the total number of birds in the region. Over 80 per cent of the non-breeders were first-year

birds. Using the Hillcrest data only and for the years 1927 to 1937, inclusive, during which period the more efficient trapping in the Outfield would insure fewer wandering birds being missed, recalculation indicates that during the first breeding period, 15 per cent of the males and 13 per cent of the females did not make serious attempts at nesting. Similar calculations for the second period give 20 per cent of the males and 25 per cent of the females. These figures lie below the minimum given in the earlier calculations, but are for a smaller group of birds and on the Hillcrest area which may furnish special inducements for the birds to nest. The figures include 2 per cent each for males and females that omitted entire seasons for breeding, so that they were not trapped during the year at all. The figures for the males exclude from the non-breeding population those individuals that attempted nesting but were unsuccessful in obtaining mates. If these latter are included, the non-breeding male population rises to 28 per cent during the first period and 35 per cent during the second. Unpaired males were found in the European wren by Kluijver *et al* (1940) in territories lying next to mated birds, even birds that were polygynous. The presence of the non-breeding, but potentially breeding, population seems to have an effect on territorial behavior of nesting birds and to cause them to be continually alert in the defense of their possessions.

These non-breeding birds were not infrequently seen lurking around the nesting territories of other birds, but they did not often sing and were usually well hidden among the bushes and crannies which they frequented. Many, perhaps most, of them spent their time in shrubby fields, forest edges, bushy fence rows, etc., where nesting is usually not attempted. It happened not infrequently (4, 30, 38, 51, 69, 103, 179, 210) that some of these males got a temporary urge of procreation, established a small territory for a few days, then disappeared. In all such instances, the males were young birds. In some this urge lasted longer so that infrequently a male and female became active together at a box and attempted nesting activities (8, 25, 60, 154), although such attempts were frequently not carried through. This happened more often late in the first breeding period or during the second period. It is uncertain whether the birds were already partially paired at the time that they made their appearance, but they may have recognized each other as of opposite sex just previously and then sought a nest box. One or the other or both of them may have been potential non-breeders that through mutual stimulation acquired the initiative towards reproduction.

There is a record of six males who went through the entire season unmated (22, 28, 42, 52, 74, 165). Four of these birds had small territories, indicating probably that their reproductive vigor or energy was not high. All except one (165) were young birds in their first breeding

season. Four of their territories were in the upper apple orchard, and it is possible that females tended to avoid this area, although nesting there in other years was frequent. Altogether there are 75 records of "bachelor" males for single breeding periods. Of this number, 80 per cent were first-year birds. This percentage seems significantly higher than the percentage of first-year birds among the total males that did find mates (57 per cent). Female birds have often been observed to visit these males without staying to nest.

The point to be emphasized here is that there appear to be degrees of reproductive vigor manifested in different birds: (1) those who do not attempt to nest at all, (2) those in whom the urge occurs in sudden temporary and unsuccessful splurges, (3) those (males) who maintain territory throughout the season, but do not mate, (4) those who have mates and nests for a single period, (5) those that make two nesting attempts during the season, and finally (6) perhaps another and last group may be added consisting of those birds that become polygamous. Young birds predominate in the lower categories, most adults and many young fall in the upper ones.

*Multiple Nesting.*—Although the female ordinarily remains with the young until they become independent, there is a tendency towards the end of the first period when the nestlings are being cared for in the box for the female to begin preparations for a second brood. She may inspect other boxes either of the same male or of other males in different territories. If acceptable, mating may occur very soon, nest-lining inserted, or even egg-laying begun before she is through caring for her first brood. The number of instances when these early attempts at second nestings have been definitely recorded is not great (45, 46, 62, 68, 144, 146), and this kind of behavior has seldom been observed in the house wren. Only a few additional instances have been found in the literature (Holts, 1907). It is but a small step to actual desertion of the first brood by the female in order to start a second brood that much sooner, but desertion does not ordinarily occur without provocation. When the female leaves, the male will ordinarily care for the young alone. He mostly stops singing and applies himself assiduously to the task of hunting food for his offspring. However, he does not brood nor does he stay in the box at night. If the female deserts before the young have acquired self-regulation of their body temperature, death usually follows, but after a week's development, the male is often able to bring them off successfully.

In at least two cases, the female when disturbed has appeared to desert a nest, only to return later. In territory 46 in 1924, return female, 6882, came to box 51 on May 17 and had six eggs laid by May 25 when she was captured at the box. This disturbed her and she did not incu-

bate steadily again until May 30. The eggs hatched June 10, which was sixteen days after the last one was laid instead of thirteen days which is usual. If the five days of her absence be subtracted, it leaves eleven days as the incubating period. This is too short, and it seems probable that the female between May 25 and 30 must have been on the eggs part of the time, probably at night. Another case of interest was in territory 212 in 1939 where the young of a first-year female, 36-38455, hatched in box 43A, June 11-13. On June 17 she was caught and apparently deserted. However, the young birds survived, and the male fed them faithfully. The female must have brooded them at least at night. During the day she was occasionally seen and heard in the nearby bushes, and finally by June 26 she began gradually to regain her former behavior, and from then on she fed and cared for the young to an increasingly normal degree.

The tendency is better developed for the opposite situation to occur, for the male to become active at other boxes while he still has a first brood. Thus polygyny may occur. If the male participated more actively in incubation, polygyny would be far less likely. The percentage of matings that were polygynous in character was not large, being only 6 per cent. Likewise the percentage of unprovoked desertions not resulting in polygyny was negligible. The female almost invariably, although there are some exceptions, takes care of at least part of the young after they leave the box. As a rule the male aids the female in caring for the young in the box, but after the young leave, the male continues this aid only about half the time. When the male does not immediately do so, he begins at once soliciting a new mate, and the successful finding of one immediately may often explain the continuance of his inattentiveness toward the care of the young out of the nest. It sometimes happens that a male will divide his time between the care of the young off the nest and the seeking of a new mate, and may attempt to keep the young within or somewhere near to his territorial boundaries.

Polygyny is not developed to as great an extent in the house wren as in the European wren or long-billed marsh wren. Kluijver *et al* (1940) state that almost fifty per cent of the males in the former species become polygynous, a few even having as many as three mates at the same time, a condition we have never observed with the house wren. Welter (1935) found between one-fourth and one-third of the territories of the long-billed marsh wren to possess two females and a male. In this species, the females occupying the same territory were quite intolerant of each other even to the point of fighting. We have never observed this strife between females in the house wren, although they sometimes occupied boxes at the opposite ends of a male's territory (59). Welter also describes one case of multiple nesting by a female in the long-billed

marsh wren. Perhaps the greater development of polygyny in the European wren and in the long-billed marsh wren is correlated, as Kluijver *et al* suggest, with the male taking a smaller role in caring and feeding of the young, for in the house wren the male regularly shares in this duty.

## VI. MATING BEHAVIOR

THE MECHANICS or manner in which mates are selected is of very great interest and is the chief goal in territory establishment. What determines whether or not two particular individuals will mate, and how is this accomplished?

The males are mostly confined throughout the mating season to relatively small areas and hence cannot seek out the females. Females are more free to wander and they initiate the mating procedure by coming into the territory of the male. They are attracted to these territories and appear able to recognize males of their own species from the nature of the song. The song varies in structural character between different individuals and at different times even in the same individual. We suspect these variations are relatively unimportant to the female as long as they can be recognized as of the species. Very likely the behavior of the sexes and the procedure they go through leading up to coition is mutually stimulating and functions in their emotional preparation.

*Nest Inspection and Courtship.*—The courtship behavior and inspection of territory and nest that is involved as the female arrives in the male's territory are similar for first and second broods. The following observations are quoted at length as they are quite representative. This is a case of *remating* for a second brood of the same two individuals at box 25 in territory No. 50, 1925 (Fig. 8).

June 21—First brood leaves box.
June 22, 23—No activity at box, both adults with young.
June 24—Male back giving territory song.
June 25—Male singing as yesterday but not so persistently.
June 26—Male removes lining from old nest, singing.
June 27-29—Male carries in many new sticks, singing.
June 30—Male persists in vicinity of box, often enters and carries out old pieces of feathers and straw from former nest-lining.
July 1—Male carried in sticks energetically for two hours this morning. A female appeared, inspected, left. So much carrying in of sticks seems unnecessary in an already well-built nest and may be simply a release of surplus energy and nervous excitement concerned in territory maintenance and getting a mate.
July 2—Male carried in sticks all morning. A female inspected once, left. Once when we inserted some feathers into the nest he "very indignantly" removed them.
July 3—Frenzied excitement of male as a female was here today to stay. Not certain whether the female is the same bird as during last three days. From 9-10 A.M. the male sang continuously, flying back and forth to all sides of the box and to the top, but not carrying in sticks. Was singing six times a minute, but when the female appeared his song increased in volume and was given

nine times a minute. Female uttered call-notes three times while at box 10-10:30 A.M. Male and female, flying from opposite directions, met in mid-air, then fluttered almost to the ground. Male gave a squeaky, coaxing, or mating song, the female acted shy and unconcerned, but seemed to notice what the male was doing. Female stayed 10-15 seconds at the box, inspecting it on all sides and within, and then when she left was pursued by the male. At 10:40 the male left for seven minutes probably for an inattentive period after food, and the female remained giving clucking notes. The male returned with a stick and met the female at the box. He flew off and dropped the stick without delivering it. At 10:55 both adults inspected another box in the territory. Both sexes fluttered their wings a good deal. Copulation probably occurred today, but was not seen.

July 4—Male back at box 25, singing all day. Female not very much in evidence, but occasionally in with nest-lining.

July 6—Male was here singing all day; female not very active.

July 7—First egg laid, probably four days after copulation.

When preparing a nest for a second brood, the male always removes the nest-lining inserted by his first mate. His new mate then carries in her own nest-lining. The female may come to the box voluntarily or she may be guided or enticed there by the male after she enters his territory. He flutters and flies toward the box ahead of her, goes to the top or to the perch, or may go in and out until the female begins her investigation. He then remains outside "squeaking" and very excited. If a female inspects a box, but then leaves and does not return in a few minutes, it shows she has some uncertainty. Insertion of nest-lining is a sure sign that the female is satisfied and is receptive of the male. The following observations at box 10 in territory No. 65 on June 27, 1927 (Fig. 10), give an idea of the relation between nest-lining and acceptance of mating. The male had been singing at this box for several days, although not very energetically. At 8:20 o'clock this particular morning a female approached and entered the box very deliberately before the male became excited or began his squeaking, mating song. This he gave on top of the box and on the entrance perch itself. The female during the next fifty-four minutes several times dropped to the ground, and returned to the box without nesting material. When the female was away the male would sometimes enter the box and would frequently fly after her when she left, as if to copulate. Finally on the seventh visit to the box she carried her first piece of nest-lining. Her next trip to the box was without lining material, but the following six trips were all with lining. Thus the transition in this case to continuous nest-building was a very gradual one, probably involving a change in emotional stage to a higher pitch. Until the female started regularly to carry in nest-lining the male persisted in giving his mating song, but after her routine became settled, he changed back to an excited and eager singing of his "territory" song, usually pursuing the female whenever she appeared. Copulation was not observed, but likely it took place this same day. The next day both birds were active at this box in the morning, but because of interference from

me transferred to box 9 at noon with hardly any interruption in activity. The first egg was laid July 1, four days after the female's first appearance.

*Coition.*—Copulation or coition does not occur until the female is ready and invites it. One such invitation may be described. The female crouched on a branch of a nearby maple tree and gave a series of squeaks varying between a monotone, an ascending, and a descending scale with shaking of tail and wings each time. This went on for a minute or two when the male responded with similar but softer notes, and approached her slowly. When within a few feet, the female would leave with the male in pursuit, or they would fly down to the ground. Probably copulation occurred then.

On another occasion at a different box, the squeaking sounds were produced artificially by kissing the back of the hand. An unmated female was near, scolding. She had recently inspected a male's box. The male on hearing these squeaks came over very excited, squeaking in turn, singing softly, tail upturned, wings a-flutter, and tried to copulate with the female, unaware that these inviting sounds were not coming from her. In the long-billed marsh wren it is usually the male that induces the female into copulation, but Welter (1925) mentions that occasionally the invitation comes from the female. Song attracts the female into the territory, but thereafter display is of greater stimulating value for the female. In the European wren the quivering wing display is also of importance for mutual stimulation leading to copulation, and the female has a short call that expresses her willingness.

The actual act of copulation has seldom been observed in the house wren. Probably it takes place on the ground or in low bushes, although sometimes in trees. There is no reason to believe that it occurs inside the nest box. Copulation probably does not occur immediately on the female's acceptance of the box, but apparently does so sometime that first day after the nest-lining has been begun. Possibly the act of preparing a nest-cavity for the eggs is stimulating in itself and is necessary as well as the excitement of the male to put the female in the proper condition. The male seems always most excited this first day, and sometimes this excitement continues into the second day but thereafter gradually subsides. Copulation may, however, occur repeatedly through at least the early part of the egg-laying period.

The following description of the copulatory act was made on June 4, 1926, at about 10:00 A.M. in the Outfield, the morning the fifth egg of a seven-egg set was laid: "The male wren flew to a branch of the tree in front of the box and gave his territory song in an excited manner. The female came out of the box and perched about two feet (0.6 meter) below the male on the same branch. She fluttered her wings like a young bird and made little cheeping notes and squeaks, keeping her bill open

all the time. The male quickly ran down the branch and copulation was consummated. It lasted only a few seconds. The male fluttered his wings rapidly and apparently did not rest on the female but held his body erect in a vertical position with his tail down. He then ran rapidly up the branch about three feet (0.9 meter). The female still fluttered her wings and cheeped and the male faced her, putting his bill almost on the branch in a crouching position. The female approached and the male fled. After a short chase in which the male succeeded in eluding the female, she flew to the field and I could not see whether she was feeding or gathering additional nest-lining. They then both flew to a small bush where the male chased a song sparrow. The whole scene lasted eight to ten minutes."

*Female Discriminations.*—The female exercises most of the apparent discrimination in the pairing of the sexes. Her first selection is of the territory to investigate which is advertised by the singing male. Perhaps the character of the male's singing and its stimulating force is here important. The next point where discrimination enters is in the selection of the nest-site. The extent to which the male has built the nest foundation of sticks seems not in itself to be of primary importance. Females have chosen nests in all stages of completion, although most frequently of medium size. Kluijver *et al* (1940) state that in the European wren the character of the nests begun by the male does have an importance. In the house wren the shape and size of the nest-site do not appear to be very influential, but this was not well tested, as practically all boxes erected were of similar dimensions. Of course, the cavity needs to have a certain minimum size, and cavities of too great size are also avoided. The location of the nest-site may have importance, and the females will examine this most thoroughly on their inspection trips. Perhaps the combination of these three characteristics gives importance to the nest-site. Certain nest-sites are favored over others, as mentioned elsewhere, and doubtlessly males in possession of these locations have an advantage in getting mates. Sometimes a female will examine two or three boxes in the territory of one male and not satisfied go to the territory of another male before finding what she wants (52, 90, 102, 108, 129). Thirdly, there is the eagerness and stimulation of the male and his physiological readiness for her. Miss Sherman (1925) considered the nest-site rather than the male of paramount importance in making a choice, but there is not much that can be discussed on this point as the physiology of mating needs detailed study and analysis. There is no plumage display except for wing quivering that is indulged in by both sexes. Perhaps all these factors are involved, but it is difficult to judge their relative importance.

*Sex Recognition.*—Sex recognition with the house wren seems to depend on a difference in behavior. There is no automatic recognition of

the opposite sex either through some unknown sense or by color, size, or form (Noble and Vogt, 1935). Only the male sings, so the female's recognition of him on his territory is not difficult. Call notes are similar in both sexes, although "churring" notes and rarely a little whine seem more often uttered by the female. The churring notes may have some sex recognition value for the male but not for mating purposes, as these notes are more commonly uttered after nesting has begun. No recognizable differences in plumage exist.

Non-singing males and sexually inert females have similar manners, postures, and behavior, and the adult birds cannot separate themselves sexually. A female seeking food in another male's territory is driven out as if she were a male on a scouting expedition. An observation is even on record of a male unexpectedly meeting his mate while foraging for food and chasing her to the edge of his territory until she, by non-resistance, permitted his excitement to subside. Once two birds, believed to be females, arrived simultaneously for an inspection of a box of an unmated male. The females seemed to vie for the male's attention. They ran along the ground and in the low shrubbery with wings spread and quivering. The male followed singing but not very far. He appeared bewildered and confused and did not respond sexually because of the exceptional situation. When a female comes to inspect a box for possible mating, the male sometimes does not get excited until her inspection has begun. He seems then to first recognize her as a female and may show her several boxes. Males on neighboring estates quickly respond to a bird as a female if she is so recognized by one male. The female's immediate starting to insert nest-lining after accepting a nest-site may have a value of further demonstrating her sex to her desired mate. After nesting has begun, differences in the duties and mannerisms of the two sexes probably allow individual recognition, as they become adjusted and accustomed to each other.

Further evidence that recognition of sex is primarily by behavior is available from an unusual observation made in 1939 (209—Fig. 32). A male on a scouting trip is quiet and inspects boxes in much a similar manner as does a female. So far as known, a male does not ordinarily inspect boxes occupied by other males active there. In this case, the male bird, apparently a non-breeder, inspected box 74 on July 4, and the active unmated male there behaved towards him as if he were a female. Four days later, this peculiarly acting non-singing male appeared again and in the company of the sexually excited male from box 74 inspected boxes 70, 74, 68, 54. There was no chasing and no attempt at copulation, yet otherwise the behavior was that of male and female. This pseudo-female would have been identified without question by us as a true female had the bird not possessed a red celluloid band around its leg in addition to an aluminum band which indicated not only its sex but also that it was

a return bird from some previous year. Attempt at capturing it was not successful.

*Remating for Second Breeding Period.*—When the first brood leaves the box the male and female may each continue to care for a part of the young. If a second brood is attempted, remating must take place whether it be with the same female or with a different one. The same relation between sexes occurs in the European wren. Each nesting is a cycle in itself independent of other nestings, so that a changing of mates is to be expected (Nice, 1930). In 70 first nestings terminating successfully and followed by renesting for a second brood by both adults, remating of the same individuals occurred in 40 per cent of the cases, while in the other 60 per cent of the cases new mates were secured. The whole mating procedure is repeated for each nesting cycle.

Perhaps it is worthwhile to consider the factors involved and the chances for a pair of individuals to remate for a second brood. Although we know almost nothing about it, it seems logical that if physiological rhythms are involved a pair of individuals who have successfully mated once and become adjusted to each other will be more likely to be attuned for nesting again than will two strangers. There may also be recognition of each other as individuals by physical characters or by mannerisms, as Lorenz (1937) has demonstrated for other species.

If the male aids the female in the care of the young out of the box both are ready for remating at about the same time, but if he does not help her, he often finds a new mate before his former female is free to return to him. In 42 instances where the action of the male was known, the male aided in the care of the young exactly half of the time. When he aided, he did not acquire a new mate for 10 days after his first brood left the box, never earlier than 7 days, and once he had to wait 23 days. Burns (1937) mentions a rest period of 3 to 6 days between breeding periods when the wren does not sing. This doubtlessly refers to the time when the male is temporarily occupied with young birds newly out of the nest and when the intensive singing for second mates and territory is not yet started. When the male did not aid the female in the care of the young off the nest, he usually began intensive singing at once and had a new mate in 8 days, not infrequently within a day or two, although once he had to wait 18 days. The above figures do not take into account simultaneous nestings by either male or female, nor do they reckon with birds unable to find mates at all for a second brood. Further analysis showed that when the males aided in the care of the young out of the nest, they remated with the same female in 65 per cent of the cases, but where they did not aid, they remated with the same female only 33 per cent of the time. The same principle holds for the female. In other words, there is twice the likelihood of the same birds remating

for second broods if both share alike in the full care of the young. There is interest in that both male and female of the European wren accompany the fledged young, but the male frequently does not feed them. However, he often attracts the young at night to roost in one of his extra nests. This has never been observed in the house wren.

In 57 instances for the house wren the interval between the first brood leaving the box and the female's first beginning of the second nest is known. This interval varied from 3 days before the first brood flew to 17 days after the young flew. Forty, or 70 per cent of all the records, are for an interval of 7 to 13 days after the young leave the nest with the largest number, 9, falling at 11 days. A similar time interval occurs between broods in the European wren and about two weeks in the long-billed marsh wren. It is quite possible that for some of the shorter intervals the female had earlier deserted her first brood, and it is also possible that for a few of the longest intervals the first visits of the female to her second nest-site were missed. The young house wrens are normally cared for by their parents for about 13 days after leaving the nest. It is apparent that the female does not seriously start a second nesting attempt until her first brood becomes nearly independent, but that she will often continue some care of them for a few days after beginning nest-building or egg-laying. The male ordinarily becomes active for a second nesting sooner than the female and has frequently been observed to alternate attention to the young and to singing around his proposed nest-site. Sometimes the male and occasionally the female care for the young off the nest within the boundaries of the territory, but the usual procedure is to conduct the young some distance away—beyond the territorial limits.

To return to the analysis of the chances for a pair of birds to remate, other factors must be considered. If a territory is isolated from other territories and the birds do not wander far in caring for their young out of the nest, both are likely to return to the same place to renest and they naturally remate (5, 104). When territories are close together or where a new male comes in, replacing the former one who may be caring for young, new mates or shifting of mates commonly occur. There is at least one case where two females exchanged territories, although not mates, for a second brood (10). There are also cases (56, 169) where the attraction of the old territory meant more to the female than did her former mate at a nearby box. The extent to which the adults conduct their young is concerned, as either bird may find new localities and new mates that take precedence over the old. The female is also less likely to attract the attention of her former mate if he has already found a new mate, although she sometimes does and polygyny occurs (169).

*Remating in Subsequent Seasons.*—Remating of the same individuals in subsequent years is, as one might well suppose, less frequent than for

the second brood during the same season. In the records for Hillcrest, there are only 14 instances where the same male and female have mated together again in subsequent years. Altogether there are 105 records of subsequent matings of males, so remating of males with their mates of former years constitutes only 13 per cent of the possible cases. There are 65 records for females, and a similar computation gives 22 per cent.

The record of matings between 36-38856, male, and 36-38040, female, is of exceptional interest in showing the highest degree of fidelity to each other. These two birds returned for three years, 1937-1939, inclusive, and each year they mated for two broods, thus mating together six times. The first four times were all at box 47, the last two times at box 79 and 43A. Two of the broods were unsuccessful, but neither adult mated with other birds. Altogether they raised twenty-six young to leave the box, their fertility being especially high the last year with nine young in their first brood and six in their second.

Male, A38398, and female, B45348, were mated together each of three years, although but once each year, and each time at box 51. Although the male was banded as a nestling in 1926 and was last heard of in 1930, he was captured only once with another female early in the season and no brood resulted. Female, B45348, likewise was recorded only once with another male in the period from 1928 to 1930.

The following record of male, F45987, is unusually interesting because he kept the same mate for both broods each year but had a different female each year except one in his long life. The record of his mates until his death in 1937 is as follows:

| | *First Period* | | *Second Period* | |
|---|---|---|---|---|
| 1932 | Box 54A | F45992 | Box 54A | F45992 (?) |
| 1933 | Box 54A | H18587 | Box 54A | H18587 |
| 1934 | Box 43A | L24955 | Box 75 | L24955 |
| 1935 | Box 75 | L24955 | Box 43A | L24955 |
| 1936 | Box 47 | L73248 | Box 37 | L73248 |
| | | | Box 34A | 34–86014 |
| 1937 | Box 34 | 36–38389 | ..... | ..... |

Once he was polygynous, three times his broods were unsuccessful, and altogether he helped raise thirty-three offspring.

To illustrate the other extreme of a male with a great diversification of females for mates, notice the record of the mates of male, 48785. Incidentally this male returned to nest in the territory in which he was raised the year before, although it wasn't until he was three years old that he returned to nest in the exact box in which he was raised.

| | *First Period* | | *Second Period* | |
|---|---|---|---|---|
| 1921 | Box 25 | (nestling) | ..... | ..... |
| 1922 | Box 23 | 26520 | Box 26 | 22987 |
| 1923 | Box 47 | 6884 | Box 47 | 6885 |
| 1924 | Box 25 | 58024 | Box 23 | A87 |

If remating with the same individual in subsequent years were entirely a matter of chance, it would not happen so frequently even as indicated here, when one remembers the wide choice of mates possible. The fact that birds often do remate in following years is of more interest and requires more explanation than the acquiring of new mates. One important and obvious reason for birds not to remate in subsequent years is the failure of one of the pair to return, probably due to death. Twenty-six instances since 1921 are known for Hillcrest where both male and female, mated together one year, have both returned the following year. In eleven, or 42 per cent, of these instances remating occurred. It is worthwhile to attempt an analysis of why remating did not occur in the other fifteen cases. Three times the male was already mated with another bird at the time his former mate put in her appearance. Theoretically polygyny could occur under such circumstances, but there happened to be no such record. Twice the male did not appear until after his female had found a mate. In one case the male's activity at the time of the female's arrival may have been modified because of his recent capture at the box. There is also one record where the female found a mate in the Outfield, so it is uncertain whether she actually revisited Hillcrest. If these seven cases, where there are extenuating circumstances involved, are subtracted from the twenty-six instances noted above, then the eleven times the pairs remated constitute 58 per cent of the times they had opportunity to do so. Of the eight records where remating did not occur, two males mated with other birds on the very same day their former females arrived. Here the new females may have had a priority of only a few hours or even minutes where otherwise remating might have occurred.

In all instances where male and female remated in a following year, both birds returned to territories that overlapped the areas they occupied the year before. In the eight instances where remating did not occur the male returned to an overlapping territory only three times, and likewise the female only three times. In no instance did both male and female of the same pair return to their former territory. From this it seems that lack of remating is often due to a scattering of the birds into other, although nearby, areas, while remating is greatly aided by both birds returning to the same old nesting grounds. The possibility exists that where a female did not remate with her former mate she may nevertheless have returned to her last year's territory or visited her former mate on a new territory without succeeding in making a union, although actually there are no such records available of the female having done so. There is no evidence that the birds migrate and winter together in pairs, although it is possible that both may winter in the same region and

migrate over the same route. The "group habit" in this species has not been demonstrated.

The question naturally arises as to whether the birds are able to recognize each other as individuals from one year to the next and if this influences mating. It seems probable that they would more readily respond to familiar mannerisms or to fall back into old routines of behavior, if these were presented, than to work out new ones. Two individuals who have mated and nested successfully together one year might well attract and stimulate each other to a more certain degree than would strangers. If there is any truth in this principle, the effect persists from one year to the next to as great an extent as from the first to the second breeding period in the same year, since the percentage of rematings among individuals that renest is practically the same in the two cases, being 42 per cent and 40 per cent respectively. This problem, however, must for the present remain in the field of conjecture.

In spite of the fact that adult birds regularly return in following years to renest in the same locality and young birds occasionally return to nest at or near the place where they were born, there is no record of inbreeding between father and daughter, between mother and son, between brother and sister, between step-fathers and step-daughters, or between first cousins. Probably the chief factor that prevents inbreeding is the tendency for first-year birds to wander into other regions for breeding purposes. Actually only five nestling birds raised on Hillcrest have returned to nest on Hillcrest in subsequent years in the twenty-six years that wrens have been banded here. Close inbreeding is not out of the realm of possibility, however, and might very rarely occur, as any one of these five birds could have mated with a member of its former family group. Inbreeding can definitely be ruled out as a factor of any significance in the mating relationships of this species.

## VII. TERMINATION OF NESTING

Seventy-three records give the median date for second broods to fly as August 11, the earliest being July 22 and the latest September 1. Since the young birds after leaving the box must be attended another thirteen days, the median date when the adult birds are through with reproductive cares is about August 24. With the flying of the young from the nests, they soon leave the territories and there is no longer need for maintaining them. Actual defense of territory begins to lapse even before the young fly, as competition becomes greatly lessened. This is in contrast with the European wren which maintains its territory throughout the year, although even with them its defense is at a minimum in August.

Both adults continue ordinarily to take their proper shares in the care of the second brood both before and after it leaves the nest. The incidence for desertion of second broods is higher, however, than of first broods (19), probably because, with the advance of the season, physiological changes are occurring inimical to breeding but inducive to moulting. In nine instances, females have deserted eggs or young at the median date of August 3. Twelve times we have record of males deserting also by the median date of August 3. Our impression is that males desert more often than we have recorded the fact in our notes and in a greater ratio to the desertions of females. Males that lack broods and mates for this period leave sooner than the mated birds, the median date being July 23 in 33 cases, with extreme dates of July 13 and August 10. Responsibility for the care of the young therefore prolongs the period of reproductive activity of males by another month. It is probable that the disappearance of these unmated males is in part responsible for the easing off of the territorial strain before the young are ready to fly. Since the median date for the arrival of males in spring is May 11, and August 11 is the median date for the flying of second broods, territories are of use in this species for only three months during the year. When the birds give up their territories they spend their time in shrubby fields and fence rows, brush piles, forest-edges, and similar locations until they are ready to migrate south from late August to October.

Territories are ordinarily defended throughout the breeding season, as is true also with the European wren and the long-billed marsh wren. Some of the most vigorous combats and competitions in song have occurred late in the breeding period (p. 26). One may reason from this that the territory has importance as a reservoir of food. However, strife among males is generally most vigorous early in each breeding period when the territories are first becoming established, and much of this rivalry is undoubtedly for mates. Singing is less vigorous after nesting begins but is continued automatically until the young leave the nest and on occasion becomes intense, if a newcomer challenges possession or a new female appears. Since this species has two breeding periods, this maintenance of territory throughout the first period has a value in allowing males more often to retain the same territories for the second period with less expenditure of energy and more certainty of success than might attain if a complete relaxation of territories occurred during the first period. However, maintenance of territorial defense generally continues through the second period, even though there is no further nesting and some males become negligent late in the season. Aside from the food value, maintenance of the territorial and mating behavior throughout each period makes polygyny possible. "Territory," then, is of primary importance in the lives, the behavior, and the nesting success of these birds.

# VIII. HISTORY OF INDIVIDUAL TERRITORIES

In order to make available to others the vast amount of information that accumulated at the Baldwin Bird Research Laboratory from 1914 to 1939, case histories of territories of individual males each year have been compiled, and for many years, maps showing the boundaries and growth of these territories have been prepared. Complete data of all mating of birds on Hillcrest are also given. When the bird is a return from previous years it is always so indicated the first time it is mentioned in the case history, so that where there is no notation to the contrary the bird should be considered a new one on the area. These case histories are referred to in the preceding general account as supporting evidence for the statements that are made. It is my hope that they will be useful to others in compiling other types of information than here considered. The record for the first seven years is fragmentary and preliminary to the serious study that was begun in 1921. If for nothing else it has a historical and personal interest in showing the growth and evolution of an idea and of a method of study in the mind of its originator, Dr. S. Prentiss Baldwin.

### 1914

Two broods of nestling birds banded.

### 1915

Dr. Baldwin wrote (1919): "During 1915 I had banded every House Wren, old or young, on the farm . . . ." Records of adult birds in his notes are as follows:

| | | |
|---|---|---|
| Box 9 | June 19 | 27739 |
| | | 27740 |
| | August 15 | 27740 |
| | | 27782 |
| Box 49? | August 14 | 27739 |
| Box ? | June 8 | 27712 |
| Box ? | June 21 | 27731 |
| | | 27732 |

There were apparently 7 adult birds on the place, but no distinction between males and females was made. Dr. Baldwin was not then aware as to how sex could be determined in the species. Likewise the system of box numbers had not been well worked out.

### 1916

| | | |
|---|---|---|
| Box 49? | June 23 | 38491 |
| | | 27739 |
| Box ? | June 17 | 38479 |

Due to absence, not all the birds were trapped.

### 1917

| | | |
|---|---|---|
| Box ? | July 1 | 38946 |
| | | 38947 |
| Box ? | July 3 | 44001 |
| | | 44015 |
| Box 51 | July 4 | 44008 |
| | | 44009 |

It is uncertain whether these 6 birds constituted the entire wren population.

**1918**

Beginning this year the trapping and recording of adult wrens became more systematic and complete.

| | | |
|---|---|---|
| Box 51 | June 19 | 44100 |
| | | 44008 return |
| Box 25 | June 19 | 44515 |
| | | 44516 |
| Box 40 | June 23 | 44525 |
| | | 44526 |
| Box 47 | July 14 | 45205 female |
| | | 45206 male |
| Box 59 | July 14 | 45207 male? |

**1919**

| | | |
|---|---|---|
| Box 19 (9?) | June 17 | 44008 return |
| | | 44100 return |
| Box 25 | June 17 | 45302 male |
| | | 45303 female |

"He (45302) sang and carried on nest building by himself until driven out by 45349 and 45335."

| | | |
|---|---|---|
| | June 26 | 45342 male, alone, singing |
| Box 26 | June 17 | 45206 male, return |
| | | 45311 female |
| Box 3 | June 19 | 45322 female |
| | | 45324 male |
| Box 40 | June 24 | 44526 return, mate not caught |
| Box 63 | June 24 | 45334 female |
| | | 45335 male |
| Box 53 | July 4 | 45335 male |

Male, 45335, was here two days after his first brood left box 63. Dr. Baldwin believed this bird a female, but later records proved it to be a male.

| | | |
|---|---|---|
| | July 4 | 45349 male, building nest same day |
| | July 20 | 45349 male |
| | | 45303 female |
| Box 30 | August 2 | 45334 female, mate not caught |

**1920**

| | | |
|---|---|---|
| Box 49 | July 15 | 45955 female |
| | | 45335 male, return |
| Box 25 | June 17 | 45303 female, return, two broods here |
| | | 45342 male, return, two broods here |
| | July 29 | 45303 female, return, second brood |
| Box 53 | June 22 | 45968 male, alone, nest building |
| | July 5 | With female, 45325, return |
| | July 16 | 46013 male, alone |
| | July 22 | 46030 female |
| Box 63 | July 5 | 45988 female |
| | | 45335 male, return |
| Box 47 | July 13 | 46006 female, incubating |
| | July 25 | 45349 male, return |
| Box 6 | July 14 | 46010 |
| | | 46011 |
| Box 37 | July 24 | 45955 female |
| | | 46032 male |
| Box 59 | July 28 | 45968 male |
| | | 45325 female |

**1921**

*Territory No. 1.*—Male, 45963, a return nestling, was at box 3 by May 19 and at box 6 by May 27. About May 22, a female, 21212, came to box 3 and their brood flew June 26. On June 17 at box 6 the male obtained return female, 45303, whose young had flown from box 25 only 5 days before, and they raised a second brood by July 22. He was thus polygynous in part. During July the male's place at box 3 was taken over by the male who came from box 25 (2).

*Territory No. 2.*—Return male, 45342, came to boxes 25 and 26 by May 4 and got return female, 45303, very soon. Their young flew June 12. While busy feeding his young out of the nest a new male (3) usurped his territory, so he moved over to box 3 on July 2, taking it away in turn from the male formerly here (1) who was busy with young at box 6. At box 3 female, 21206, whose young at box 63 had flown 9 days before, came on July 4, and their brood flew August 9.

*Territory No. 3.*—Male, 21315, came to boxes 25 and 23 on June 16 and usurped the territory of the male here earlier (2) who was helping to care for his young out of the nest. Female, 21213, whose young had flown 10 days before from box 59, came to him at box 25 on June 29, and they raised their brood to fly on August 5.

*Territory No. 4.*—Male, 21271, was active at box 30 from at least June 18 to July 3 but did not get a mate.

*Territory No. 5.*—Male, 21231, was at box 37 by May 17 and at box 40 by May 27, and a female, 21211, came to box 37 by May 22. Their first brood flew June 30. The male (same one?) was back on July 3, and the same female came back on July 6, only 6 days after her young had flown, and their second brood left the box on August 22.

*Territory No. 6.*—Return male, 45968, was probably at box 75 by May 11, but was not very active. Sparrows started to build here on May 27, but the male returned May 30-June 1 and removed most of their nest. He was at box 47 by May 16 and return female, 46006, came May 22, but on June 16 their young were destroyed and removed by sparrows. The male again shifted back to box 75 and his former female came to him here the next day. However, about July 17 or 18 she deserted her young, which were 9-10 days old, for some unknown cause and went to box 68 (9). The male at box 75 succeeded in bringing off the young alive on July 23. This male was polygynous, as it was probably he who had another brood at the same time at box 47. He was not captured at that box. After his first nesting at box 47 was destroyed on June 16, he threw out the nest-lining on the 18th, and had a female, 21294, here July 1. He deserted this box about July 18, the same day he was given full responsibility of the young at box 75. The female brought off the young at box 47 on August 7. Several days after his young at box 75 had flown, the male occasionally visited his brood at box 47.

*Territory No. 7.*—Male, 21232, was at boxes 49 and 51 by May 17 and had a female, 21207, at box 49 by May 23, and their young flew June 29. Perhaps he helped care for the young out of the box; anyway he was replaced on his territory by another male (8) and disappeared.

*Territory No. 8.*—Male, 21264, seems to have been active first on May 31 at box 57 where male, 48775 (9), had deserted on capture, May 25. His appearance here possibly coincided with that of a female, but they did not stay. The female was possibly the same bird, 21234, who came to box 53 to stay with him on June 2, again after another male, 45335 (10), had been caught there and deserted on May 29. On June 25, 4 of the 5 young at box 53 were destroyed and removed by an unknown agent, but the remaining young left on July 8. The male was around box 59 on June 27, but did not stay and retained some activity at box 53 through July, but on July 2 he was caught back at box 57 which he had visited off and on during June. On July 4 he went down to box 49, replacing the male (7) who had a first brood leaving there 5 days before. Here his former female returned on July 8, the same day her single young bird left box 53, and they started a second

brood which flew August 14. The single young bird that left box 53 may have died, as it was heavily infested with lice and below normal in weight.

*Territory No. 9.*—Male, 48775, was at box 59 by May 11 and had new female, 21213, here May 14, and their brood flew June 19. By May 25 he was also active at box 57, but was caught and soon replaced here by the male from box 53 (8). On June 11, a male, probably 21225, contested with him in song around box 59, but the next day this other male went to box 57 where he was caught and deserted. Here is a case of a male coming in to set up a territory, but, running into competition with two males (8 and 9) was unsuccessful. Although 48775 had probably been at box 68 between May 20 and 22 he did not return for much activity until June 18. He obtained on July 17 return female, 46006, who had just deserted her young at box 75 (6). They attempted a brood, but it was destroyed by a storm August 6. After the male's first brood flew from box 59, male, 21264 (8), was sometimes active at this box, although on July 11, 48775 was also here.

*Territory No. 10.*—Return male, 45335, was at box 63 by May 11 and had female, 21206, here about May 18. On May 28 and 29 he was active at box 53, but, when caught, he shifted back to box 63 where his young flew June 25. The male probably did not help to take care of the young out of the box, as on June 27, he showed a female, 21212, boxes 63 and 63A, and she chose box 63A where their young flew August 6. These two females changed places for second broods, as 21206 went to box 3 and 21212 had her first one fly from box 3 (1) only the day before she came to box 63A. However, 21212 did not lay her first egg here until July 5 and so probably attended to her young from box 3. Possibly also her polygynous mate at boxes 3 and 6 helped in their care.

1922

*Territory No. 11.*—Return male, 45335, was at box 3 by May 4 and had a female here about May 15, but by June 2 her eggs were destroyed and she was gone. The male was caught on June 8, and he also deserted inside of another day or two. On June 19 he was caught at box 25 and died in the holding cage.

*Territory No. 12.*—Male, 22995, was caught in the greenhouse April 24 and was at box 6 by May 27, but when caught there on June 8 he deserted. Probably on this date he transferred to box 25 and may have been there earlier. Possibly he was responsible for the destruction of eggs there between June 5 and 8. He had a female, 26520, visit here on June 16, but after being caught on June 19, he was not recorded again during the season.

*Territory No. 13.*—Since males at both box 3 (11) and box 6 (12) left soon after June 8, there was a free area here. Male, 26523, appeared at box 6 by June 16, but when caught on June 19 transferred to box 3 the next day. A female visited him there, June 29, but did not stay. He also disappeared.

*Territory No. 14.*—With the male gone from box 6 (13) on June 19, a new male, 26600, came in by June 24 and had female, 26595, here by July 2, and they raised a brood by August 9. After the male disappeared at box 3, 26600 had some activity there July 8 to 13, being frightened away by capture on this latter date. On July 27 the male from territory 20 whose first brood left box 47 on July 10 and whose place there was usurped by another male, appeared at box 3, was caught, and did not stay.

*Territory No. 15.*—Male, 48785, a return nestling, appeared at box 25 by May 4 and at boxes 23 and 26 by May 20. About this time a female, probably 26520, appeared and very likely her presence inspired the male's activity at boxes 23 and 26, but she stayed at box 25. On June 5 one of her eggs was gone, and on the 8th all the eggs had small holes pecked in them, possibly by male, 22995, who transferred to this box on June 8 from box 6 (12) after he had been caught and banded at that box. Male, 48785, went immediately to box 23 where he was caught also on the 8th. He transferred to box 26 by the 13th and was caught there on the 19th. Meanwhile at box 25, 26520, probably the same female who was here

before, came to the male, 22995, on June 16, but on the 19th both deserted after being caught at 11 A.M. There appears to have been a lively competition involved for both box and female on this date as return male, 45335, came over from box 3 (11) and was caught here at 2 P.M., accidentally dying in the holding cage. It was also on this date that 48785, probably excited and involved in this competition, was caught at box 26 nearby. Three days after female, 26520, deserted box 25, she had remated with 48785 and had laid her first egg in box 23. Their brood flew July 25. The male probably did not aid much in their later care, as on July 17 he was again active at box 26, and a female, 22987, who had deserted both box 53 and box 47 on July 13 and box 49 on the 15th (21, 24) when caught during inspection trips, came to him there on the 18th. However, her eggs were removed and destroyed by some unknown agent July 29 and nesting was over.

*Territory No. 16.*—At box 25 a male, 26638, and a return female, 45303, appeared on June 29, the female coming 12 days after her first brood at box 30 (17) had flown, and they raised a brood by August 4.

*Territory No. 17.*—Return male, 21231, arrived at box 30 by May 4 and had return female, 45303, about May 8, quite early. Their young flew June 17. He apparently disappeared while caring for them, thus avoiding the strife at boxes 23, 25, and 26 around June 19 (15).

*Territory No. 18.*—Male, 26504, was at box 9 by June 10, had female, 26542, by June 13, and their young flew July 19. The male stayed more or less around for another 10 days, but there were no further developments.

*Territory No. 19.*—Male, 26512, was at box 37 by May 4, had return female, 21212, about May 13, and their young flew June 21. On June 24 and again on the 29th there were two birds at the box but neither was identified, and on July 2 female, 21212, was back, 11 days after her young had flown, and laid her first egg. The male, probably 26512, deserted July 22, but the young flew August 4.

*Territory No. 20.*—Male, 26546, was at box 47 May 4, and female, 22988, was here with her first egg on June 3. On the 5th, two marked eggs out of three had disappeared, but the female stayed to lay seven more (ten in all) and her young flew July 10. The male, while probably caring for young out of box, was displaced by a new male usurping box 47 (21). This male showed up at box 3 in late July, but did not renest.

*Territory No. 21.*—At box 47 there appeared on July 13 a male, 26601, and a female, 22987, the latter having deserted box 53 (24) at 7 A.M. that morning when she was caught nest-building. She did not stay. A female, 22989, whose first brood had flown from box 52 on June 30 and who was caught at box 63A with a nest ready for eggs on July 13 (23), had her first egg in box 47 on July 17 before any lining had been inserted, and the pair probably raised the brood successfully. Which male fertilized her eggs, 26601 in this territory or 45342 in territory No. 23?

*Territory No. 22.*—A male, probably 26629, was at box 75 from early June to late July without getting a mate.

*Territory No. 23.*—Return male, 45342, was at box 63 by May 4, but had no further activity here all summer. He was at box 52 by May 20 and at box 63A by May 27. At the latter box he had some activity intermittently all during June. At box 52 he had a female, 22989, about May 23, and their brood flew June 30. Possibly both adults cared for the young out of the box, but both were back at box 63A on July 9. However, with her nest-lining well along, the female was caught on July 13 and deserted, later appearing at box 47 (21) on July 17 and laying her first egg there on that date. The male also left about the same time.

*Territory No. 24.*—Return male, 21264, was at boxes 49, 51, and 53 by May 4. About May 16 a female, 22987, came to box 53, and their brood flew June 24. The male was intermittently active at boxes 51 and 49 all season. The male probably did not aid in the care of the young out of box. On July 6 he had a female near box 53, and again on the 8th, 9th, 12th, and on the 13th. She was caught and proved to be his old mate, 22987, who the day before had started a nest-lining.

However, she deserted and appeared next at box 47 (21) at noon the same day. She deserted box 47 also and returned to box 49 with 21264, but when again caught she again deserted and showed up at box 26 (15) on July 18. On July 17, the male had another female at box 53, but she did not stay. From July 20 to 24 there was a female around, and on the 27th, female, 22988, whose first brood had flown from box 47 (21) on July 10, laid her first egg. Although she had laid 10 eggs in all at box 47, she laid only 3 here. Her brood probably left successfully.

*Territory No. 25.*—Return male, 48775, appeared at boxes 59 and 57 by May 20 and had a female, 26502, accept box 59 the same day. Their first brood left June 26. While caring for his young the male was forcibly displaced from his territory by an incoming male (26) and disappeared from the area.

*Territory No. 26.*—On June 29, a male, 26553, and possibly also a female appeared at box 57, and there was competition for its possession with the male from box 59 (25). Male, 26553, won out. The identity of the female on June 29 is uncertain, but female, 26502, came to box 57 on July 5, nine days after her first brood had flown at box 59 (25), and they raised their brood by August 7.

1923

*Territory No. 27.*—Male, 6899, was at box 3 by May 14 and had a female, 6881, here by May 23. Did this male destroy the robin eggs on top of box 52 May 29-31? On June 17 both adults were captured at box and deserted their 3-4-day-old young. The male then spread his activity down to box 63A where up to June 1 sparrows had been nesting, and on the 30th he had a female, 57798, there. He ceased activity at box 3, and between June 24 and July 1 he persisted around box 53. On the latter date, although his new female at box 63A had just laid her second egg, he was interested in another female, 6885, recently unsuccessful in box 25 (29), who had come to inspect box 53. Both were caught and neither stayed thereafter, the female, 6885, going down to box 47 (35) on July 4 and the male returning to box 3 on July 2 and 3, and then back to box 63A where he helped to raise his brood by August 4.

*Territory No. 28.*—Male, 6893, was at box 6 by May 29 and at box 11 May 30. At box 11 the last of several sparrow nests was removed May 25. During June the bird vacillated between the two boxes, but between June 28 and July 8, he was displaced at box 11 by a new male (30), so he confined himself largely to box 6 until about July 23 when he was last recorded. There is no record of a female having visited him during the entire season.

*Territory No. 29.*—Return male, 22995, was caught in the greenhouse on April 24. He was active at box 25 by May 10 and a female, 6885, appeared here by May 19. By May 27 he was found at box 30, and on the 29th return female, 21212, came to him here, so he was polygynous. He was active at both boxes, although less so at box 25 after June 23 when he was caught there. On June 25 he was captured also at box 30. On June 29 a calamity occurred at box 25 when the young birds and nest-lining were torn out of the box onto the ground below by another wren. It is possible, but improbable that male, 22995, did it himself. However, it is more likely that either of two other males that appeared were responsible (30, 31). Neither of these other two males stayed very long, due partly to their capture and possibly in part to competition with 22995. This bird's young at box 30 left July 8, and both adults disappeared with them.

*Territory No. 30.*—Male, 57782, appeared June 28 at box 11 and may have sought to include box 25 (29) also in his new territory. On July 8 a female, 6891, who deserted box 40 (34) when captured on June 28, inspected box 11 but was caught and did not stay. The male shifted to box 25 on July 11th, was caught there on the 13th, sang all day the 14th, then disappeared.

*Territory No. 31.*—Male, 57759, was caught at box 25 on July 1. He stayed and sang around box 25 a few days more, then shifted to box 53 where he found a female and raised a brood.

*Territory No. 32.*—Male, 57783, who had been caught singing at box 53 July 3 and then left, showed up at box 25 at least by July 17 along with female, 26551, a return nestling, and together they raised a brood by August 20. Thus at box 25 during the season appeared in order the following males: 22995 (29), 57759 (31), 57782 (30), 57783.

*Territory No. 33.*—Male, 6888, was at box 75 by May 14, and a female came here by May 25. The female was found dead on the nest the second day of incubation, June 6. The male then removed the lining and another female, 6887, inspected the box on June 9. Both were caught, and this interfered with the normal progress of their nesting. The male decreased his activity, and the female did not reappear until June 12. She laid an egg on the 15th and deserted. The male must have been around, although he was not noted as very active until the 19th when he was again singing. On June 22, a female wren laid another egg, the first one still remaining in the nest. The new egg was different in color, being nearly white, so the two females were not certainly the same. On June 23, another egg was laid, but that was all. The female, 6887, was recaptured two times afterwards, but the fate and number of young, if any, is unknown. Possibly the young did not hatch or survive. The female was last caught on July 8 and on July 9. The male shifted to box 37 and obtained female, 6891, who had inspected box 11 (30) the day before and whose former mate at box 40 (34) had disappeared with their young. They raised a brood by August 12.

*Territory No. 34.*—Return male, 26546, was at box 40 by May 25, and possibly had been at box 37 as early as May 10. New female, 6891, came to box 40 on June 1, and their brood left on July 8. On June 28 both adults were caught at the box. Possibly the female deserted, as on July 8, the day their young left the box, she was caught inspecting box 11 (30), but did not stay. On July 9 she was back at box 37, mated with another male, and there she raised a second brood (33). Her desertion of box 40 left the male to care for the young alone, and consequently forsake his territory, which in turn allowed this new male (33) to come in and take possession of box 37 and 26546's former territory.

*Territory No. 35.*—Return male, 48785, appeared at box 47 by May 10. A female, 6884, was here by May 27, and their first brood flew July 3. The male did not help with the young, as the next day the old lining was removed from the box. Another female, 6885, whose brood was destroyed at box 25 (29) on June 29 and who had inspected and been caught at box 53 (27) on July 1, appeared and started a new nest-lining. On July 8 she had laid 3 eggs, but 2 were broken and discovered outside the box. She was caught and deserted the nest. She remained in the vicinity, however, and on July 15 started re-laying. Their young flew August 14. The male may have been the one heard singing around box 75 July 23 and 24.

*Territory No. 36.*—Return male, 26600, was at box 51 by May 17 with female, 6882. Their brood left June 27. On July 4 the male was back with a female, but they chose box 50 instead of box 51, probably because of mouse activity at the latter box. Three eggs were laid by July 8. On July 9 there was only one egg, and the female deserted. The cause of the egg loss is not known, although when the nest was removed on the 12th a mouse was found in it. On July 12, there were 2 birds at box 51 where the mouse nest had been cleaned out several days before. This may have been the same female formerly at box 50, or more probably was 6882 who mated with male, 26600, at box 59 on July 16. She may have been looking over boxes about this time, 15 days after her first brood had flown. Their second brood left August 18.

*Territory No. 37.*—Return male, 26601, was at box 59 by May 10 and female, 6892, came to this box about May 31. While the female was egg-laying and incubating, the male became active at box 53 on June 6. When caught there on June 10 he returned to box 59. Their brood left July 8 and neither adult was heard of again. The male from box 51 (36) took over the box within 4 days.

*Territory No. 38.*—Considerable shifting of activity occurred at box 53. Return male, 26601 (37), from box 59 was active here June 6-10 but left after capture. Male, 6898, appeared and was caught on June 16, but then disappeared. Return male, 6899, from box 63A (27) was interested here June 24 to July 1 and even had a female, 6885, whose brood at box 25 (29) was destroyed on June 29, inspecting there, but both were caught and neither stayed. On July 3 male, 57783 (32), appeared and was caught at this box. He likewise left, going to box 25. Finally on July 5 male, 57759, came over from box 25 (31) and obtained on this same day female, 57799, and together they raised a brood by August 13. Probably this male included boxes 9 and 52 in his territory. The replacement of so many males at this box by others may have been due to their being frightened away by capture as well as by territorial competition.

**1924**

*Territory No. 39.*—Male, 58023, was at box 3 by May 8 and box 6 by May 21. On May 22 return female, 26551, came to box 3 and started lining her nest, but when caught on May 25 she deserted. She apparently stayed in the vicinity as two birds were at box 3 on May 27, but on the 29th they both went to box 6 where their first brood was raised to leave the nest on July 2. The male remained interested intermittently in box 3 all this time, and on June 17 he had a female visit him there, and on the 19th female, A28, started her nest-lining. However, on June 27, the first day of incubation, she was caught and deserted and was not seen again. Within two days the male threw out the eggs and very soon also the nest-lining. His activity here during July gradually decreased as he was busy at box 6. He apparently did not take much care of the young out of the nest but kept singing and active near the box. On July 14, 12 days after her young had flown, female, 26551, was back at box 6 where she raised another brood.

*Territory No. 40.*—Male, A22, was at box 10 by May 22 and, although occcasionally at box 11, centered his attentions around this box throughout June. On June 30 female, A47, came to him and they raised a brood during the second breeding period.

*Territory No. 41.*—Return male, 48785, was at box 25 by April 29. On May 17 a female was here and started a nest-lining, but it was not until May 22 that feathers were added to the lining and not until the 28th that the first egg was laid. Female, 58024, who was caught at box 75 (44) on May 17 and so probably was not the female bird at box 25, raised her brood here to leave the box by July 3. As soon as the female started egg-laying, the male expanded his territory to include box 30. By June 15 he had been to box 23, and on June 30 had a female, A87, here and raised his second brood. Through July he was somewhat active at box 30, but no longer at box 25 at all, since he did not even clean out the old nest-lining.

*Territory No. 42.*—Male, A13, did considerable wandering and establishing of temporary territories. His identity during May was not established, but he was probably the one at box 37 on May 7 and intermittently thereafter during the month. From June 1 to 6 he was down at box 75. Possibly he "commuted" back and forth between boxes 75 and 37 in spite of the male's territory at box 43 (44) lying in between, as after his capture at box 75 on June 6, he returned to box 37 until the middle of the month. A female visited him here on June 9, but on June 25 he had left box 37 for boxes 50, 49, and 51. On July 10 he showed both box 50 and box 51 to a female, and on the 13th female, A27 (45), was also here, but no females ever stayed, and he went through the season unmated.

*Territory No. 43.*—A male, A50, came to vacated box 37 on June 26 with a female. However, the female did not stay, and the male remained a bachelor, although females again visited him on July 9 and 20.

*Territory No. 44.*—Return male, 26546, was active around boxes 43, 43A, and 75 through May, although he gave up box 75 when he got a mate at box 43. Female, 58024, visited at box 75 on May 17 but did not stay (41). Female, A10,

first came to box 43 soon after this male and the male at box 47 (45) competed for the box (and her attentions?) on May 23. However, on June 4 she was caught at the box and deserted her eggs. By June 10 both birds had gone to box 43A and started renesting. Although on June 15 her first 3 eggs were broken and carried out, she completed the set. On July 10 both adults were captured and the female again deserted, the young later dying. Perhaps it was this male that was active at box 75 and 47 during July after 57759 (45) had deserted the boxes. On July 12, female, A10, was at box 75 and probably raised a brood.

*Territory No. 45.*—Return male, 57759, was at box 47 by May 7, but did not show much activity until May 28 when a female came, laid an egg the next day, and then deserted. On June 8 female, A27, came to him there and she succeeded in raising a brood by July 13. Strangely, this female also inspected box 50 (42) on July 13, and may have done so on the 10th. She did not stay as she was still with the young from box 47. Male, 57759, had been more or less active at box 75 between June 17 and 25 in the interval between A13's and 26546's occupancy of that box (42, 44). After his capture on July 4 at box 47, he deserted and went up to box 53 which was then vacant. Perhaps this is the reason for the female's interest in another male and box, July 10-13. At box 53 a female visited him on July 13. Could it have been A27, his old mate, who also inspected box 50 on this date? However, he did not start another brood.

*Territory No. 46.*—Male, A20, was at boxes 53 and 51 by May 7. Return female, 6882, came to box 51 May 17 and had 6 eggs laid by May 25 when she was caught at the box. This disturbed her and she was away from the box, probably not entirely, but a good share of the time until May 30, after which she incubated steadily. The eggs hatched June 10, 16 days after the last one was laid, but if the 5 days are subtracted when the female was mostly away it leaves 11 days. This is an unusual behavior. Perhaps for the period she was away from the eggs during the day she was on them at night. The young left the box June 26. The male stayed around until about June 30, then shifted over to box 68 where on July 3 he was putting in sticks on top of the nest of the birds that deserted there on June 26 (47), without bothering to remove the old nest-lining. On July 5, return female, 57799, was here in the morning, although still feeding young in box 59 (47) and with her mate still present. However, she did not stay. On July 8, his female, 6882, returned to him at box 68, 13 days after their young had flown from box 51, and they raised another brood.

*Territory No. 47.*—Return male, 6899, was at boxes 59 and 68 by May 20. On May 30 return female, 57799, came to box 59, and their brood left on July 8. The male maintained his activity at box 68 and on June 21 had a female there, but she deserted her 4th egg on the 26th. The male threw the eggs out of the nest within a couple of days and then returned to box 59. Strangely on July 5 when the box 51 male (46) became active at box 68 the female went down to visit him and was captured there at 10:00 A.M. By 10:50 A.M. she was recaptured at box 59 feeding her young. She must have been temporarily enticed by the new male's sexual activities. Both adults cared for the young off the nest on July 8.

*Territory No. 48.*—Male, A15, was at box 63 by May 13 and throughout May showed some activity here in singing. On June 11 he was caught at the box, so during the next few days he transferred to box 63A. Although often singing nearby, he was not active at box 63 again until July 16. The next day return female, 57799, nine days after her young left box 59 (47), came to him here, and they succeeded in raising a brood.

**1925 (Figs. 7, 8)**

*Territory No. 49.*—Return male, 58023, was active at box 3 by May 5. By May 18 he had return female, 6892, and on June 25 their brood left the box. The male had been more or less active at box 6 since June 15, so that he cared for part of the young from box 3 in the vicinity of 6 until about July 6. On this date female, 31917, came to him there and they raised their second brood by August 10.

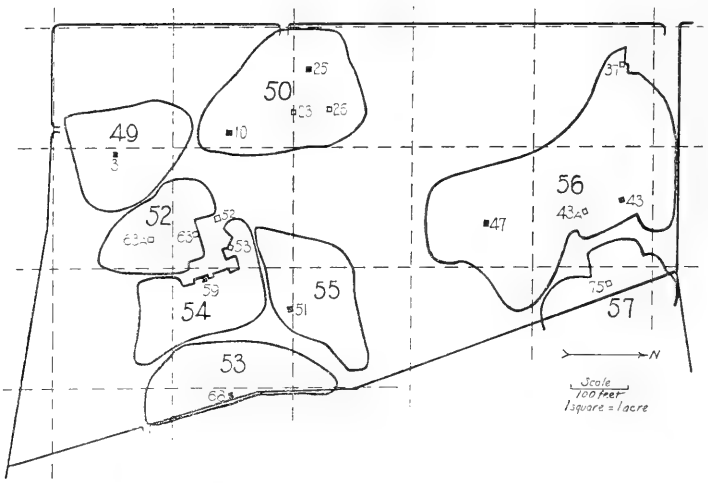


FIG. 7.—Map of territories for the first breeding period of 1925. The areas enclosed within the irregular boundaries are the territories, each one being identified by a number which refers to the case history where detailed information may be obtained. Boxes marked as solid squares are those where the males succeeded in getting mates and starting to nest; others marked as hollow squares are accessory boxes claimed by males. The grid of large squares is to aid in locating the territories by reference to Fig. 3.

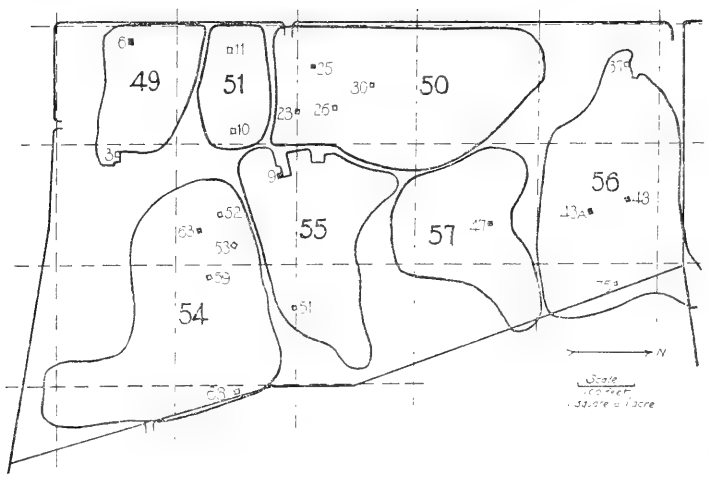


FIG. 8.—Map of territories for the second breeding period of 1925.

He was more or less active around box 3 until the middle of July, but thereafter he stayed with his brood at box 6 and aided in their care out of the nest until about August 24.

*Territory No. 50.*—Male, A154, was at boxes 23, 25, and 26 by May 5 and at 10 by May 6. On May 19 a female, A173, came to box 25, and their brood left June 21. Meanwhile on May 29 female, 167, caught in the greenhouse the day before, came to him at box 10 and started another brood for this polygynous male. However, when both adults were caught at box 10 on June 9, they both deserted. On this day the young at box 25 hatched, and the male returned there. The male did not aid in care of the young when they left the box, but stayed singing near boxes 25 and 30. His same female, A173, came back to this territory on July 3 or possibly as early as July 1 and 2 for occasional visits and may have inspected box 30, but chose box 25, and their second brood left August 9. Both adults cared for the young until about August 21.

*Territory No. 51.*—An unknown bachelor male came to boxes 10 and 11 about June 26. He was mostly active at box 10 where the box 25 male (50) had deserted on June 9. A female was around boxes 10 and 11 on July 17 and 19 but not to stay, and he did not raise a brood. He left early in August.

*Territory No. 52.*—Male, A61, a young bird of last year, came to box 63 by May 5 and to box 63A by May 13, displacing sparrows that had started to build a nest. A female was around and probably inspected both boxes May 13 to 15 but did not stay. The male was not very active. On June 12, female, 153, who was forced out of box 68 (53) the day before, inspected box 63A, was caught, and did not stay. By June 27 the male's activity at box 63A largely ceased, and on July 2 he was caught at box 63. His territory is indicated only approximately. On July 3, it was probably he that sang here all day, stimulated perhaps by the new male, 31852, who had come to nearby box 59 (54). On July 4 both males had a female inspecting box 52, but she did not stay. Then both males disappeared as A20 took possession (54).

*Territory No. 53.*—Return male, 6899, was at box 68 by May 5 and female, 153, came the next day. Four eggs were laid by May 18 when the box was accidentally knocked down. It was not replaced until May 21. The adults had apparently remained nearby, as they started renesting at once. On June 7 the male was found dead, cause unknown. His territory as marked is only approximate. The female continued incubating until June 11 when a new male, probably A20, appeared singing. Perhaps the female did not want to go it alone nor the male want a ready made family, anyway they, or perhaps he, cleaned the house of all eggs and lining. The female went next day to box 63A (52) but did not stay, probably frightened by being captured there, and she disappeared from the place. The male returned to his duties at box 59 (54) and did not stay longer at box 68 without a female. A mouse occupied the box the latter half of June, although in mid-July a male was here occasionally.

*Territory No. 54.*—Return male, A20, came to box 59 four days after a robin's nest was removed from the top of the box. Perhaps he was aroused to nesting activity by the appearance on the same day, May 25, of female, A183. On June 11 he had an adventure at box 68 (53). His young left June 27 with him taking care of part of them. Within 3 days after his leaving, male, 31852, coming up from box 75 (57) where he had not succeeded in getting a mate, appeared at box 59 and for the next couple days there was some dispute between the two males for possession of the box, although A20 had to divide his time and attention with caring for his young. By July 4, perhaps it was 31852 from here and A61 from box 63 (52) who were competing for a female at box 52, but after that A61 disappeared and 31852 went to box 47 (57) as A20 returned. Although A20 and 183 were still occasionally with young until at least July 6, 9 days after they left the box, possibly she was the female at box 52 on July 4. Certainly the male was active at box 53 on July 5. He had a female, probably A183, around here from

July 5 to 8. However, on the latter day both shifted to box 63 where the male had also been active singing. Here they raised their second brood, which flew August 14 and was probably cared for chiefly by the female.

*Territory No. 55.*—Return male, 26523, appeared at box 51 by May 5 and centered his activities mostly around here during the first breeding period. On May 15 return female, 26551, came here, and on June 27 their first brood flew. The male cared for part of the young out of the box, remaining for the most part in the vicinity of box 51. An unknown male was active at box 9 from June 24 to 30 but then left. On July 3 male, 26523, from box 51 came to box 9 and on the 5th his former female, 26551, came to him here. On July 30 the male was caught at the box and deserted. The female raised the young that left the box August 11.

*Territory No. 56.*—Return male, 57759, was at box 47 and probably box 37 by May 5. Possibly a female inspected box 47 on May 13, and return female, 6891, was here May 19. Their brood left on June 26 and was partly cared for by the male. Meanwhile, the male was active at box 43A by June 10. The next day, or perhaps even on the 10th, a female was inspecting the box here. The male was caught at the box on the 11th. On the 12th both the male and female, A167, who had deserted box 10 (50) on June 9 at capture, transferred to box 43 where a brood was started. The female had first inspected box 75 (57) on June 11 with another male. The young hatched July 5. For the first half of July the polygynous male was mostly absent from box 43 since he was helping with the young from box 47 and was also active at boxes 43A and 37. Between July 3 and 6 it may have been he who had a female around box 75 but she did not stay. This female may have been No. 6891, his former one at box 47, for on July 6 she returned to that box and to a different male (57). The attraction of the old box was apparently greater than her previous mate. Male, 57759, after the female left him at box 75 on July 6 went to box 37 July 8-12 and even had a female visit him there on July 9, but again came back to his brood at box 43 on July 17 after his long desertion, and on the first day he took part in feeding of the young. On July 18, he was feeding them more frequently than the female and at the same time attempting to court her as a new female with song and action. Their young left July 19 with the male taking part of their care, although also somewhat active at box 43A. On July 26 he had his former female, A167, back at box 43A, 7 days after their young flew, although he continued part time with young until July 29 at least. The male deserted box 43A on August 6 and the female deserted August 17, three days after the time her eggs were due to hatch. Only a few hours after she left, one of the eggs did hatch in the heat of the sun. The delay of hatching was caused by an experiment conducted here.

*Territory No. 57.*—Male, 31852, was at box 75 by June 9 and had females visit him on June 11 (A167?) and on June 18 to 20. Later in the month, the male left this box and went up to boxes 59 and 52 (54), but meeting considerable competition there he came back to box 47 about July 4. Here he succeeded in wresting away part of 57759's territory (56) and even obtained that male's former mate, 6891, at this box. Their brood left on August 11, cared for by both adults.

### 1926 (Fig. 9)

*Territory No. 58.*—Return male, 57759, was the first bird to stay on the farm, May 2, although a few days before a non-singing bird was here temporarily. This May 2 bird actively gave a territory song west of the greenhouse. On May 4 he was scouting around, inspected box 26 and also the greenhouse where he was caught. By May 14 a female inspected box 25 but did not stay. The male was active at boxes 25 and 11, although on the 18th a singing male south of the main house may have been he. On May 24 a female came to him at box 25 but may not have stayed. A female was here on May 29 and returned to stay on May 31, but on June 9 she died a natural death, the day the 6th egg was due to be laid. The male had no more activity at this box. Before this happened the male had ex-

plored box 6 on May 27 and box 10 on May 28. During most of June his activity centered around boxes 11 and 6, although he investigated box 3 on June 18. On June 17 a female inspected box 6 but did not stay. On June 25 another one inspected the box and on June 27 either she or another female began carrying in lining for a nest. However, on the 28th the female, 38446, transferred her attention to box 11. Here she raised her young to 6 days of age and then deserted. The male continued his activity at both boxes 6 and 11, the former at least to July 17, but after the 25th he had to raise the young at box 11 alone. They flew on August 5. On July 28 a strange female was around and the male visited box 23 with her. On the 29th she came around box 11, probably attracted by the male's scolding, but he payed no such attention to her as he had the day before. This may be due to the fact that on the 28th while the young and nest and box were removed to dry out after they had been drenched by a heavy rain, the male reverted to his territory song near box 6 and other parts of his area. When the young were replaced later in the day he was called back to their care by my squeaking and discontinued his territory song. After August 5 he wandered away while caring for young.

*Territory No. 59.*—Male, A34236, arrived on the place May 6, singing between the greenhouse and the main house and later near the garage. On May 7 he roamed between boxes 53 and 80 and was caught at a banding station near box 80. His song did not seem to be as complete or as vigorous as later in the season. From May 8 to 14 he kept pretty much between the front lawn and the southeast corner. He had some nest-building activity at boxes 70A and 80, but between May 14 and 24 he was not in evidence and may have gone across Mayfield Road to a neighboring estate. By May 24 he was again active at box 70A and also began activity at box 59. The next day, the 25th, he was also at box 53, and on the 27th he came to box 51. On the 28th a male bluebird had begun nest-building at box 70A but was found dead in the box with the back of the head and neck greatly bruised as by a bird. I believe this male wren killed it but have no evidence aside from the fact that in more certain cases of murders by wrens the wounds have been similar. At any rate the wren did not keep possession of the box and two days

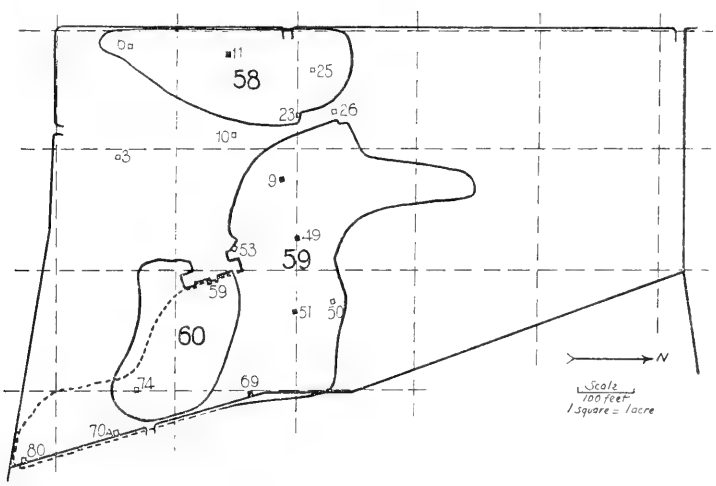


Fig. 9.—Map of territories for the whole breeding season of 1926. Where territories are indicated to be overlapping, actually one male has taken over a portion of another male's territory. The boundary of the territory that has been relinquished is shown by a broken line.

later sparrows began to build there. On May 28 he returned to box 51 and also went to box 49. On the 30th a female inspected both boxes 53 and 49 (possibly also box 51). The next day she was observed near box 49 but was not very active. However, she seemed definitely interested in the male and this box, and the male confined himself mostly to its vicinity, giving up boxes 59, 53, and 51. On June 3 the female, 63810, started her nest-lining. The male soon became involved in territorial behavior elsewhere. On June 12, a new male arrived and started to carve out a territory (60) on the front lawn, centering at box 59. Male, A34236, from box 49 gave chase, as this whole area to the southeast corner had formerly been his "tramping ground." This competition lasted for 5 days, or until June 17, and it was especially keen because a female was around and had inspected box 59 with the new male on the 13th. On June 15, the new male went down to box 69 and started tearing out the nest of bluebirds whose brood had flown June 9. Two dummy eggs were inserted to see what would happen. They were thrown out the next day. The new male was captured and banded here in the morning of the 16th. This may have disturbed him; at any rate, he made no further attempt to hold the box but retired to box 59. The male from box 49 then filled box 69 with sticks in a formless mass and with the entrance pretty well clogged. The two males had now pretty well divided the front lawn between them, and strife largely ceased after June 17. The male from box 49 continued his activity at box 69, and on the 28th a female came to him there and laid a set of eggs. Meanwhile at box 49 the female had been attending to her duties. Her young hatched June 26. The male aided her in feeding them until the female came to box 69, but after that in decreasing amounts until he had mostly deserted her by July 3. The female at box 49 now went as far west as the water tower and into the maple grove for food for the young, although the male at that time had not, as far as I could tell, incorporated this area into his territory. Later on, however, when he had a second brood at box 9 he did so. The female did not obey territorial limits, as she could not enter another bird's territory in this direction this side of No. 58. On July 5 a strange unknown bird, probably a male, came to the box, looked in, and left when he saw it occupied. He did not sing. On July 7 a male came again, this time more obtrusively. He sang repeatedly, got both himself and the female very excited, and attempted copulation with her at least three times, of which twice he may have succeeded. The male from box 59 got interested and came down to investigate, but did not stay. Male, 34236, however, was not seen. The strange male did not stay, although he was active for a few days at box 9 carrying in sticks. The female at box 49 left with her young on July 11. Strange things happened on July 11, although not related to the young leaving from box 49—more probably related to the coming in of a new female, 71653. Male, A34236, took her to inspect box 53 early in the morning, although she did not stay. This male still had young in box 49 at that hour, eggs in box 69, and was simultaneously attempting to get a new mate here. This is probably the nearest approach to a male having three females at the same time of which we have record. The male became active at box 9 adding it to his territory and carrying in sticks. On July 12 he investigated box 50. On the 14th a female was observed still around box 53 and on the 15th both male and female were at box 53, but then transferred to box 9 and started nesting at once. With the male interested in this new female he lost interest in his female at box 69 in the same manner he previously had lost interest in his female at box 49. On July 12 two eggs were missing from the 6-egg set at box 69 and on the 14th another egg was gone. The female deserted presumably due to the loss of eggs and also because of an experiment performed here on the 13th. Quite possibly the male removed the eggs in an attempt to prepare this box for the inspection of the new female mentioned above, although after the female chose box 9 he was no longer observed at box 69. His story is not yet complete. On July 22 when his box 9 female was incubating, 63810, his former mate at box 49, again made her appearance, 11 days after her brood had flown. She inspected box 51 with him and chose to stay.

By August 11 her eggs hatched while the young in box 9 were 7 days old. The male was never observed helping to feed the young in box 9, although he would sing nearby and alternate back and forth between boxes 9 and 51. On this same day he deserted his territory entirely. Once the male from box 59 came down and even looked into box 9. The female at box 9 had her brood leave on August 19, but the female at box 51 had her 6-day young destroyed on August 17, possibly by a black snake.

*Territory No. 60.*—This male, 63751, did not come in until about June 12, and then he was forced to compete strenuously for possession of the southern half of the front lawn with the male from box 49 (59) who had possessed the whole territory from the flower garden to the southeast corner. Perhaps a female came with him, as one inspected box 59 on the 13th. On the 15th and 16th he was at box 69 cleaning out a bluebird nest where the young had flown and removed two dummy eggs that I had inserted. He deserted the box after being captured there. On July 3 he had a female, 38479, at box 59, and their young flew August 11. At the time, the male did not have another box in his territory, so he frequently made quiet scouting expeditions to other areas. On July 5 he was once noticed coming down from the water tower, and he once looked in at box 49. Also he may have been the male driven away by the bluebirds at box 70A on this date. Box 74 was erected on July 22 after a new male was heard singing near the old tennis court. This new male immediately took possession, although for the next couple of days he was forced to compete strongly against the box 59 male for its possession. Perhaps he lost out and discouraged by the lateness of the season he left on the 26th. On August 11, when the box 59 brood flew, 63751 looked in on box 9. In both this case and earlier at box 49 his visits to other boxes occurred when the females there were alone with young, deserted by their mates. He cared for part of the young out of the box, keeping them mostly within the limits of his territory and continued to sing occasionally until August 21, after which he and the young drifted away.

### 1927 (Fig. 10)

*Territory No. 61.*—Male, A93433, was first seen at box 53 with a female on May 21. He was captured here on May 30 and deserted. The box and territory were claimed by the male at box 59 (64). He then appeared to shift to box 70A by June 8, with the male at box 74 (62) probably offering some competition. On June 10 he had shifted to box 80 and had a female. On the 14th when her 3rd egg was laid the eggs and part of the nest-lining were found gone. There were two birds here, perhaps one a new female which so excited the male to prepare a nest for her that he destroyed his own eggs and established a nest. She or some other female, A94233, was not here to stay for certain until June 19, and their brood left July 25. Box 80A was erected on June 28, and the male had some activity here during July. The male left the vicinity of the box by July 26 or 27.

*Territory No. 62.*—Male, A93419, along with a female, was at box 74 on April 29. On May 4, a female, possibly A94201, was here to stay, and their first brood flew June 27. During early June this male was active at box 70 and probably competed with the box 80 male (61) who came to box 70A on June 8. At box 70A both wrens gave way to sparrows which started to nest, but when I destroyed their nest, male, A93419, returned to box 70A by June 22. I purposely closed the entrance here to stop the wren from building. On July 16 with the entrance reopened bluebirds started to build but soon abandoned the attempt, possibly due to competition with the wren as he was observed at the box a few days later. Meanwhile the male had remained active at box 74. Return female, 63810, whose first brood left box 59 (64) on July 3, was here, July 1-3, inspecting the box and even starting a nest-lining, but deserting on the 3rd when her young left box 59. Female, A94201, returned on July 7, 10 days after her first brood had flown, and she raised a second brood by August 12.

*Territory No. 63.*—Male, A38398, a return nestling, was at boxes 6 and 11 by May 4. On May 9 he and a female, A93420, were captured at box 6. The male disappeared. A new male, A94242, came to box 11 on this same day and had female, A93420, here by May 14. Their young left on June 30. On June 11 the male became excited by the presence of a new female and became active at boxes 3 and 6, the female choosing the latter box and starting her nest-lining on June 15. The male paid no further attention to his female and young in box 11. However, the new female at box 6 soon left, and the male tore out the lining on the 19th. On June 20th female, A94248, appeared at this box and their young flew July 27. The male remained singing at box 6 and occasionally entered the box until August 19. The female, although still with young in box 6, inspected box 53 (64) on July 25 and later visited box 30 (68). She laid her first egg at the latter box on July 30th but continued care of her brood from box 6 until at least August 2, the day her 4th egg was laid in box 30.

*Territory No. 64.*—Return male, A34236, was near boxes 51 and 59 by April 21 and at boxes 68 and 69 on April 27. He had no further activity at the latter two boxes, as on April 29 bluebirds started to nest at box 68. By May 4 he was at box 63 and was sporadically active there throughout May. On May 7 he was caught at a banding station near the lower windmill. On May 8 a female was with him near box 59 but return female, 63810, did not come to stay until May 23. Their first brood left July 3. From June 22 to 24, male, A34236, was active at box 53. On July 6 a female came here, and he had to compete with the male from box 51 (65) for her. She did not stay. On July 8 he was singing near box 63, but on the 10th had a female come to him again at box 53. On the 12th he had another female start at box 59. However, neither was successful. On July 13 or 14 the female was frightened away from box 53 and the two eggs later destroyed (by the male?) probably because of my disturbance and possibly because of lack of attention by the male. On the 15th his box 59 female also deserted two eggs. These eggs placed in an incubator proved infertile. From July 16 to 25 he transferred his activities to box 3. On the latter date he went back to box 53 and box 59 where the female from box 6 (63) inspected the former box and probably also the latter. He remained more or less active until August 6.

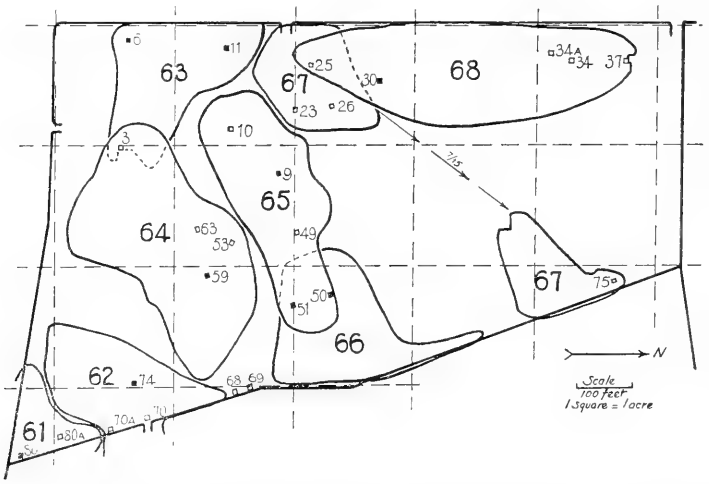


FIG. 10.—Map of territories for the whole breeding season of 1927. Territory 67 is unusual in that the male gave up his territory around boxes 23, 25, and 26 on July 15 to establish a new territory around box 75.

*Territory No. 65.*—Male, A94249, was not evident until May 23 at box 9, May 24 at box 49, and June 2 at box 10. On June 16 a female inspected box 9 first, then box 10, but did not stay at either place. On June 27 female, A94247, first came to box 10 but was disturbed there and transferred to box 9 the next day. She raised a brood by August 5. On July 4 the day his female at box 9 laid her 4th egg, the male went down to box 51, probably because a female, A93513, was around there. This female had had a successful first brood on another estate, had even had a new nest elsewhere with lining on June 30, but was caught, transported to the laboratory, and released on this date. She did not return to her own nest but was seen at box 51 on July 5 and had her first egg there on the 6th. When this egg was broken she wandered up to box 53 and created a squabble between A94249 and the box 59 (64) male. On July 7 she was back at box 51, laying her second egg. Possibly the laying urge prevented her from deserting the nest, and her brood left August 7. Thus this male was polygynous. For a time he appeared to aid both females in feeding the young, but he deserted both early during the first week in August.

*Territory No. 66.*—Male, A94202, was at boxes 50 and 51 May 4, and a female inspected box 50 the next day. On the 9th, female, A93418, was caught at box 50 and deserted, this not certainly the same bird that was around on the 4th. On May 23 a female came here again but was accidentally killed during the incubation period on June 7. The male tore out the old nest-lining here on the 9th and 10th, but beginning on the 7th he was more active at box 51. On June 22 a female inspected this box but did not stay, possibly continuing on to box 23 or box 53. By July 1 the male had left entirely and established a new territory across Mayfield Road on a neighboring estate. Why did he leave?

*Territory No. 67.*—Male, A94222, was at box 25 June 17-20 and at box 23 on the 20th. On the 23d a female (from box 51?) inspected box 23, but did not stay. On June 27 the male came to box 26. Another female came to box 23 on July 3 but deserted her second egg on July 5. The male remained more or less active between boxes 23 and 26 throughout June and until July 15 when he gave up this territory and established a new one at box 75 where he remained until August 10.

*Territory No. 68.*—An unknown male came to box 37 by June 15 and to boxes 34 and 34A by June 18 and 19 but was not very active at the boxes. On July 25 female, A94248, accepted box 30 with this male, although she had to continue care of young from box 6 (63) until August 2, the day she laid her 4th egg in box 30. The male deserted about August 14, but the female was still caring for her 15-day-old young in this box on September 1.

*Territory No. 69.*—New male, A93633, was active at box 75 June 22 to July 2 only. Perhaps he was an immature non-breeder with a first splurge of reproductive ardor. His territory was not mapped.

*Territory No. 70.*—An unknown male was at box 3 from May 29 to June 8 and then apparently shifted across Mayfield Road to a neighboring estate.

### 1928 (Fig. 11)

*Territory No. 71.*—Male, B45320, was at box 80A by May 17 and female, B45321, was here by May 25. On May 26 the male had to defend his territory and his female from the male in territory No. 72 (not mapped). On May 27 the female was captured, banded, and deserted. The male then shifted to box 80, and a female was here June 16 but deserted on the 17th. Was this the same female? The male of territory No. 72 after inspecting boxes 70 and 80A came to box 80 on June 30 and was caught, banded, and deserted. Male, B45320, returned the next day and got female, B45536, on July 6. Their brood flew on August 9. This female had been released at the laboratory after being transported on June 30 from an outlying estate where she had a brood of young. The male's territory probably extended across the road.

*Territory No. 72.*—On June 1 a male wren, probably 664716, was observed destroying a nest of a black-capped chickadee in the ice pond woods. Later in June he was active at boxes 70, 80A, and 80, perhaps excited by a female there, took possession away from the male (71), but was not able to keep the female. On June 30 he was caught at box 80 and either left on his own accord for the ice pond woods or was displaced by the male in territory 71. In the ice pond woods a few days later, he obtained female, B45516, in the former chickadee's nest-site who had a first brood fly from a box on the next estate June 29. Their second brood flew August 11.

*Territory No. 73.*—Return male, A93433, was at box 74 by May 3. A female, B45349, was here by May 21, and their first brood left June 27. The next day the male became active at box 70. On June 30 male, 664716 (72), inspected the box and tried for its possession but failed. A female was also at box 70 on June 30 to stay, which may have been the attraction for 664716. On August 8 the young left box 70. The female was banded, but was not caught for identification. Since all the banded females on the place were accounted for during the second breeding period except B45321, who deserted box 80A in May, it may have been she.

*Territory No. 74.*—An unknown male was at box 3 by May 12 and box 3A by May 30. Not getting a female here he became active from June 17 to July 10 at box 10, formerly occupied by the male of territory No. 75. Although a female inspected box 3A on June 28 he never succeeded in getting a mate, and when male, A94249, terminated his nesting at box 6 (75) on July 15, he was displaced from box 10 and was no longer recorded.

*Territory No. 75.*—Return male, A94249, came to box 11 by May 10. On May 21 he had a female, but she deserted her 6 eggs May 29. Meanwhile the male had been active at boxes 6 and 10. On June 15 he got female, 664751, at box 6 and on July 1 obtained female, B45350, at box 11, the latter having a first brood to fly from box 47 (79) on June 27. This is a short interval between nestings, but possibly she deserted when caught on June 25, or perhaps the male cared for the young out of the nest a few days longer. The young at box 47 did not leave until they were 17 days old, about two days longer than usual. On July 10 female, 664751, was caught at box 6 and deserted. The male tried to continue care of the young, which were then 6 days old, but by the 15th they had all died. He immediately transferred his attention to box 10. On July 16 female, 664751, was looking for another mate, so he showed her box 23, really outside his territory and in the area formerly defended by the box 25 male (76), but she did not stay. On the 17th she accepted box 10; thus the male again had two nests going simultaneously. On August 7 the female, B45350, was caught at box 11 and deserted. Male, A94249, continued their care alone, as they were 11 days old, and was also active part time at box 10. On August 10 he was captured at box 10 and thereafter spent all his time with the brood at box 11, which flew the next day. On August 17 the female deserted the single remaining young bird in box 10 after she was captured. So with all his effort this male succeeded in raising only one brood during the entire season.

*Territory No. 76.*—Male, 664601, was at box 30 by May 9, at box 26 by May 12, and box 25 by May 13. On May 14 return female, A93526, came to box 30, but when caught she deserted. On May 16 she settled at box 25, but was accidentally killed on June 22, so that the male cared for the young alone and brought them off June 26. Before the female's death the male had returned for activity at box 30, and had extended his territory to box 23 and on east of the laboratory. On July 6, 10 days after the young had flown, the male was active again at box 25, and on the 9th a female came to him at box 30. She deserted on July 29 when her eggs failed to hatch.

*Territory No. 77.*—An unknown male was at box 63 by May 15 and had a female here May 21, but she died egg-laying on May 26. By May 30 he had gone to box 59. On June 11 he had a female here, but when one of her eggs was

broken (accidentally?) on June 21 she deserted. On June 16 and again on June 25 the male here had to fight in defense of his territory with the box 51 male (78) in a real battle. Perhaps this box 51 male destroyed the egg in box 59 on June 21, although there is no evidence. A singing male was near on June 27, and this may have been the box 59 male, but he disappeared the following day.

*Territory No. 78.*—Return male, A38398, was caught May 8 in the greenhouse and was active around box 50 by May 9, box 9 by May 12, box 51 by May 21, and box 52 and 53 by May 23. A female was at box 51 on June 3 but did not stay. On June 12-14 the uneasy male was active at boxes 53, 50, and 69. On June 16 and again on June 25 this male invaded the territory of the box 59 male (77) and there were serious fights. On the latter day female, B45348, came to box 51 after being first trapped at a banding station near the lower windmill on June 21. This female may have been the one that deserted box 59 (77) on June 21. After this date the box 59 male was no longer recorded, and a month later the male, A38398, was active at box 59. On July 29 his young flew from box 51.

*Territory No. 79.*—Male, A93573, a return nestling, was first active at box 37 on May 10, but when caught there on May 14 he transferred to box 47. By May 22 female, B45350, came and the male probably showed her both boxes 47 and 47A, although it was at the former box that she raised her first brood by June 27. On July 6, female, B45349, came 9 days after her first brood had flown from box 74 (73), and their second brood left on August 17.

*Territory No. 80.*—Male, whose identity is unknown, came to box 37 soon after May 14 when male, A93573, who was first active here (79), was frightened away. Female, 664708, was here by May 21 after the male had probably also shown her box 34. Misfortune came to their young, all but one of whom had disappeared by June 17. The female deserted on June 17 due in large part to interference from me. The male remained active until about July 25, going also to boxes 34A and 35, but he did not renest.

*Territory No. 81.*—An unknown male came to box 75 by May 23 and box 78 by June 9, and had female, 664708, who left box 37 (80) on June 17, at box 75 on June 22, and their young flew July 27. The male did not care for the young much after July 16, although he probably remained in the territory somewhat longer.

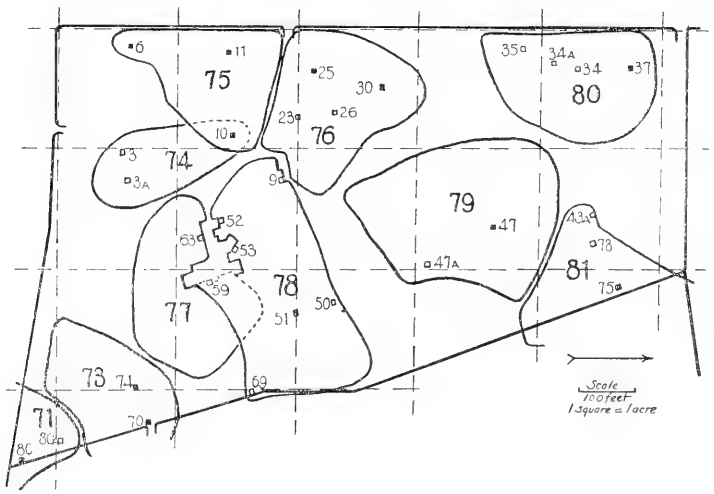


FIG. 11.—Breeding season, 1928

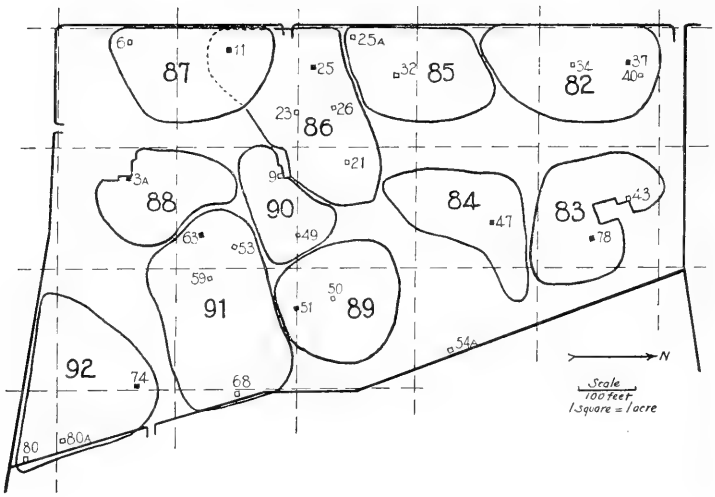


FIG. 12.—First breeding period, 1929

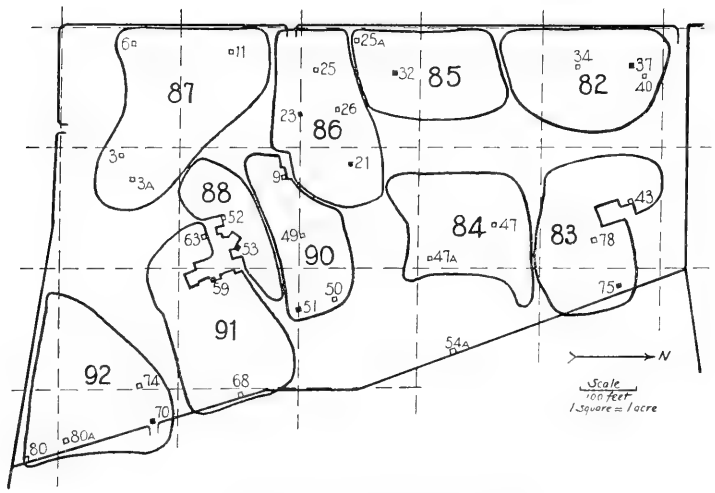


FIG. 13.—Second breeding period, 1929

**1929 (Figs. 12, 13)**

*Territory No. 82.*—Male, B97101, was active at boxes 34, 37, and 40 in May. By May 15 return female, 664708, was at box 37 (from box 43 (83)?), and on June 22 her young flew. On July 1 a female inspected box 37 but did not stay. On July 10 female, B97102, did stay and she raised a brood.

*Territory No. 83.*—Male, B46487, was caught on the laboratory porch May 6 and was active at box 43 by the middle of May. By May 15 a female (664708?) came to box 43 but soon deserted. Female, B96433, came to box 78 by May 24, however, and their young flew June 30. On June 22 the male was somewhat active at box 75, but not much again until July 8, eight days after his first brood had flown. He must have taken care of the young entirely after June 25 when the female was captured and deserted. Female, B96900, whose first brood at a neighboring estate had flown about 8 days before, appeared at box 75 on July 11. It is possible she deserted her first brood 13 days before when captured at the box. Her second brood flew August 21.

*Territory No. 84.*—An unknown male was present at box 47 by May 15 and a female here May 20, but she deserted her eggs May 24. On June 11 female, B97003, perhaps the same one as was here earlier, came again and their young flew July 16. This male was apparently kept out of box 54A by bluebirds which nested there all season. Instead he went to box 47A, where wrens were seldom seen. From July 8 to 23 he was active at this box but was interfered with by a mouse that succeeded in raising her young even though the male wren had earlier carried sticks onto the top of her nest.

*Territory No. 85.*—Male, B97007, was at box 32 with a female June 1. On May 24 a sparrow's nest had been removed from the box, and its presence may have delayed the wren's starting earlier to nest. On June 6 the female deserted the eggs and nest. Before June 15 the male had some slight activity at box 25A. From June 18 to 20 a female was again at box 32, perhaps the same one, although she did not stay. On June 29 female, B96433, arrived, although her first brood at box 78 (83) did not leave the nest until the next day; perhaps she deserted when captured June 25. Their young flew August 6.

*Territory No. 86.*—Return male, A94249, first appeared at box 11 on April 27. An unknown female came on May 14 but deserted her first egg, May 20. The male next became active at boxes 23 and 26, and when the sparrow nest at box 25 was removed on the 24th, he soon shifted over there. On May 30 female, B56490, brought in from an outlying estate on May 17, came here, and their first brood left July 6. On May 30 when the male was all excited with his new female, he apparently destroyed the eggs of a pair of bluebirds at box 21 and had some nest-building activity there. Later, during the middle of June, he was active again at box 23 for a few days, but by July 2 he returned to box 21. On July 8, two days after their first brood had flown, he had female, B56490, back at box 21, and their second brood flew August 17. Their first brood at flying consisted of only one bird and it did not interfere much in the birds' remating activities.

*Territory No. 87.*—Male, B96434, was not noticed until about June 1 at boxes 11 and 6. This was the time that the male in territory No. 86 was occupied at boxes 25 and 21 with a female, although he had previously been with a female at box 11. Female, B96001, came to box 11 on June 1. This female had been brought in from an outlying estate on May 27, at which time she was nearly ready for egg-laying. Their brood left July 8. By July 11 the male had wandered to box 3 and by July 16 had gone to box 3A, vacated since June 26 by the male in territory No. 88. On July 27 a female came to him there, but on August 3 she deserted her fifth egg, possibly due to the lateness of the season.

*Territory No. 88.*—Male, B56491, together with female, B96417, were at box 3A by May 25, but the female deserted her young, and the young died on June 26. The male was not caught at this box, but may well be the bird of this number that on

July 7 became active at boxes 52 and 53, over two weeks after the male in territory No. 91 had ceased activity at the latter box. Female, B96001, came to him at box 53 on July 9, the day after her first brood of two birds had left box 11 (87). (What happened to them?) Their second brood left August 14.

*Territory No. 89.*—Return male, A38398, arrived April 27 and by May 15 had return female, B45348, at box 51. Their first brood left June 23. In May the male had been active at box 50, possibly disrupting a bluebird nesting there, as his sticks were later found on top of the nest. However, he did not prevent bluebirds from nesting at box 49. The male may have helped care for the young wrens when they left the box, although there were only 3, as he was not seen again and the female was hunting a mate 4 to 7 days later.

*Territory No. 90.*—Male, B97018, was active throughout June at box 9. On June 4 he had to defend this box against the male from box 3A (88). After the bluebird brood flew from box 49 on June 11 the male became active there, and on June 27 a female inspected the box. About this time the male also became active at box 51 which the male in territory No. 89 had recently vacated. This female may have been the one that deserted box 3A the day before, or it may have been B45348, whose young had flown from box 51 on June 23. More certainly the roving female June 30-July 4 was this latter bird. She inspected box 9 on June 30, box 50 on July 1, box 49 on July 2, and was back at box 9 July 3 and 4 and might have stayed here except that my interference disturbed her. On July 4 she returned to box 51, and her second brood left there August 6.

*Territory No. 91.*—Return male, A93433, was active in early May at boxes 63, 59, 53, and 68. By May 19 he had return female, 664751, at box 63, and their young left on June 26. He remained more or less active at the three other boxes through June, but on July 1 a female came to him at box 59. Her identity is not known as she deserted her 7-day-old young, leaving the male to care for them entirely, which he did successfully.

*Territory No. 92.*—Male, B96418, was at box 80 by May 15; his activity there being terminated in middle June when a mouse took possession. He was not at box 80A until after May 24 when a bluebird nesting was completed. He had activity there for only a few days in early June, as by the 14th the bluebirds were back for renesting. Probably he did not defend these boxes vigorously. A return nestling of two years before, female, B5640, came to him at box 74 by May 20, and their first brood left June 26. The male then switched to box 70 on July 6, perhaps partly persuaded by a mouse appropriating box 74 on July 5. His former female returned to him on the same day, 10 days after their first brood had flown, and their second brood left in the middle of August.

### 1930 (Fig. 14)

*Territory No. 93.*—Return male, B56487, was singing in the barnyard on May 4, was at boxes 75 and 43A by May 12 and at boxes 43 and 78 by May 18. On May 13 return female, B96433, came to box 43A from box 47 (95), and their first brood flew June 20. The male did not aid in their care much after the first couple of days. He was at box 78 on June 23, at boxes 75 and 43A on June 24, and at box 43 on June 25. Female, C68705, came to box 43 on June 26 but deserted her young on July 23, probably because of my interference at the nest, and the young were placed in another box. On July 2 a female visited the male at box 78, and 2 days later even laid a first egg before she deserted. The territory of this male as originally marked included box 47, but this was later subdivided (94).

*Territory No. 94.*—An unknown male came to box 47 on June 20 and an unknown female on June 26. Could this have been female, B96433, from 43A (93)? They deserted their nest at hatching of the eggs due to interference. Probably C68801 (95) was the male here early in the season, but he had left this box by May 25.

*Territory No. 95.*—Male, C68801, was at box 47 by May 4 and had return female, B96433, here May 9, but after being captured she deserted. The male continued to be active at the box until May 25, with occasional activity also at box 47A, and perhaps was more or less around through June. The female went over to the male at box 43A (93) on May 13. Bluebirds, which had been nesting at box 54A, had their nest destroyed by sparrows, probably June 9. Male wren, C68801, came to this box July 7, and female, C68257, who had deserted box 49 on July 3 (97), came here July 9, and their brood left August 13.

*Territory No. 96.*—Male, C68911, was in the territory by May 12 at boxes 11, 26, and 30. Female, C68253, came to box 26 on May 15, but their young were deserted on June 7 due to my interference. On July 11 the pair was observed at box 30, but the female did not stay. On the 12th they started a nest at box 25 where the male had been more or less active since June 5. Their young left July 19, the male questionably aiding in their care. A female also came to box 6 on June 16, but eggs and nest were deserted on July 2, so this male was polygynous.

*Territory No. 97.*—Return male, B97018, and an unknown female were at boxes 49 and 53 by May 3. Probably this same female, C68254, remained near box 49 until May 11 when the male was frightened from the box by me, then the next day the two shifted to box 53 and started a nest. The young flew June 28. Meanwhile the male had been somewhat active at box 52, possibly once at box 21, and also at box 49, for on June 8 or 9 female, C68257, came to this latter box. Perhaps she was the female that deserted box 74 (102) on June 7 when she laid her 2nd egg. However, on July 3 she deserted box 49 after being trapped, apparently a very timid bird. The male thus was polygynous and he may have been absent with the young from box 53 at the time the female was caught at box 49. He remained active at the box until about July 15.

*Territory No. 98.*—Return male, A38398, arrived in the vicinity of boxes 50 and 51 by May 7, and return female, B45348, was at box 51 on the same date. Their young left on June 23. The male became active at box 50 on June 27, had a female (his old one?) here on July 3, but due to interference she deserted on July 7. The male then transferred back to box 51 on July 8; a female was here on the 11th, but no nesting was undertaken.

*Territory No. 99.*—A bluebird was nesting early in the season at box 3A, but on May 15 its eggs were gone, and very shortly male wren, C68800, became active

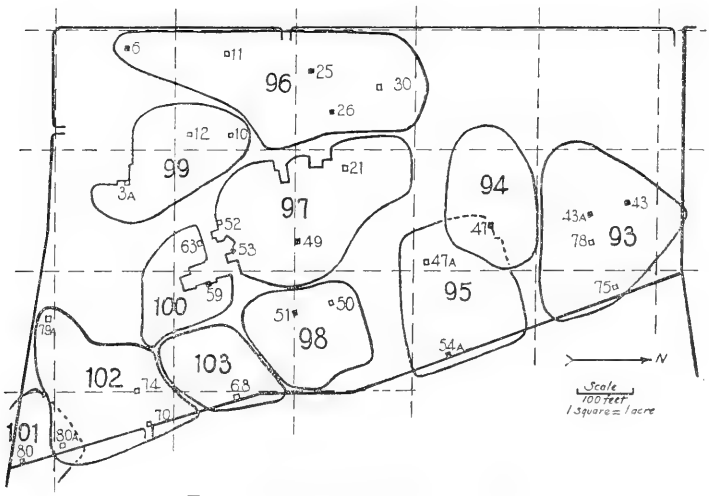


FIG. 14.—Breeding season, 1930

here. Did he destroy the bluebird nest? On May 27 a female wren was here. Could she have been the one that deserted box 80A (102) on May 23? On June 3 she laid her 3rd egg, but due to interference deserted. The male continued active at boxes 3A, 12, and 10 through the rest of June. On July 2 a new female came here but was accidentally killed. Male activity was noted until July 16 only.

*Territory No. 100.*—Male, C68910, came to box 59 soon after a sparrow's nest was removed on May 4. On May 22 he had return female, B5640, here, but due to destruction (by sparrows?) of eggs as they were laid she deserted on June 1. She started egg-laying again on June 6, but on the 8th the eggs were again gone. The male shifted over to box 63 for a brief time three days after this failure, but was back at box 59 on the 9th. His persistence was probably a drawing force, as the female came back a third time, assuming her to be the same bird, on June 15. Their young flew July 20, the male aiding in the care.

*Territory No. 101.*—Male, C68252, was at box 80A a day or so after the box 74 male (102) had been caught here and deserted on May 3. He had female, B96282, a return nestling, here by May 15, but due to my interference she deserted her 6th egg, and on the next day both adults transferred to box 80. The first new egg was laid on May 28, and the young left about July 1. The male disappeared after July 5, although he may have been seen with young July 15. The female renested across Mayfield Road beginning about July 2. It seems very probable that the male cared for the 2 young entirely. It is possible that the female deserted the nest on June 24 when she was trapped at the box.

*Territory No. 102.*—Return male, A93433, had a female on May 3, and they inspected boxes 80A, 74, and 70 in this order, staying at none. However, he had another female at box 74 by May 12, but she deserted her second egg May 20. A female, perhaps the same one, was nearby scolding on the 21st and inspected box 74 on the 26th, about the time the male had some activity at box 79A. The female did not stay until June 2, and on June 7 she again deserted due to my interference after she had laid her second egg. This female was probably C68257, who was caught at a nearby banding station on June 6 and went to box 49 on June 8 or 9 (97). The male paid some attention to box 70 on June 9 and was more or less active until July 7. A mouse took over box 74 on July 1, and the male finally disappeared.

*Territory No. 103.*—A pair of bluebirds was at box 68 until June 17 when the first egg laid disappeared and the birds deserted. There was activity at the box on June 19 and 21, either of bluebirds or of house wrens. On the 22nd an unknown male wren was definitely here. The bluebird pair returned once on the 25th, then disappeared. On June 30 and July 1 there was an intense song competition between this new male and the male wren from box 74 (102), and the stranger won out. Female, C68901, may have been the cause of it as she was caught at the box July 1 and stayed until the 5th but did not nest. The male remained active until about July 9 and may have been back July 17 but was not noted later.

*Territory No. 104.*—Male, B96446, was in the ice pond woods by May 12 and had female, C68563, at box 72A by May 18. The first brood flew June 27, and the male aided in their care. They remated and started a second brood at box 72B about July 19, but the young met disaster 4 days after hatching. This territory is not mapped.

**1931 (Figs. 15, 16)**

*Territory No. 105.*—On May 9 a return male, C68910, was captured at box 3A and then deserted or was replaced by a new male, later going to box 49. Male, C94215, was at box 3A by May 18 and female, C94216, was there by May 27. This male kept expanding his territory down toward the main house. On June 12, perhaps partly stimulated by the male from box 25 (106) and the presence of an unattached female from box 49 (108), he added box 53 to his area in the morning, was competing with the box 25 male at box 9 by noon, and competing with him for

part of the orchard in the afternoon. He cared for part of the young that left box 3A on July 1 until July 13, the young following him about on his territory. The female cared for the others but seemed to have a crippled leg. Neither renested. A female inspected his box 63 on July 17.

*Territory No. 106.*—Return male, C68801, was at box 25 by May 7 and return female, C68253, was here May 15. He was active also at box 30 about May 28, and a female visited him here June 3 and 19, but neither time stayed. On June 12 the male was caught in the morning. Perhaps this disturbed him, and in addition the female who deserted box 49 (108) was looking for a box and mate, so by noon he was competing in song with the box 3A male (105) near box 9 and in the afternoon in the orchard. From June 14 to 25 he was more or less active at box 10, which a brood of bluebirds had vacated on June 10. On June 23 his own brood left box 25. He aided the female in caring for the young but was also active part of the time at boxes 25 and 30. Beginning June 27 the female cared for the young alone, while the male remained intermittently active at box 25 until August 7 without getting a second mate.

*Territory No. 107.*—Male, C94194, was at boxes 53, 50, and 51 May 9 and a female was at box 53 on May 18, but she deserted her first egg May 24. The male was not heard of again. The male from box 49 (108) was at box 53 either the 25th or the 26th and may have had something to do with the female's desertion. The territory is not marked.

*Territory No. 108.*—This return male, C68910, was a very energetic one. He was trapped at box 3A on May 9. This apparently frightened him and he left or was replaced by the new male that came in (105). He may have been active at box 63 by May 26 but then transferred to box 49. His early temporary territory around boxes 3A and 63 is not marked. He may have influenced the female to desert at box 53 (107) on the 24th as he was active there until the 28th. On the 30th a female (this same one?) came to him at box 49 and was in the 3rd day of incubation on June 10 when my interference for an experiment caused her to desert. This male had meanwhile been active at boxes 53 and 52 but probably not at 50 and 51. On June 11 he conducted a female, probably the same one, to inspect box 51 in the morning, but she did not stay. In the afternoon they inspected box 50 but did not stay. In the evening they examined box 53 and likewise did not stay. On June 12, the males from boxes 3A and 25 (105, 106) entered energetically into the competition for territory and the female. Male, C68910, however, led the female, F45359, into an entirely new area, for on June 13 they were at box 54A to stay, replacing the male from box 47 (113) with eggs who had been active there the day before. Their young left July 18, and the male aided in their care. The male occasionally returned to box 51 for activity and singing.

*Territory No. 109.*—Male, B97203, a return nestling from two years back, was active at boxes 70 and 74 by May 9. On May 18 return female, B5640, came to him at box 74, and their first brood left the box June 27, the male aiding in their care. A strange male had looked into the box on June 15. The day after the young left, the male from box 80A (111) started activity here, so that when B97203 became free of young he found his territory occupied. He then went up to boxes 59 and 53, not then in use, but could not get a new mate, July 7-18.

*Territory No. 110.*—Until June 13 a pair of sparrows had a nest in box 59, but on this date it was removed. On June 19 male wren, F45357, came in, had to contest for the box against house sparrows, especially the female sparrow, and on June 21 was competing vigorously with the male from box 74 (109). He succeeded in wresting away a slice of that male's territory, so that by June 25 he covered a large part of the front lawn. On June 21, a return female, C68681, came to him, but on July 3 after laying her 4th egg she deserted. On July 4 the male was caught and rather roughly handled, so he also deserted. This vacated the territory, so that on July 7 the male from box 74 who formerly owned part of this territory came up and took possession.

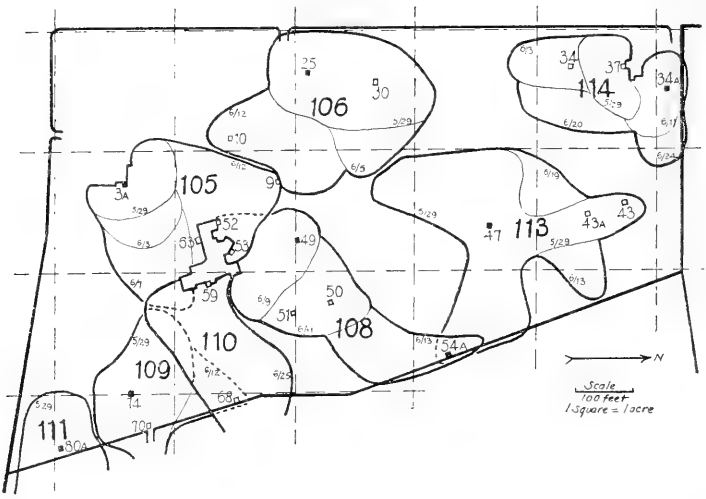


FIG. 15.—First breeding period, 1931. Progressive changes in the size and shape of the territories are indicated by light lines along with the date on which these territorial limits were first recorded. The greatest extent of the territories is shown by heavy lines. Broken lines are boundaries of areas given up by one male to another.

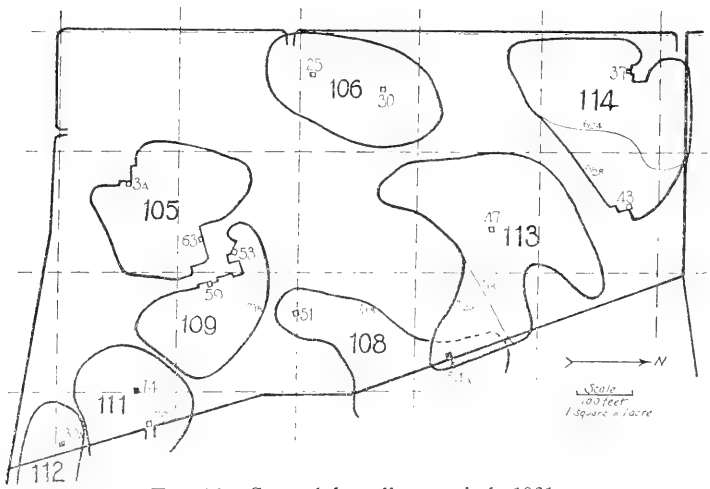


FIG. 16.—Second breeding period, 1931

*Territory No. 111.*—A strange unidentified male was at box 80A by May 7. On May 10 there were two male wrens competing at the box, and C68252, a return, won out. On May 15, female, C94331, came, and their first brood flew June 25. The male appeared to be taking care of the young mostly in the ice pond woods and the female was not again found. While the male was away his territory was preempted by another bird (112), and so beginning June 28 he began singing at box 74, although still obliged for part of his time to be with the young from box 80A in the ice pond woods. The male originally here at box 74 (109) was also away caring for young. On July 7 he started to spend nearly full time at the box and at box 70, partly because his young were now 12 days out of the box and possibly also because the former male here (109) was again making an appearance after caring for his young. That male, however, transferred to box 59 instead of contesting for box 74. On July 13 a female inspected box 74 but did not stay. A female stayed on July 18, and their second brood flew on August 23. Perhaps this female was the same one that visited the male at box 63 (105) the day before. The identity of the female is not known as she deserted the nest about August 15. The male had another female visit him July 29, but she did not stay.

*Territory No. 112.*—While male, C68252, was busy caring for his young (111) a new unknown male, possibly the one seen at box 74 on June 15 (109), took possession of box 80A on June 27, and on July 2 a female visited him there. This was probably either C94331 or B5640, although the latter was still caring part time for her young from box 74 (109), only 5 days out of the box. B5640, however, laid her first egg here on July 8, and the young died from an experiment August 11.

*Territory No. 113.*—Return male, B56487, was at box 47 by May 7, at box 43A and possibly box 43 by May 18, and probably box 54A by May 25. On this latter date female, C94217, came to box 47, so he mostly ceased his activity at the other boxes until June 12, the day of the intense competition around box 9 for the unattached female (108), when he became active again at box 54A. However, the next day the male from box 49 replaced him here as he was probably the more vigorous of the two, being without a nest but with his old female, while B56487 had a nest at box 47. B56487 transferred his excess activity to box 43A June 13 to 17. On July 1 his young left box 47 and he aided in their care. This male did not get a second brood, although he was active at box 54A from July 20 to 30, recapturing this former portion of his territory.

*Territory No. 114.*—Male, C68418, a return nestling, was active at box 37 by May 18 and had a female here May 30. She laid her 3rd egg on June 4 but not her 4th until June 7. Possibly it was because her behavior was so irregular that her eggs were destroyed on the 8th by the male. The next day the male turned his attention to boxes 34 and 34A and female, C94219, probably the same one, came on the 10th, first to inspect box 34, then to stay at box 34A. Again she laid only 3 eggs, but she raised the brood to leave the box on July 18. The male did not aid much with the young, being somewhat active at box 43 June 28 to July 13. On the latter date he transferred all his attention to box 37. Female, F45565, came here on July 15th, and their young flew August 15, the male probably aiding a little in their care. This female had a first brood on another estate, with her young leaving July 16, although probably she deserted her nest when trapped at the box on July 11.

### 1932 (Figs. 17, 18)

*Territory No. 115.*—Male, F45934, was first active at boxes 37 and 40A about May 1, but due to capture on May 10 he shifted down to box 43A and got a female, H18249, there by May 19 or before. The young left by June 25. Meanwhile he expanded his territory into the maple grove and to box 43. His attention to box 75 was not very serious as another unknown male was active here June 24-29 and even had a banded female visit him on the 29th. Either F45934 or this new male from box 75, I believe the former, was at box 43A on June 28. A female came on the 29th, but on the 2nd day of incubation the nest box was accidentally torn down.

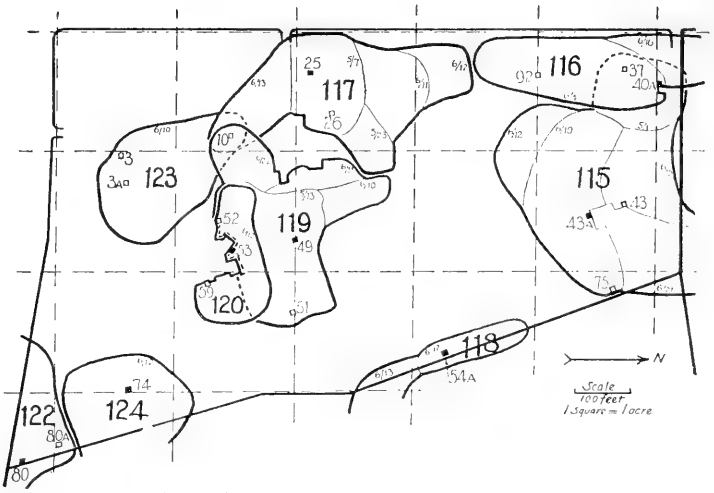


FIG. 17.—First breeding period, 1932

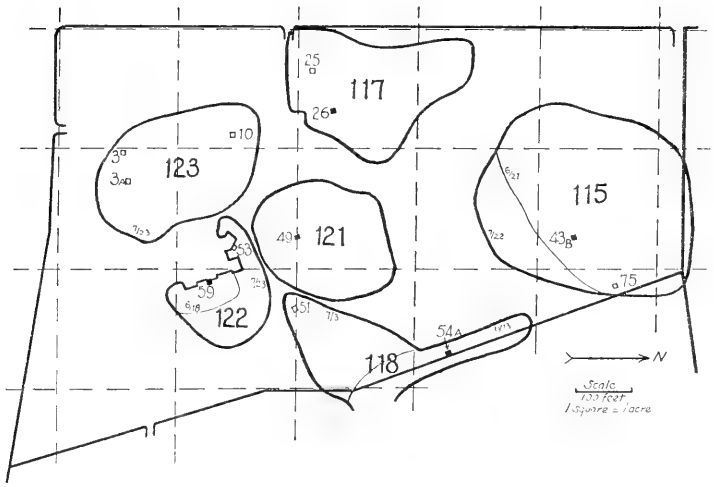


FIG. 18.—Second breeding period, 1932

The male then looked over box 75 again the next day and once went up into territory 116 where he was chased out. He settled at box 43B where female, F45945, came probably on the same day (July 11) and laid an egg 4 days after her (?) box 43A had been destroyed. The young left on August 22.

*Territory No. 116.*—Male, F58648, was at box 40A on May 31 after the previous male (115) had deserted. Return female, F45359, came on June 4, and on July 11 the young flew. On June 12 a foreign male (115) attempted copulation with her, but the male chased him away. From June 4 to 20 the male was somewhat active at box 92, but apparently not at box 37.

*Territory No. 117.*—Male, F45946, had arrived at box 25 by April 28. A female visited the area on May 7, but the male could not coax her into the box due to human interference nearby. On May 12, however, female, F45942, was here to stay, and on June 21 the young left. The male was trapped at the box on June 11. Possibly that stimulated him someway, as on the 11th and 12th he expanded his territory into the maple grove and on the 13th to box 10. He had been active at box 26 by June 4. The male may have cared for the young or part of them a few days after they left the box, but he was back at box 25 from June 26 to 29 and on the 28th and 29th had a female there who did not stay. On July 3, however, a female, probably his old one, F45942, came to him at box 26. This might have been the female to visit him at box 25 a few days previously. She deserted him and her young on August 1, so the male had to continue their care. They left on August 6. It is interesting that on this date the male visited box 25 a few times.

*Territory No. 118.*—Male, F45987, was at box 54A by May 24 and female, F45992, was there by May 29. Due to experimentation their first nesting was terminated unsuccessfully July 5. Between July 3 and 16 and possibly until the 23rd the male had some activity at box 51. However, on July 6 a male was also at box 54A, on the 8th a nest-lining was in, and the next day the first egg was laid, this only 3 or possibly 4 days after the first nesting was abandoned. Neither the female nor male was trapped, but probably they were the same pair that was here for the first brood, more certainly so for the female. The brood was again unsuccessful, July 28, due to my interference.

*Territory No. 119.*—Four males were involved in a tangle of relations and the interpretation may not be everywhere correct (119, 120, 121, 122). Return male, C68910, was active at box 49 by April 28, box 53 by April 29, box 51 by May 13 and perhaps box 52 by May 7 when a female inspected this last box. The female did not stay there but possibly the same one, F45947, stayed at box 49 on May 12 and raised a first brood by June 24. The male had some activity at box 10, but when the young left box 49 he helped to care for them and disappeared.

*Territory No. 120.*—Male, F45994, was probably the bird at box 59 on May 3. A female came on May 18, but their first nesting was terminated when the eggs were broken on May 29. The male remained more or less around the box until June 7, but by June 2 he was also active at box 53 and later at box 52. The male formerly at these two boxes (119) was now more interested in and confined to the neighborhood of box 49. On June 4 return female, C94219, came to box 53 four days after her nest at box 80 (122) was destroyed, and on July 11 their first brood left the box. The female died accidentally in the apple orchard two days later, so the male probably cared for the young, and he left the vicinity.

*Territory No. 121.*—Male, F45763, a return nestling, came to box 49 on June 29, possibly from box 75 (115) and took possession of nearly the entire territory of the former male there (119). On this date he chased out of his territory the female from box 53 (120) who was going into the flower garden for food for her young. However, on July 7 he paid no attention to that same female in his territory, as he was then trying to get a mate of his own at box 49. Female, F45947, returned to box 49, 11 days after the young of her first brood had left this same box (119). Her second brood left August 12, and the male accidentally drowned in a bucket of water at the farm-house on the same day.

*Territory No. 122.*—Return male, C68252, came to boxes 80 and 80A by April 28 and had a female inspect his two boxes on May 3, but she did not stay. On May 13 a return female, C94219, accepted box 80. Her eggs were destroyed on May 31 and she left. The male then turned to box 80A for his activity but left on June 2 or soon after. With the male in territory 120 withdrawing from box 59 to become active at box 53, male, C68252, reappeared at box 59 by June 18 and had a female the next day. Their nesting was interrupted on the 23rd. This same or another female tried again on June 30, but again the eggs were deserted on July 22. The male had expanded his territory to include the vacated box 53 on July 14, three days after the male there had left with young. On July 9 a banded male, possibly this one, visited box 3A but did not stay. On July 28 a female inspected box 59, but the male attempted no further nesting.

*Territory No. 123.*—The male here was never banded but was at boxes 10 and 3A by May 31 and box 3 by June 6. A female inspected his box 10 on June 9 but did not stay. He obtained a female at box 3A on June 20, but she died with the 5th egg in her oviduct on June 30. By July 5 he left boxes 3A and 3, and on July 6 returned to box 10 where since June 9 males from boxes 25 and 49 had been briefly active (117, 119). On July 15 a female may have visited him but did not stay, and he remained active only until the 23rd.

*Territory No. 124.*—Return male, B97203, came to box 74 by April 28, and a female was here on May 5. The female flew towards territory No. 122, and there was some strife in song between the two males for the female and territory. Possibly this female was the one that inspected boxes 80 and 80A on May 3 and perhaps the same one that stayed there May 13. On May 16, the male had return female, B5640, at box 74, and their first brood flew June 23. The male aided in caring for young out of the box. He returned to activity at the box on July 1 but then disappeared. A silent male was seen near the box on July 13.

### 1933 (Figs. 19, 20)

*Territory No. 125.*—Male, H18577, became active around boxes 59 and 63 late in April and early in May. On May 24 a female arrived at box 63 and laid 6 eggs but deserted them for some unknown cause on June 1. On this date the male was caught in a mammal cage nearby—did this disturb the female? This male then transferred to box 3A where the 4th attempt of a sparrow to nest had been destroyed. On June 8 the male was back with a female, H18581, at box 59, which female may have been the one that deserted box 63. Their first brood left the box July 17. There was little further activity in the territory. The male may have moved across Mayfield Road.

*Territory No. 126.*—Male, H18580, with female, H18583, came to box 10 by May 20. After the female was well established here, the male spent considerable time in early June at boxes 3 and 3A. On June 20 when this male was away, the male from territory No. 127 looked into box 10 and was driven away by the female. On June 22 the female deserted, possibly because of neglect by the male. The male came back to the box on this date after the female left, but it was too late. He remained on his territory until about the middle of July.

*Territory No. 127.*—Male, H18600, came to box 11 by May 20, possibly driving out the male from territory No. 128, formerly active near here, as that male then had a female starting to nest at box 25. A female was also at box 11 on the same date but left on May 23, when her first egg was accidentally broken. Perhaps she was F58955, return nestling, who came back to the box on May 29. Their first brood left on July 8. The male was more or less active in the territory and at box 6 until late in July but had no second brood. Probably he did not help much with the young out of the nest as he was at box 6 most of the time.

*Territory No. 128.*—Male, H18582, was active at box 25 on April 27, and in early May extended his territory to include box 11. However, on May 12 he had a return female, F45942, at box 25 and later allowed another male to supplant him

at box 11 (127). Their young left June 23. He probably helped to care for them, although he again became active at boxes 25 and 26 on June 29, and on July 14 had a female visit box 25 in the morning and box 26 in the afternoon without staying at either. The male remained around only a few days longer.

*Territory No. 129.*—Return male, C68910, was singing near the laundry and in front of the laboratory and active at boxes 21A and 49 during the latter half of April, first on April 14. On April 29 female, H18566, arrived and under the male's supervision inspected box 21A at 7:15 A.M., then box 21, and at 7:30 A.M. came to box 49 where she was more satisfied. She was trapped there on May 2 and deserted. When recaptured on June 13 (130), her right leg was noticed to have been broken at some time previous but was then healed. Did this occur on May 2? On May 1 the male drove off a male introduced into his territory from another estate. On May 2, when the female deserted, the male began some activity at boxes 51 and 53 as well as at box 49, but later gave up box 21 and 21A as another male took possession there (130). On May 6 a return female, probably F58248, was seen near but not at box 49. On May 20 she started her nest-lining in the box. Then the male ceased activity at boxes 51 and 53 and confined himself pretty largely here. By June 15, however, he was active as far east as the spring ponds. On June 24, while the male in territory No. 130 was busy with a female at box 92, male, C68910, was able to extend his territory into the maple grove. The young left box 49 on June 27. The male did not take much care of the young, as he was apparently the bird active at box 51 beginning June 27, and on June 30 he was at box 49. On July 1 he and an inspecting female were at box 53, but she did not stay. The male remained active at boxes 53 and 49 until the 5th, then was mostly inactive until the 9th when he returned to box 53. Female, H18820, came to that box on July 10 from an outlying estate where her young had flown about 12 days before. On the 15th the first egg was found to have been thrown out, possibly due to its being numbered. The nest was not deserted, and the young flew August 11. Possibly, but not certainly, this male was also the mate of the female that came to box 51 also on July 10 and laid 5 eggs before desertion. Perhaps the female here was the old one from box 49, as on July 12 she was captured at a banding station on the lawn east of the main house. She then was 3 grams over normal weight, as if laden with eggs.

*Territory No. 130.*—Return male, F45946, was probably the one singing near box 47 during the middle of April. Sparrows took over this box from April 28 to May 5, although the male continued more or less around. When the sparrow's nest was cleaned out for the third time on the latter day, the male wren began nest-building here more energetically and continued until May 9 or later. He took over box 21A about May 14, either driving out the male from territory 129 previously here or after that male had voluntarily relinquished it for his box 49. Male, F45946, had no further activity at box 47 which had become pretty well covered with vines. On May 17 female, H18566, 15 days after deserting box 49 (129), inspected box 21A and stayed. On June 26 the first brood flew. The male probably did not aid with the young after June 19, as he was at box 92. On June 20 a female came to that box. On June 26 the first egg was laid, but the wrens were continually in conflict with robins at a nest about 10 feet away. The robins got the better of the wrens, and on June 29 the female wren was gone, although the male stayed around for part of the day. On July 3, he was back at box 21A, and on the 4th a female, the same one as was at box 92(?), inspected that box but did not stay.

*Territory No. 131.*—An unknown male was at box 80 from April 29 to May 2 but was then absent until May 12. A female came May 16, but on the 29th her six eggs were destroyed, two being found on the ground with small punctures as if made by a wren. This male's territory probably extended beyond the limits of this area. He may have been the male heard in the ice pond woods on April 28 and 29.

*Territory No. 132.*—Male, H18570, was at box 74 on April 30 and at box 70 on May 12. A female had her nest-lining in box 70 and had deserted by May 20. During most of June there was only mouse activity here. By May 20 the male and

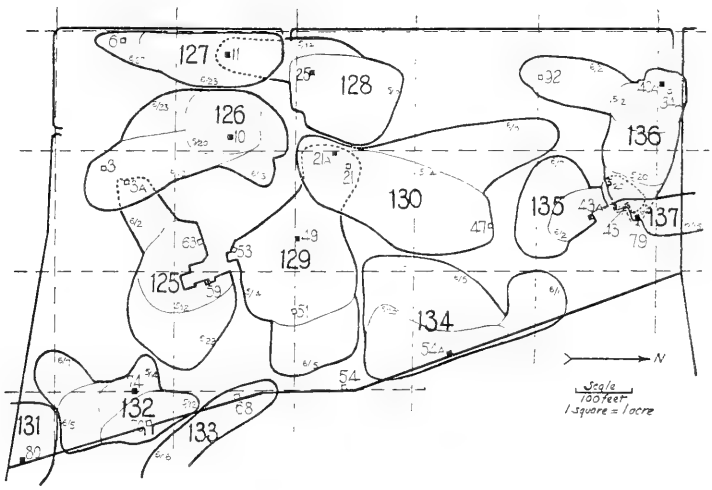


FIG. 19.—First breeding period, 1933

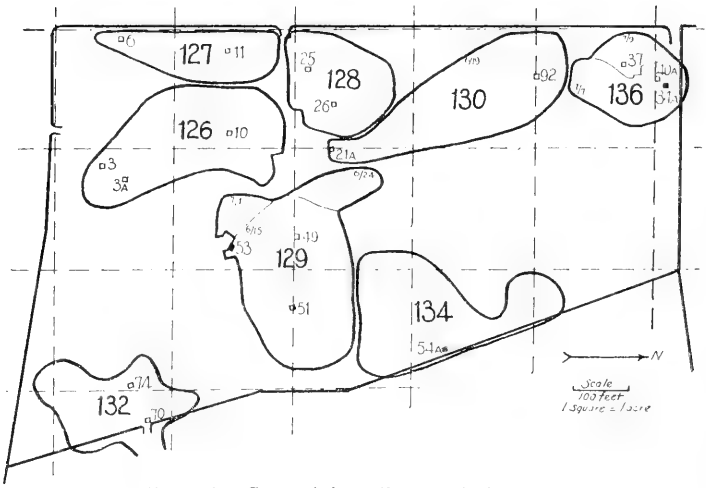


FIG. 20.—Second breeding period, 1933

perhaps the same female, F58493, return nestling, were at box 74. Their young were killed on June 24 by a small mammal. During the first week of June, the first week of incubation, the male's activity increased and he expanded his territory to the south. After the young were killed at box 74 he removed the lining on June 25 and 26, but was no longer active there. During the middle of July he may have had some activity at box 70 after the mouse had left and possibly also at box 72 in the ice pond woods, but no second brood was attempted.

*Territory No. 133.*—Male, H18588, was at box 72 in the ice pond woods on May 12 but later shifted to a natural cavity (Nest 169) and had a female with eggs on June 7. On June 15 the 5 young were found dead at 8:30 A.M. and the nest deserted. At 4:40 P.M. the male was captured at box 72A also in the ice pond woods. From June 16 to 19 this male was active at box 68 and perhaps even had a female starting to line a nest, but nothing came of it. By June 29 the male was on a neighboring estate across Mayfield Road where he had a second brood. The young there either left early or were killed, as one dead bird was found left in the nest on the 13th day after hatching.

*Territory No. 134.*—Return male, F45987, was at box 54A probably by May 12, and female, H18587, was there by May 20. On June 15 the young were killed and thrown out apparently by a killer wren (137) just before 8:30 A.M. I watched the unknown killer here from 8:30 to 10:00 A.M. and during this period he was chased three times by F45987. The killer was the more timid of the two and entirely quiet, while F45987 was pugnacious, chasing the killer, chasing another wren (female from box 49 (129)?), and visiting a nearby martin house. Later this pair of birds had the first egg of another set on June 23, and the young left on July 27.

*Territory No. 135.*—Male, L24102, was at box 43 by May 20, and at box 43A by May 29, possibly being forced out of box 43 previous to the 24th by the male in territory 136. Female, L24101, came to box 43A on June 2, and their young left July 7. There was no further activity here.

*Territory No. 136.*—Return male, F58648, was at box 40A on May 9 or earlier, and female, H18900, was here by May 16. This female had been brought in from an outlying estate and released at the laboratory on May 1. The young left on June 21, and there was no further activity at this box. During the incubation period this male wandered to box 34A by May 20, box 43 by May 24, box 92 by June 2, and box 79 by June 5. At box 43 female, H18584, arrived May 24, so that this male was polygynous. Probably he did not aid much in caring for the young in either of his two nests. Before 8:30 A.M. on June 15 the young in box 43 were found destroyed, probably by the killer male of territory 137. Male, F58648, had no further activity here. On June 29 he had his former female, H18900, at box 34A, 8 days after their first brood flew, and their second brood left August 5. The activity at box 37 on July 8 and 9 may have been by this bird and possibly also the July 3rd visit to box 92.

*Territory No. 137.*—Male, H18586, may have been a killer. The history of his activities, if they were all his, is here pieced together from scattered scraps of information and with some freedom of interpretation. Possibly there were two or more killers involved, but the facts can be explained by the activities of one bird alone. Possibly H18586 arrived in the region before May 5 but did not establish a territory. This was a peak year of wren abundance with 13 other first broods attempted and 12 territories established and with 3 pairs of bluebirds being present as well as sparrows and mice. Perhaps there was not room for another territory, and the activities of this bird may be explained by his attempt to make room. On May 5 the bluebird eggs in box 54 were destroyed, apparently by some bird. On May 29 the eggs at box 80 (131) were destroyed by a small bird. On June 1 the female bluebird was killed at box 68 and her eggs destroyed. From June 1 to 9 a new wren, probably this bird, was active at box 68 but then disappeared, apparently unable to establish a territory in competition with males in territories 129 and 132 and possibly 134 besides the male bluebird himself. On June 15 or late on

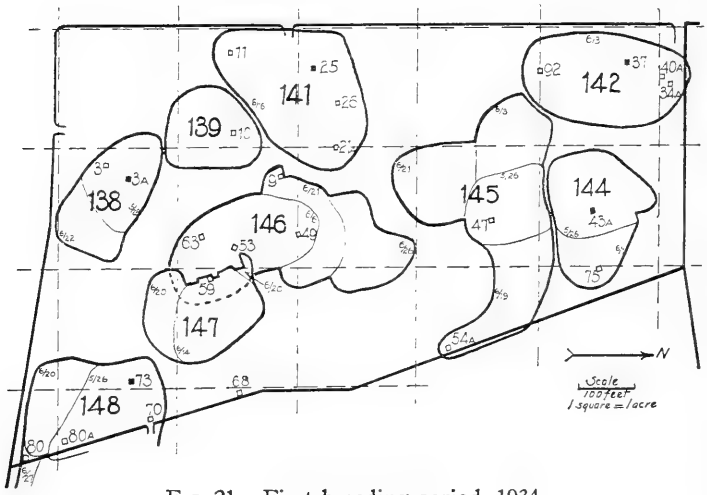


FIG. 21.—First breeding period, 1934

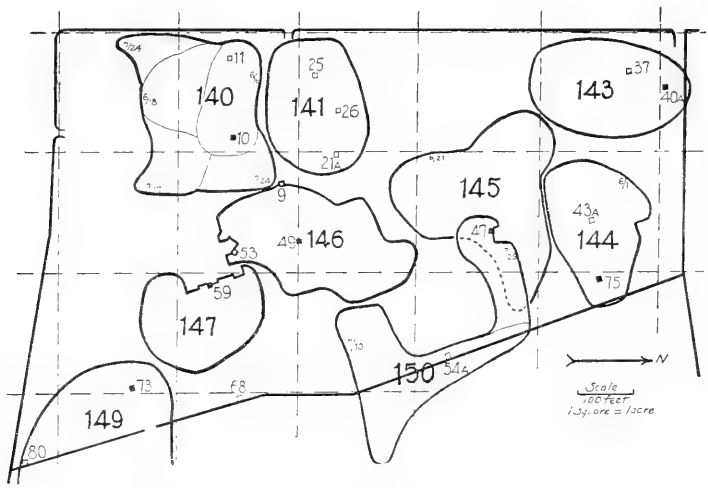


FIG. 22.—Second breeding period, 1934

June 14 he (?) ran rampant. The young at nest 169 (133) in the ice pond woods, at box 54A (136), and at box 43 (134) were destroyed before 8:30 A.M. I saw the intruding male at box 54A at 8:30 A.M. and even returned a couple of the young, still warm and alive, to the box, although they did not live. From 8:30 to 10:00 A.M. there was fighting between the two males here. At 11:00 A.M. I caught and banded this new male, who I believe was the killer, at box 79. He was one gram underweight. Was there a condition of hyperthyroidism in this bird? An unknown female came to him on June 18 but deserted her 5 eggs on the 26th, probably due to excessive heat at the box which was exposed to the sun. A male was singing here on July 6, but there is no other record of this bird.

**1934 (Figs. 21, 22)**

*Territory No. 138.*—Return male, L24102, was at box 3A by May 17 with female, L24948, and they raised their first brood by June 22. Probably it was he at box 3 by May 25 and who about June 18 got a female there to lay 3 eggs before she deserted on June 23. Did she desert because the male left her for his first brood? The male came back to box 3 on June 26 and cleaned house. However, he must have had a large part in care of the young, as on June 28 the female went to box 59 (147). On July 4, probably now free of the care of the young, he cleaned out box 3A but then disappeared.

*Territory No. 139.*—Male, L24956, was at box 10 by May 18 but apparently deserted when caught on June 16, not having obtained a mate. The limits of his territory can only be approximated.

*Territory No. 140.*—Male, L24933, came to boxes 10 and 11 in mid-June, and had female, L24987, at box 10 by June 22. Their young flew July 26. The male had meanwhile expanded his territory in various directions and included box 6 within it.

*Territory No. 141.*—Return male, H18600, was near box 25 by May 1, singing at box 21A by May 11 and at box 26 by May 16. He had return female, L24101, at box 25 on May 16, and their brood flew June 22. On June 16 the male lost out in competition for possession of box 11 with the male in territory No. 140. He must have had a large part in care of young out of nest, since the female had simultaneously started a second nesting at box 49 (146), 2 days before the young flew. The male later returned to clean house, then transferred chiefly to box 21A, where he had been slightly active during June. Perhaps on July 9 a female inspected this box but did not stay. The male remained active until about July 10.

*Territory No. 142.*—Return male, F58648, was at box 37 by May 4, at boxes 92 and 34A by the middle of the month, and at box 40A by June 1. However, on May 18 he had female, L24950, at box 37, and their brood flew June 27. He must have accompanied them for he disappeared.

*Territory No. 143.*—A male, 34-4277, appeared quietly on June 28 at box 40A and inspected the locality. He preferred box 37 and had a female half-heartedly interested in this box from June 29 until July 11. She may or may not have been L24950 who was still caring for her first brood out of this box (142), but anyway L24950 came to him in earnest at box 40A on July 12, fifteen days after her young had flown, and had a second brood leave August 15. The limits of his territory approximated those of territory No. 142.

*Territory No. 144.*—Return male, F45987, had female, L24955, at box 43A on May 18, and their young flew June 25. This male had added box 75 to his territory by June 1. On June 22 his female, L24955, came to him there although her first brood at box 43A did not fly for another 3 days. Her first egg was laid June 26. It is uncertain whether the female deserted box 43A when captured June 15; more probably it was a case with her of multiple nesting, with the male also interested in both nests. The male cleaned out box 43A June 28 to 30. Their second brood flew from box 75 on July 29.

*Territory No. 145.*—Box 47 was down and not replaced until May 18. A male was here by May 26 and at box 54A in early June but did not have a female inspecting until June 22 and 23. Female, 34-3509, whose young left a nest on a neighboring estate 10 days before, came to box 47 to stay June 27. The male was accidentally killed July 19 and the nest, being undefended, had the young killed on July 25, probably by the male from territory No. 150 who then became active here.

*Territory No. 146.*—Male, L24996, was more or less active at boxes 53, 59, and 63 during May but had largely shifted activities to box 49 by June 6. On June 11 and again on June 14 a female inspected box 49 but did not stay. On June 20, return female, L24101, came to this box, although her first egg was not laid until June 26. She was from box 25 (141) where her young did not fly until June 22, and she was noted caring for them on the 23rd. Perhaps this explains the long interval before her first egg was laid. Their young left box 49 on August 1.

*Territory No. 147.*—Male, L24954, was active at box 59 and visited box 63 during May, but during June he was mostly at box 59, displacing the male in territory No. 146. After the bluebirds deserted box 68 June 22 he attempted to add this box to his territory, but a red squirrel had taken it over by June 30. A female visited him at box 59 on June 15 but had left by the 22nd. Female, L24948, from territory No. 138 had been caught near the box on June 12 and came to him June 28, only 6 days after her first brood at box 3A had left, and they raised a second brood successfully.

*Territory No. 148.*—Male, L24946, was at box 73 by May 11, boxes 70 and 72 in the ice pond woods by May 18, box 80A by May 23. Female, L24944, was caught at a banding station in the old tennis court on May 19 and was at box 73, 2 or 3 days later. Her brood flew June 29. When the male was captured at this box June 14 he deserted, had some activity at box 80, then went across Mayfield Road and got female, 34-3502, there by June 25 and raised another brood.

*Territory No. 149.*—An unidentified male and female had a natural nest in the ice pond woods, and the male had probably been there since May 4 when he inspected box 72, but both deserted when the natural nest was transferred to a box on June 14. It is possible that the female was the one that inspected box 49 (146) the same day and on June 22 started a brood at box 10, being L24987 (140). The male is believed to have been at box 80 by June 27 and to have transferred to box 73 when female, L24944, came back about July 10, 11 days after her first brood had flown from here (148). The male had deserted by August 4 before he could be caught, but the brood left August 13 or 14. The territorial limits can only be approximated.

*Territory No. 150.*—Male, L24949, was at box 91 in the thick woods to the north of the barn by May 18 with female, L24951, and their young flew about June 24. This is not the best wren habitat. Five or more days before the young left, the male was at box 54A and came here for serious activity July 10-19 but did not get a mate. On July 25 the unprotected young at box 47, where that male had died (145), were found killed, probably by this male, L24949, as he then cleaned house and became active here. He disappeared near the end of the month.

### 1935 (Figs. 23, 24)

*Territory No. 151.*—Male, 34-86035, came to box 3 by May 13 along with a female. However, when she laid her third egg she deserted for some unknown reason. Female, 34-86036 (the same one?), was here by May 28. Two of their young left July 3 and probably the male cared for them. The rest left July 6. The male was more or less active around box 3 throughout July but did not remate. Sparrows occupied box 3A until their nest was removed on May 22, and during the middle of June a mouse was here, but from the end of June through July the male wren was active here.

*Territory No. 152.*—Male, 34-4239, came to boxes 10 and 11 by June 13 and stayed through July without getting a mate, although a female was with him at box 10 July 4-7 but left before she laid any eggs.

*Territory No. 153.*—Return male, L24956, came to boxes 25 and 21A by May 13. Return female, L24101, inspected box 21A on this date, was caught, and did not stay. She next showed up at box 25 by May 17, and her young left there June 25. During June the male was active in the maple grove, extending his territory even as far as box 92, although he did not prevent the male from territory 155 taking over that box on June 26. His female was caught on June 15 and deserted to appear at box 49 (160) two days later. The male was therefore forced to care for the young both before and after leaving the box. A new male had already become established at box 21A by June 13 (154), and on June 26 and 27, the two days after the young left box 25, there was intense competition in song for possession of the territory between the males from territories 152, 153, and 154, with the male of territory No. 154 winning out. By July 7 the young, then 12 days out of the nest, were independent and the male reappeared at box 92 with return female, 34-4201, whose young had left a box on a neighboring estate 11 days before. The male of territory No. 155 who was here for some days before was no longer active and did not offer much competition. The male became interested on July 25 in box 34 but deserted soon after August 1 when caught at box 92. The female brought off her brood successfully.

*Territory No. 154.*—Male, 34-86085, showed up at box 21A by June 13 with a female although she did not stay. Female, 34-86072, came to him on June 22, but her young were killed by a milk snake on July 22 and there was no further activity at this box. On June 25, the male of territory 153, who was caring for his young alone, had them leave the nest, and then for the next two days 34-86085 entered into a keen song and chasing competition against the males of territories 152 and 153 for the possession of box 25 and won out. By July 4 he obtained female, 34-4445, at box 25, whose young had left box 47 (159) nine days before. His activity at box 21A largely ceased except for occasional feeding of the young. By July 16 he added box 26 to his territory. On July 29 the female caught at box 25 deserted and on the 31st the male caught, deserted likewise, so the young had to be transferred to another box to keep them alive.

*Territory No. 155.*—Male, 34-86015, was at box 40A on May 13 and box 37 on May 17. On this latter date female, 34-86014, appeared and chose box 40A where she raised a brood by June 27. This male probably aided in the care of the young out of the box, as a new male came in immediately (156) and displaced him from his territory. On June 26 and 30 it was probably he who was at box 92, on the latter date with a female, perhaps the female from box 47 (159), but they did not stay.

*Territory No. 156.*—Male, 34-86088, and the male in territory 155 were competing for box 37 on June 26 and 27. Apparently 34-86088 won, and it was probably he who cleaned the lining from box 40A on June 28 and was at box 34A June 30. This male through most of July kept some activity at his various boxes but was mostly at box 34A. Female, 34-86014, whose young had flown from box 40A (155) fourteen days before, came to him at box 34A on July 11. On July 22 half of his mate's eggs were removed from the box by an unknown agent. Could it have been the female's former mate from territory No. 155 still around? On August 5 the male was caught and soon deserted. The female raised the young by August 19.

*Territory No 157.*—Return male, F45987, was at boxes 43, 43A, and 75 by May 13. Return female, L24955, came first to box 43A on May 17 but deserted on June 1 or 2 when her set of eggs was completed. I believe this desertion was due to her bringing in so many feathers from the nearby chicken yard that they overlay and interfered with her incubating the eggs. On June 3 she was down at box 75 and raised a brood there successfully by July 11, but only after I had removed the

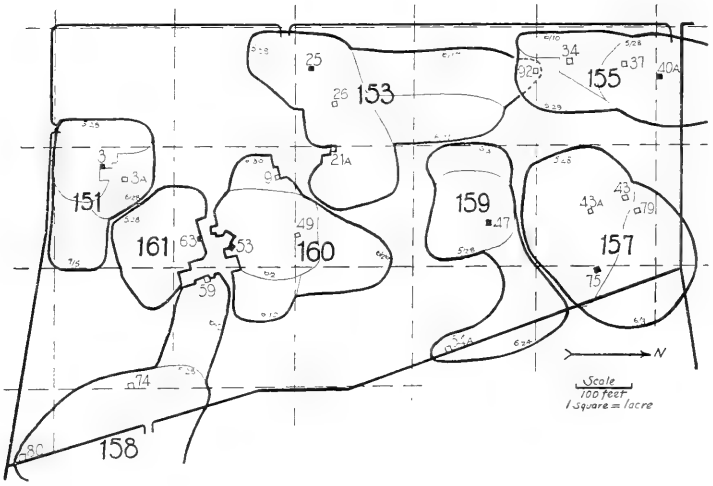


FIG. 23.—First breeding period, 1935

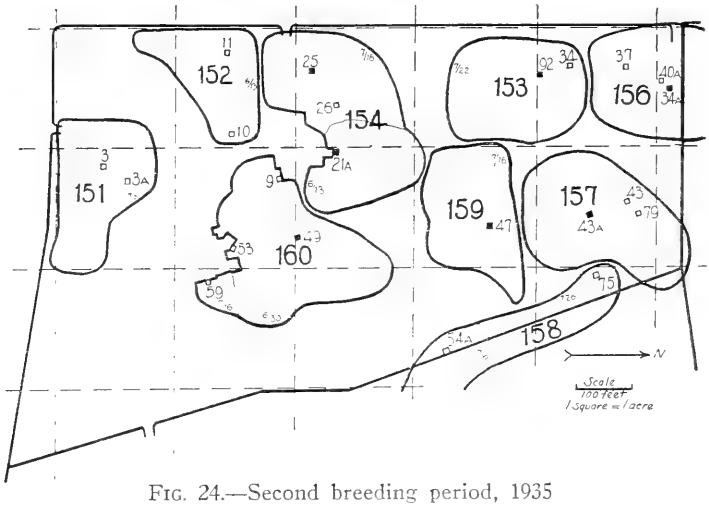


FIG. 24.—Second breeding period, 1935

excess feathers in her nest-lining as soon as the egg-set was complete. The male maintained possession of boxes 43 and 43A during June and had a female inspect box 43A on June 26. He probably did not aid very much in the care of his young out of box 75, as on July 15 he was active at box 79, and off and on during July at box 43A, and at box 43 July 18 to 24. On July 24 female, L24955, returned to him at box 43A, 13 days after her first brood had flown. She succeeded in raising a brood by August 28, not being bothered with excess feathers in her lining although there were plenty. The male deserted about August 5.

*Territory No. 158.*—This return male, L24949, was a restless one if our recognition of him through the season is correct. He was caught only once. By May 13 he had been at boxes 80 and 74. He was probably kept out of box 80 by wasps at first and later by mice. Mice also were troublesome for him at box 74. By May 17 he had replaced the mice in box 72 and was also very active at box 72A, both being boxes in the ice pond woods. On May 20 he restricted his activities largely to box 72 as a female came to him. However, on June 8 their eggs were gone and two adult mice with 4 or 5 young occupied the box. He again became active at box 80, and by June 12 he had added box 59 to his territory. By July 6 the male appeared at box 54A although still occasionally in the ice pond woods. He left here about July 16, and his final appearance was July 26 and 27 at box 75, encroaching on the territory of the male in territory No. 157.

*Territory No. 159.*—Male, 34-86013, was at box 47 by May 13 and with female, 34-4445, a return nestling, by May 17. On June 24 he was active at box 54A, but his young left box 47 successfully on June 25, the male aiding in their care. He was back at box 47 on July 1 or 2 and had a female on July 4 but not to stay for sure until July 6. Both adults left about August 1 when the eggs failed to hatch after 16 days of incubation.

*Territory No. 160.*—Return male, L24996, was at box 53 by May 13 and at box 49 by May 17. On May 24 a female came to box 49, but when on May 28 the nest was transferred to another box she deserted, probably going to box 53. However, she again deserted on June 15 or 16 as the eggs, replaced by dummies, were used in an experiment. On June 17 a female, probably L24101 who deserted box 25 (153) two days before, came to him at box 49. On June 24 she had laid 4 eggs, but around 7:00 P.M. they were all removed as if by another wren. Could it have been the male of territory 159 who on that date was searching for other boxes for activity and had been scouting down to box 54A? The female, however, spent the night in the box and laid a 5th egg the next day, a 6th egg June 26, then skipped 4 days to lay a 7th egg on June 30, an 8th on July 1, and a 9th on July 2, the last 3 eggs being recognized as from the same female by being very similar in markings and color to Nos. 5 and 6. No. 5 hatched late on July 10, No. 6 was found hatched early on the 12th, No. 7 early on the 14th, No. 8 early on the 15th, and No. 9 early in the afternoon of the same day. They all left the box July 28. The male was quite active in feeding the young, often more so than the female. He also visited boxes 53 and 9, the latter from June 30 to July 27. On July 2 a female inspected box 9 but did not stay. On July 25-27 he may have had a female with him inspecting box 59, but they did not stay.

*Territory No. 161.*—Return male, 34-4020, was at box 63 by May 17. On May 20 return female, L24944, came to box 63, and they raised their young by July 2, the male aiding in their care out of the nest. The female renested about 12 days later across Mayfield Road. The male did not renest.

### 1936 (Figs. 25, 26)

*Territory No. 162.*—Male, 35-13612, was in and out of box 3A by April 30 or May 2 and built a good stick nest soon after a sparrow's nest was removed on May 5. About May 15 he shifted his principal activity to box 3 as it was the choice of female, 35-13611, who had just arrived, even though it had a relatively poor stick nest. Their brood of young left June 21 under care of the female alone. Both

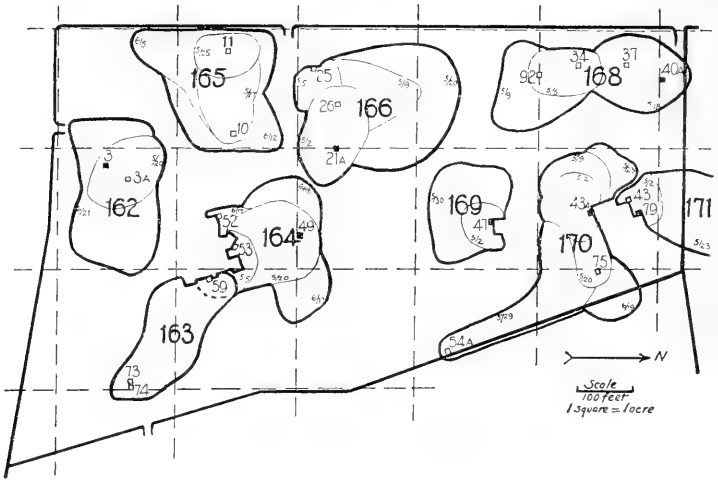


FIG. 25.—First breeding period, 1936

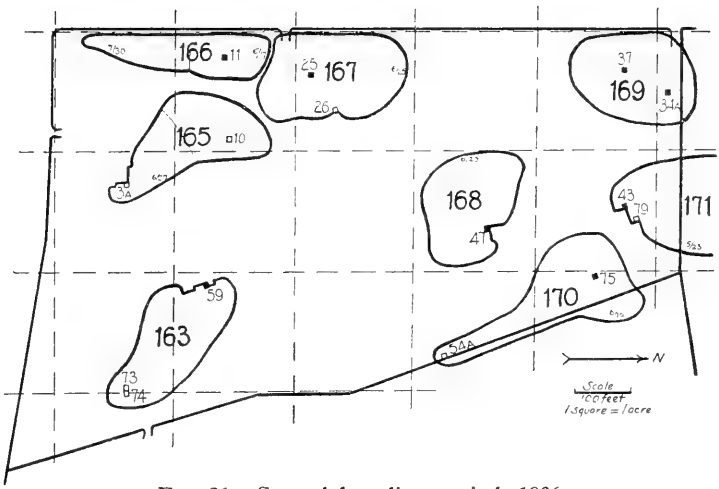


FIG. 26.—Second breeding period, 1936

adults were captured on June 21; the female persisted, but the male apparently deserted. On June 14 he was caught at box 59 where male, 35-13647 (163), had been listlessly active. Male, 35-13612, deserted this box 59 when captured and went down to the vicinity of box 73 where he had some activity carrying in spider nests and establishing a territory. However, he left the place entirely between June 21 and 24. His territory around box 3 is marked but his later wanderings are not shown.

*Territory No. 163.*—Male, 35-13647, was caught only on June 27 so he was not certainly identified through the season. However, a male was listlessly active at boxes 59, 73, and 74, especially box 59, all through the first breeding period. His lackadaisical defense of territory allowed male, 35-13612 (162), to progress through the area apparently unchallenged from June 12 to 21. However, a female, either 35-13635 or 35-13611, became established at box 59 on July 14. The eggs when due to hatch were replaced by dummies on August 1, but the hatched young birds and an unhatched egg were returned on August 2. On August 3 one adult was still around but not active at the box, and the young were dying through lack of care. This desertion of the young seems to be correlated with the poor development of reproductive vigor in the male.

*Territory No. 164.*—Male, 35-13634, was active at box 59 beginning April 30 and at box 53 beginning May 5. A female arrived at box 53 on May 14. About this time he gave up box 59, probably because he was much more interested in box 53, and another male (163) took possession there. For another box beside 53, he had by May 20 added box 49 to his territory. Due to my disturbance of the nest, the female deserted the eggs in box 53 on May 23 in the early afternoon. About 4:30 P.M. of the same day, two birds, probably this pair, were at box 49. However, female, 35-13635, did not become fully established here until May 27, so it was not certainly the same female throughout. On June 17 and 18 the first and second days after the young hatched, the male expanded his territory both to the east and west, perhaps to provide more room for finding food for young. On June 20 the female was captured and by the 26th she deserted, leaving the male to care for the young alone. The young left the box July 3. Presumably they remained under the care of the male, although he returned to boxes 49 and 52 for activity and song on July 6 and to box 49 again on the 10th and 13th, but no second breeding developed and the territory was not maintained.

*Territory No. 165.*—Bachelor return male, L24946, was first noted at box 11 May 25 and at box 10 May 27 but was possibly here earlier. He was unsuccessful in getting a female but kept adding new areas to his territory as the season progressed. On June 16 and 17 another male, presumably L24949, whose young at box 21A were just leaving (166), invaded the territory and became established at box 11. L24946 was either driven out or abandoned box 11 and became confined to box 10. Later he moved over to box 3A between June 27 and July 16, since the male there had left and was not defending that territory (162). He became quite inactive on this latter date, apparently discouraged by the lateness of the season in ever getting a mate.

*Territory No. 166.*—Return male, L24949, was active at box 21A and 26 before May 2 and at box 25 by May 4. Return female, L24101, arrived and selected box 21A by May 9. By May 20 he had extended his territory into the maple grove. Why did he not extend it southward toward the apple orchard as that seemingly is a better area and territory No. 165 was not yet established? On June 17 the young birds left the box and the male abandoned them at once. He wandered over to box 11 and succeeded in dispossessing bachelor male, L24946, of territory No. 165 who had been active there. While here, a new male (167) usurped his old territory around box 25 and separated him from the area around box 21A. On July 2 he succeeded in getting female, 35-13604, eight days after her young had left box 43A (170), and later expanded his territory to the southward. Their brood left on August 6.

*Territory No. 167.*—On June 23 male, 35-13670, became established at box 25 and two days later had a female here, 35-13671. Their brood left on July 31.

*Territory No. 168.*—Return male, 34-86105, was first active around box 34 about May 5 and visited this box or the vicinity until about June 17. He also knew of box 92 and his territory extended beyond here into the maple grove by May 9. About this time or soon after, a return female, 34-86014, arrived, and possibly guided by her he extended his territory to include box 40A where he and she raised a first brood which left the box on June 20. About June 12 he tired of his home duties and began to explore, visiting boxes 37 and 92, and possibly frightened by his capture at box 92 on June 16 wandered down to box 47 on June 29, a considerable distance away and only 4 days after the male there had completed his first breeding (169). On July 4 return female, L24951, 12 days after her first brood had flown from box 79 (171), came and, by August 8 a second brood left the box.

*Territory No. 169.*—Return male, F45987, arrived at box 47 on May 2 or before; return female, L73248, came about May 19, and by June 25 their first brood had flown. While he was helping to care for the young, the male from territory 168 preempted his old box 47, so that when he was ready to nest again he was compelled to go elsewhere. He obtained female, 34-86014, who was the former mate of the male in territory 168, and together they started a nest at box 34A on July 2. She had been seen visiting box 92 on July 1 without a male around. It would seem she had completed the care of her first brood and was looking around for a suitable nest box even in localities not in any male's active territory. Possibly her visit to box 34A on July 2 was also when this territory was unoccupied, but that male, F45987, while he was roaming with his young, saw her there or in the vicinity and was induced to start a territory to fit the occasion. This nest and young were deserted on July 23. The male here was not caught and may have been a different bird from the one at box 37, but this is doubtful. About July 8, six days after the male, F45987, got his mate at box 34A, his former female from box 47, L73248, showed up at box 37 and they raised a second brood by August 14. Thus the male was polygynous. This is an interesting case of where two males switched their territories between the first and second breeding periods.

*Territory No. 170.*—Male, 35-13603, arrived at box 43A on April 28 or May 2 and during the rest of May expanded his territory to include boxes 75 and 54A. Possibly around May 10, a female came to box 75, after a sparrow nest was removed, and put in a lining but then left. Probably the same female, 35-13604, transferred to box 43A; by May 18 nesting had begun, and on June 24 the young left the box. The male was getting restless the last week before the young at box 43A flew, and from June 17 to July 16 he was intermittently active at box 54A. On June 22, return female, L24101, was secured at box 75, and the second brood left here on August 1.

*Territory No. 171.*—Male, 34-86997, arrived at box 79 by May 2, had return female, L24951, by the 9th, and their brood flew by June 22. This male had been active at box 43 off and on since May 5, and on June 21, a day before his young flew at box 79, he obtained female, 35-13653, at box 43, and their second brood flew July 29.

**1937 (Figs. 27, 28)**

*Territory No. 172.*—Male, 36-38805, was at box 3A by May 22. A sparrow nest at this box had not been removed until May 15. He was at box 3 and may have visited box 63 by June 8 and possibly box 52 by May 24. Sparrows occupied box 52 May 30-June 4. At box 3 there was a wasp nest during May. About May 29 female, 36-38803, came to box 3A, and their young left on July 4. The male had no great activity further at boxes 3 or 3A and probably had little to do in care of the young, as on July 6 he was back at box 63 and on July 13 he was active at box 52. A strange unbanded male had been inspecting box 52 a month previously on June 8-9. On July 9 female, 36-38397, whose young had left box 59 (183) twelve days before, came to box 63. Their second brood left August 11.

*Territory No. 173.*—Male, 36-38804, was at boxes 10 and 11 by May 5. From May 15 to 30 he had a female nest-building at box 11 but not laying any eggs. They then shifted to box 10 May 30 to 31, but she would not stay. On June 1 perhaps it was this male that, disturbed by the female's leaving, removed the eggs from boxes 25B and 47 (175, 182). The male remained active most of June at boxes 10 and 11 and later at box 7. At the latter box he had a female, June 23-24, but again she did not stay, and when this male was caught at box 10 on June 24 he left the place, going across Mayfield Road where he obtained a female and raised a brood.

*Territory No. 174.*—Male, 37-93969, was at box 7 by June 22 and later at box 11. His activities became concentrated at box 10 by July 6. Here female, 36-38803, came July 14, 10 days after her young had left box 3A (172), and they raised a brood by August 18.

*Territory No. 175.*—Male, 36-38374, came to box 25B by May 11 with a female nearby. A female started nesting here May 19, but on June 1, her 5 eggs were destroyed. This was the same day that 7 eggs were destroyed at box 47, apparently by a wren. Lining was removed from box 25B by June 5. A female (from 173?) came to him at box 25 on June 10, stayed a couple of days, but then left without laying eggs. He moved to box 21A about June 19 where female, 36-38865, came on June 25, and they raised a brood by July 29. During July and August he was somewhat active also at box 23.

*Territory No. 176.*—A return nestling of two years back, male, 34-86767, came late to box 25 about June 19 as the previous male there moved to box 21A (175). He had a female at box 25 on July 2-4, but she did not stay. The male then became very active at box 92 July 5-7 as a new female appeared there, but was back again at box 26 on July 8 along with a female, probably the same one visiting earlier at box 25. On July 14 she laid an egg here and deserted. The egg was poorly formed and abnormal. Could this female be the one attempting unsuccessfully to nest previously on several occasions at boxes 10, 11, 7 (173), and 25 (175, 176)? There is no further record of her. On July 16 the egg was gone from box 26, and in a day or two the male had female, 37-93972, at box 25. Their young left on August 22.

*Territory No. 177.*—Return male, F45987, was at box 34, which had been replaced May 15, by May 19 along with female, 36-38389, and had added box 92 to his territory by May 31. When caught June 16 his leg was found broken and it was amputated. The male may have persisted around until the end of the month but was not very active. His undefended territory received visits from the male of territory 178, but the female raised her brood by June 26.

*Territory No. 178.*—Return male, L24949, was at box 37 by May 5, but a robin built on top of the box, so that the male did not become really active here until early June when the robin's nesting was over. He may have destroyed her eggs. By May 10 he had female, 36-38381, at box 40A, and their brood flew June 19. The male did not aid much in their feeding, and on June 10 when the female was scolding at the box a strange male showed up for a moment, then disappeared. He may have been a non-breeder momentarily interested. After the young left, male, L24949, removed the lining from the box on June 21 and then shifted to box 37. A female visited him there June 23. For the next two or three evenings, but not much during the day, a female, probably 36-38381, repeatedly visited him at the box but not to start nesting until June 26, only 7 days after her young had left box 40A. After getting his former female re-established at box 37 he became active at box 34 on July 3, since the male there was one-legged and mostly inactive (177). On July 5 there was competition in song for possession of boxes 34 and 92 and surrounding territory between this male, the old one-legged bird from territory 177, the male from territory 176, and a new one. L24949 had won out at box 34 by the next day, and the new male at box 92 (179). On July 7 the female, who may have incited the rivalry on the 5th, appeared early in the morning at box 92 and then shifted to box

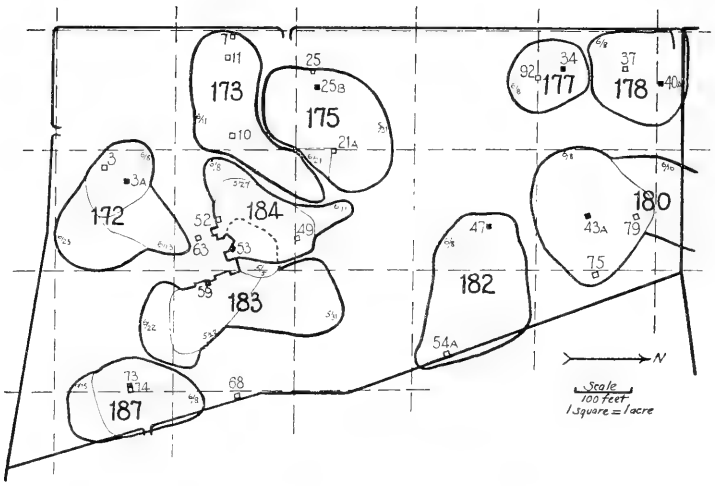


FIG. 27.—First breeding period, 1937

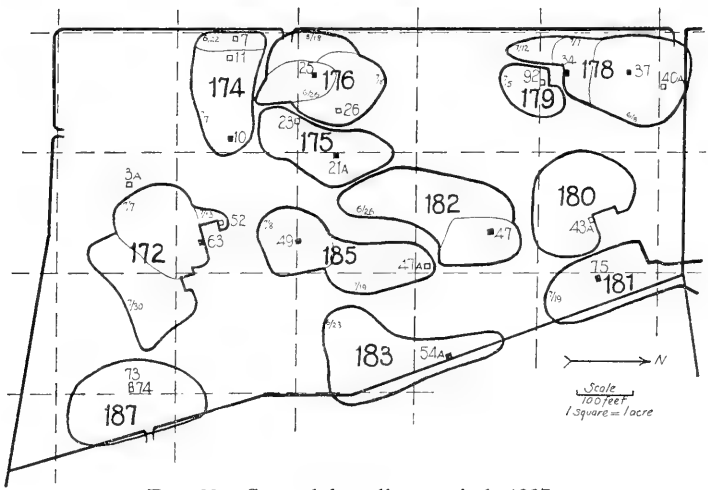


FIG. 28.—Second breeding period, 1937

34. She was 36-38389, the female formerly at box 34 (177), whose young had left 11 days before. She started a second brood that left August 12. This male then was polygynous but did not help the box 34 female much, although he would come around when she scolded. By August 1 the box 37 female had deserted for unknown cause and he had to care for the young there alone. The young flew August 4.

*Territory No. 179.*—An unidentified male succeeded in establishing a territory around box 92 beginning July 5, after severe competition with the males of territories 176, 177, and 178. A female inspected box 92 on July 7 but then moved over to box 34 in territory 178. The male remained around during July but did not find a mate. His territory is only approximately indicated.

*Territory No. 180.*—Return male, 35-13603, was at boxes 43A and 79 by May 5. Return female, L24951, was at box 79 on May 11 but left after being caught. She reappeared at box 43A on May 17, and their brood left June 25. The male had added box 75 to his territory by late May and was more or less active here until early July. Through July he was mostly around box 43A as a new male occupied box 75. About July 26 a female came to box 43A but laid only 2 eggs and deserted before August 8.

*Territory No. 181.*—An unbanded male took possession of box 75 by July 19 and had female, 37-93983, by July 24. The male had deserted by August 13, and when the female was caught on this date, she also deserted, leaving the young to starve to death. His territory is only approximately indicated.

*Territory No. 182.*—Male, 36-38856, arrived at box 47 by May 5 and had obtained a female by May 15, but their eggs were destroyed June 1 by a killer wren (173). The male removed the old nest-lining by June 3 and then became active at box 54A, June 8-13, where a sparrow's nest had been recently removed. By June 21 he was back at box 47 with female, 36-38040, a return nestling, and raised a brood by July 27.

*Territory No. 183.*—Male, 36-38378, was at box 53 by May 5 but when caught there on May 18 stayed away. He succeeded in getting female, 36-38397, at box 59 May 22. Their young flew June 27. The male apparently left box 59 before the young flew as he appeared at box 54A on June 23. Why did he go way off here? Did the male in territory 184 disturb him? At box 54A he had female, 35-13914, on July 7, whose first brood had left or been destroyed on an outlying estate but a few days before. They raised their brood by August 11.

*Territory No. 184.*—Return male, 34-86015, was at box 49 by May 15 and at box 53 by May 27, after the male in territory 183 had been caught there and deserted. On June 2 he obtained female, 36-38811, at box 53, and thereafter was at box 49 only infrequently, losing it entirely to a new male that came in on July 8 (185). His young at box 53 flew July 9. He disappeared then as the new male offered strong competition on July 8 and drove him out. His resistance was probably weakened by his care of young.

*Territory No. 185.*—Male, 35-13912, had a first brood to leave a box on a neighboring estate near the end of June and for some reason transferred over here to box 49 on July 8. He wrested this box from the male of territory 184 who was then busy caring for his young which were on the point of leaving the box. He obtained female, 36-38390, also on July 8, ten days after her young had left box 73 (187), and they raised their young to fly by August 12. He had some activity at box 47A by July 19.

*Territory No. 186.*—Male, 35-13700, was at box 72A in the ice pond woods with female, 36-38388, by May 14, and their young flew June 22. He was also at box 72 near the end of May but was not active. Mice came in there June 21-30. The male went across Mayfield Road and had another female by June 13, and this female raised a brood. Female, 36-38388, also went off the estate and was remated about

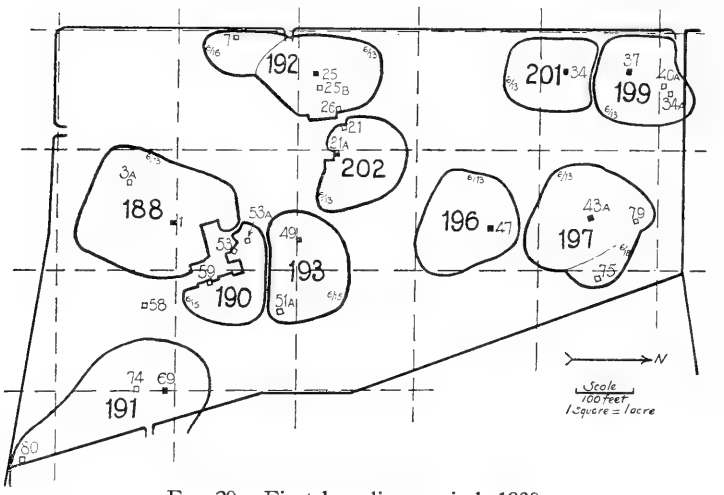


FIG. 29.—First breeding period, 1938

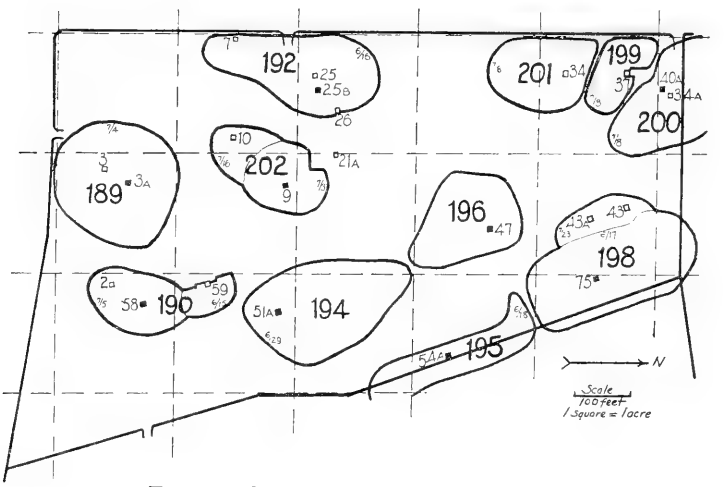


FIG. 30.—Second breeding period, 1938

June 23. It is uncertain which adult cared for the brood of young from box 72A or whether it was destroyed. The territory is not shown.

*Territory No. 187.*—Male, 36-38375, was at box 74 by May 11 and transferred to box 73 on May 17 when female, 36-38390, chose this box. Their brood left June 28. The male had expanded his territory in the direction of box 68 by June 1, although not active at the box itself. After the young left box 73 he was back at box 74 by July 6. He remained around until about July 17, and it may have been he with a female that was around the box in the early morning of August 4.

**1938 (Figs. 29, 30)**

*Territory No. 188.*—Male, 38-1640, and female, 38-1610, came to boxes 1 and 3A by May 11 and raised a first brood at box 1 by June 20. After the young left, the male was active on June 22 and 23 at box 3A, but that is the last record of him.

*Territory No. 189.*—Male, 36-38429, came to box 3 by June 27 and on July 4 went to box 3A. He had little trouble establishing a territory around these boxes as the male in territory 188 had left. Female, 36-38428, arrived at box 3A on July 6, and they raised a brood.

*Territory No. 190.*—A male, probably 38-1655 throughout, started activities and nest-building at box 58 May 11-18, but was displaced here by bluebirds who successfully raised a brood using the wren's nest instead of one of their own. The male then became active at box 53, May 27 to June 17, where a female visited him on June 13 but did not stay, at box 53A on June 8-15, and at box 59 June 8-28. The bluebird's brood left box 58 on June 28, and the male wren returned here the next day. On June 30, the following day, female, 38-1610, whose first brood left box 1 (188) 10 days before, arrived, and they raised a brood that left on August 4. On July 5-7 while the female was laying eggs, the male had some activity also at box 2.

*Territory No. 191.*—Wren activity had already started at box 69 by May 4 when there was one egg present. By May 11 house sparrows had come in, destroyed the wren's nest, and started one of their own which we removed. This incident caused male, 35-13700, return adult, to scatter his activities to boxes 74 and 80. On May 28 he was back at box 69 with female, 38-1662, and they raised a first brood which left on July 5. Possibly when they were through caring for the young it was too late in the season to start a second brood.

*Territory No. 192.*—Male wren, 38-1609, had started at box 25 by May 4 and had female, 38-1608, by the 11th. Their first brood was out of the box on June 17. He may have helped to care for the young but at the same time was more or less active at boxes 26 and 25B, and had his former female restarted for a second brood at box 25B by about July 4. While actively remating and preparing for this second nesting, he probably in his excitement went to box 7 on July 4 or 5 and destroyed a new set of bluebird eggs. The wren's nesting was unsuccessfully terminated on July 25 because of interference.

*Territory No. 193.*—Male, 38-1641, started at box 49 about May 11, female, 38-1642, was here by May 18, and their first brood left the box on June 25. At box 51A bluebirds started to nest May 4-11 but were destroyed by sparrows, and the sparrows' nesting was stopped by me May 18-21. The male from box 49 was occasionally here, June 3-22, but was not seen there later. On June 27 and 28 he removed the used nest-lining from box 49 but had no further nesting activity. He probably was occupied with caring for his young out of the box, as his female, only 4 days after the young left, mated with the male in territory 194.

*Territory No. 194.*—Return male, 37-93876, appeared at box 51A about June 29, and either the male in territory 193 had gone to care for his young or he easily succumbed, as the new bird quickly carved out a territory of his own. He obtained female, 38-1642, only 4 days after her young had left box 49 (193), and their brood left the box on August 3.

*Territory No. 195.*—From May 4 to June 13 sparrows held box 54A but then the female sparrow and nest was destroyed by me. On June 18, male wren, 36-38427, appeared. From June 24 to July 2 the male successfully withstood persistent competition for the box with a male bluebird, and on the latter date female wren, 36-38426, started here, and they raised a brood that left on August 4.

*Territory No. 196.*—On May 4, male wren, 36-38856, came to box 47 and on May 11 female, 36-38040, was also here, both birds having been mated together for a brood last year at this same box. The young left on June 16, the lining was removed June 21-22, and a second brood started June 29, but it did not turn out successfully.

*Territory No. 197.*—An old male from 1935, 1936, and 1937, No. 34-86015, started at box 43A on May 4, got a female, 38-1607, by May 11, and raised a brood by June 17. He was also somewhat active at box 79 from May 4 to 18 and at box 75 from May 27 to June 8 after a sparrow's nest was removed. He disappeared at the end of the first breeding period.

*Territory No. 198.*—From June 14 on, male, 38-1684, came to box 75, and while the male of territory 197 was partially occupied with the young from box 43A, successfully wrested away this box and territory. On June 24 he even secured female, 38-1607, formerly of territory 197 and whose first brood left 7 days before. They raised a second brood to leave on July 30. During July and early August male, 38-1684, expanded his territory to include boxes 43A and 43, and on August 4 a female wren visited him at box 43A.

*Territory No. 199.*—Male, 38-1654, was active at box 37 on May 4, and a last year's female, 36-38389, came here on May 19. They raised a first brood to leave on June 24. During May, but not during June, this male was also somewhat active at boxes 40A and 34A. After the young left box 37, there was little activity in the territory until July 5 when male wren, 34-86997 (200), an old bird from 1936, came in and carved out a territory around boxes 34A and 40A. The competition in singing was intense, at least from July 8 on, between this new bird, 38-1654, and also the one in territory 201. No. 38-1654 pulled out the old lining in box 37 and was more or less active until August 2 without success in getting a new mate.

*Territory No. 200.*—Male, 34-86997, came to box 40A in territory 199 on July 5 and successfully carved out a territory of his own. He did not meet much competition until July 8, the day after he obtained female, 36-38389, of box 37 (199) who had young out of the box 14 days before, as the male was busy caring for his young. Their brood left on August 11.

*Territory No. 201.*—An old male wren, 35-13603, from 1936 and 1937 came to box 34 on May 4. An old female from 1937, 36-38811, came here on May 11 and had a first brood leave the box on June 17. On June 27 the male was back, tearing out the old nest-lining. On the 28th his former female returned and on July 8 had laid 4 eggs. On July 9 these eggs were gone. This was the period beginning on July 8 when the arrival of the new male at box 40A caused intense feeling and competition between the males in territories 199, 200, and 201. Either in his excitement male, 35-13603, destroyed his own mate's eggs or he allowed one of the other of the two males to come in and do so. Probably the first is true, as the other males appeared confined to the vicinity of their own boxes. In that case, it is an interesting setback to an earlier phase of the nesting behavior pattern. The female left and went to box 9 in territory 202, while the male remained partially active in his territory until at least July 26.

*Territory No. 202.*—Male wren, probably 38-1681 throughout, started at box 21, May 11, and showed some activity, beginning May 18, at box 21A. About May 22, female, 38-1611, came to box 21A, and by July 11 their brood was raised. From May 18 to June 12 there was some activity at box 9, but it is uncertain whether of this male or the one from territory 193. However, on July 2 or 3 male, 38-1681, deserted the female with young at box 21A and became active at box 9. He had a

good male nest. On July 3 he was visited by a female wren who did not stay. This may have been female, 36-38811, who had started to nest for the second time at box 34 in territory 201, but was apparently away from there for a couple of days just about this time. Anyway female, 36-38811, returned to box 34 and laid 4 eggs by June 8 when some territory strife set in and her eggs were destroyed. Due to lay her 5th egg on July 9 she returned to do so in the male's nest at box 9, even though this nest was without lining and presumably this male had not fertilized the eggs (or had he?). This egg was gone on July 10, however, probably destroyed in the process of the female's carrying of nest-lining into the box. The identity of this female was recognized from the sequence in egg weights and colors. On July 13 to 15 she laid 3 eggs, this time probably fertilized by male, 38-1681, but thereupon she deserted for unknown reasons. The male wren transferred his activity to box 10 until caught there on July 19, whereafter he returned to box 9 until late in the month.

**1939 (Figs. 31, 32)**

*Territory No. 203.*—Male, 36-38466, arrived June 21 at box 1. Sparrows had nested here previous to June 10, and the male was mostly kept away from box 3A by sparrows nesting nearby. On June 23 the male was observed silently to inspect box 9 outside his territorial limits, then fly down to box 49 where he was chased back to box 1 by the male in territory 208 who had a first brood there. Female, 36-38465, was first observed at box 1 on June 27. Their young left August 5. The maps of this territory show how additional areas are added with time to an originally small territory. After the young left box 49 (208), the male added this area to his territory, and on July 26-28 successfully defended it against the male of that territory who returned from caring for his young.

*Territory No. 204.*—Male, 36-38461, was at box 10 by June 10 and female, 38-1607, a return from the year before, came about June 21. Their territory extended to the southwest in the only free area. Their young left July 27.

*Territory No. 205.*—Male, 36-38427, a return from last year, came to box 11 between June 10 and 14, and since the surrounding area was largely occupied had to squeeze in his territory along the western fringe. Female, 36-38462, came June 21, and their brood left July 29.

*Territory No. 206.*—Male, 36-38456, and female, 36-38452, started nesting at box 23 about May 21. Their young left June 27. The male was at box 21A before June 10 but not seriously until the 25th. He probably did not care for his young out of box 23 after one or two days, as a new male appeared who by persistent singing established territory 207. Male, 36-38456, defended his possessions to the extent of getting established at box 21A by June 30. On July 4 he went down to box 49 investigating, but was chased back. On July 6, an unbanded female came, for the next 2-3 days inserted lining into box 21A, but did not stay. By at least July 11, female, 36-38459, was here, 6 days after her young had left box 47 (211) being cared for by that male. Their brood left August 12.

*Territory No. 207.*—Male, 36-38467, appeared first on June 29 at box 23 where he was chased away by the male in territory 206. However, he returned and by vigorous singing established himself a territory centering at box 25. On July 8 female, 36-38452, whose first brood at box 23 (206) left 11 days before, came to him instead of to her former mate already mated at box 21A, and their brood left August 11.

*Territory No. 208.*—Male, 36-38429, a return from last year, was with female, 36-38426, also a return, at box 49 about June 4 and they raised a brood by July 10. He apparently flirted with another female at the same time as she laid one egg in box 53 by June 10 and then deserted. On the 16th, she again appeared, starting a new lining in box 53A but not proceeding further with it. On the 16th the male competed in song with the male in territory 210 on the front lawn and later with the male from territory 203 at box 59 but gave up box 59 to that male.

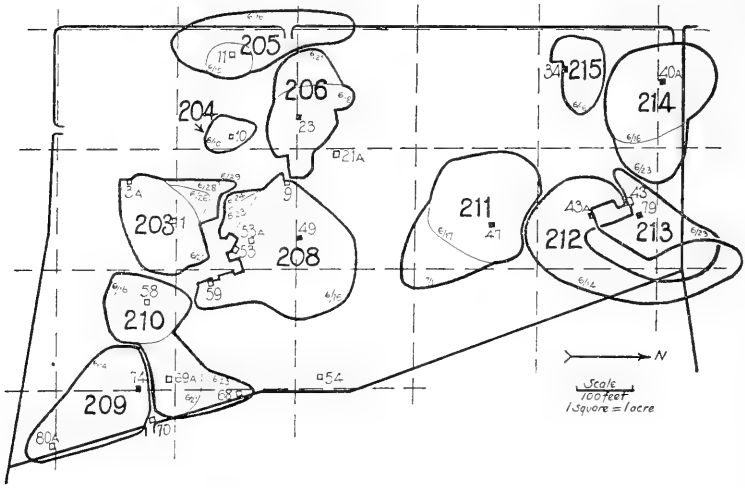


FIG. 31.—First breeding period, 1939

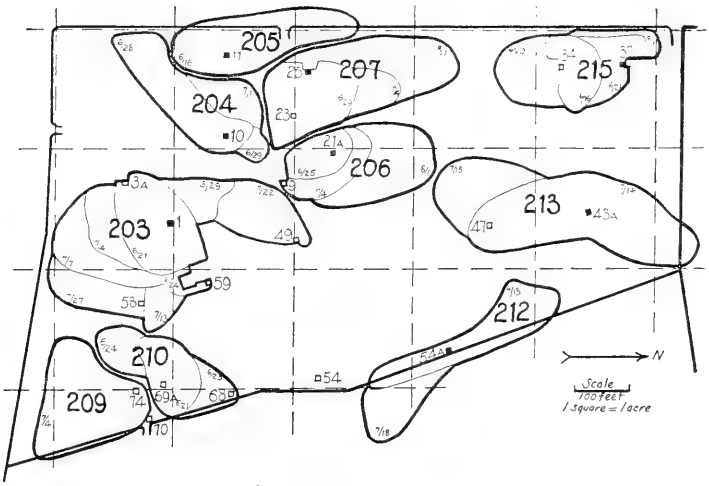


FIG. 32.—Second breeding period, 1939

On July 4 he chased away the male of territory 206 from his box 49. The female at this time was going a considerable way to the east outside of his territory for food for young. On July 10 the young left with the male caring for part of them. July 26-28 it was probably he who returned to box 49 but was driven away by the male of territory 203 who had expanded his territory in this direction. Then the male disappeared.

*Territory No. 209.*—Male, 36-38454, was active at boxes 74 and 80A during May. About May 17 female, 36-38453, came to box 74, and their brood flew June 22. Queer happenings occurred around this box. On June 13, the male was observed to chase up into the rose garden two other wrens, one a red-banded male, the other unbanded and probably from territory 210. The next day and again on June 18 he was observed to chase away a wren, probably in both instances the unbanded male from territory 210. Almost three weeks later, on July 4, a red-banded quiet male, appeared at box 74, possibly with a female, and inspected the box. No. 36-38454 acted toward it in an excited manner as if it were a female. Then on July 8, these two red-banded males, the box 74 male singing excitedly, the strange male quiet, inspected boxes 68, 70, 74, and 54 with boxes 68, 70, and 54 being outside of 36-38454's territory. There was no chasing and 36-38454 acted toward the other as if it were a female. Could this have been a male looking for a place or an opportunity to begin establishing a territory? Perhaps until he finds a place that is suitable, a male does not advertise his scouting expenditions by song, and other males react toward him as a female? Could some of these other inspections of boxes generally considered to be by females sometimes be actually males looking for territories? This box 74 male had cleaned house July 3 and was occasionally active around his boxes, but since his female deserted about June 21 he had to divide his time with caring for young. By August 3 he had ceased activity in the territory.

*Territory No. 210.*—An unidentified unbanded male was at box 58 by June 10 or soon after. He was bothered by bluebirds at a nearby box who had formerly nested at box 58. He may have been around box 74 from June 13 to 18 (209). He was at this time also becoming active at box 69A. Sparrows were starting a set of eggs here. I removed them on June 19, and the sparrows started to rebuild. On the 20th the wren was observed rearranging this sparrow nesting material to his own needs and on the following day was adding sticks. On June 21 the female at box 74 had lost interest in feeding the young there and came around boxes 58 and 69A apparently interested in these boxes and this male. At box 69A she was driven away by sparrows, especially by the female sparrow, who had started to build again. The male wren was obviously disturbed by sparrows building here but did not chase them. He once went into the box when the sparrows were away and removed a feather. The male at box 74 was busy feeding his young and did not defend his territory against the box 69A male very vigorously, although this male was enticing his female away. On June 23 the sparrows appeared to have won out at box 69A, since they had 2 eggs and the male wren had shifted activity to box 68. On June 24 this male wren recaptured box 69A and threw out the sparrow eggs, and the sparrow showed no inclination for further competition for its possession. The box 74 female visited box 69A, and the male got excited each time but he did not maintain his excitement at a high pitch for very long. The female seemed not able to respond sufficiently to start nesting. On July 25 the pair were found in an orchard east of the old tennis court. On my squeaking the male got excited and attempted copulation with the female but unsuccessfully. The female seemed not to have sufficient sexual vigor to accept copulation. By July 29 the male was still seen occasionally near boxes 69A and sometimes near box 74 but was quiet and about ready to give up possession of his territory.

*Territory No. 211.*—Male, 36-38458, had female, 36-38459, at box 47 by May 30. The young left July 5 with the male aiding in their care and then disappearing. With him gone the male from territory 213 took possession about July 6.

*Territory No. 212.*—Male, 36-38457, had female, 36-38455, at box 43A by May 19. On June 17 she was caught, after which she was not very attentive to young. She may have brooded them at night as they were only 5-6 days old, but she did not feed them during the day. She remained in the bushes near the box where she was occasionally seen during the daytime. Finally by June 26 she began to regain her former behavior and to take part in their care. The young flew June 28, the male aiding in caring for them. While wandering with the young, the male found box 54A and transferred to it by July 8. He was probably with a female at that time as she, 36-38455, laid her first egg on July 11. She was his old mate from box 43A where her young had flown June 28, 10 days at least before she came here. Transference to box 54A was aided by the fact that the male in territory 213 took over their territory around box 43A on July 2 while the male was busy with the young and did not defend it. Swarms of sparrows persisted around box 54A and the male remained close to it for defense. It is doubtful if he fed the young from box 43A much after July 8. On July 12 the eggs from box 54A were gone, probably destroyed by sparrows, but the female laid 2 more. By August 2 the male had deserted, but the young came off successfully on August 13.

*Territory No. 213.*—Male, 36-38856, a return, had female, 36-38040, also a return, at box 79 by May 11, and their young left June 21 with the male aiding in their care. There appeared to be some tolerated overlapping or neutral area between territories 212 and 213 in the barnyard for some days. By June 10 he had been at box 43. On July 1 he cleaned out box 79, and since the male in territory 212 was gone with young he also cleaned out box 43A on July 2 and got the female, 36-38040, his former mate, about July 4, 13 days after their first brood flew. Their second brood left August 6. The male took possession of box 47 about July 6.

*Territory No. 214.*—An unidentified return male had a female at box 40A by May 27, but on June 19 the newly hatched young were gone, and the female deserted. The male was no longer active at the box, although on June 24 a male, probably he, challenged the male in territory 213 for the attentions of a female near box 43. The other male chased the female into the woods, and there is no further note on this bird. His territory was partially taken over by the male in territory 215.

*Territory No. 215.*—Male, 36-38464, was at box 34 with a female in early June. On June 20 the female deserted her eggs for unknown cause—this about the same time as another female deserted box 40A (214). For the next couple days the male cleaned house, sang near the box, and then transferred to box 37. A female may have been near there June 25 but not to stay until the 27th. She was No. 36-38463, possibly the one from either box 40A (214) or box 34. Their young left August 3.

## IX. HISTORY OF INDIVIDUAL BIRDS

A CONDENSED SUMMARY of the territories and boxes occupied and the mates secured by ninety-eight birds is presented in table form. Only birds are included which were present two or more years on Hillcrest. When the bird hatched on Hillcrest its first record in the table is indicated as that of a "nestling," and the box number given is that in which it hatched; likewise the band numbers of its "father" and its "mother" are included. The nestling records of these birds are put in the proper columns for the breeding period in which they hatched. Unmated birds are designated as "bachelors." For further account of these birds reference should be made to the case histories in the preceding section.

TABLE 5.—LIFE RECORD OF INDIVIDUAL BIRDS

| Band Number and Sex | Year | First Breeding Period | | | Second Breeding Period | | |
|---|---|---|---|---|---|---|---|
| | | Territory | Box | Mate | Territory | Box | Mate |
| 6882 Female | 1923 | 36 | 51 | 26600 | 36 | 59 | 26600 |
| | 1924 | 46 | 51 | A20 | 46 | 68 | A20 |
| 6891 Female | 1923 | 34 | 40 | 26546 | 33 | 37 | 6888 |
| | 1924 | .... | .... | ..... | .... | .... | ..... |
| | 1925 | 56 | 47 | 57759 | 57 | 47 | 31852 |
| 6892 Female | 1923 | 37 | 59 | 26601 | .... | .... | ..... |
| | 1924 | .... | .... | ..... | .... | .... | ..... |
| | 1925 | 49 | 3 | 58023 | .... | .... | ..... |
| 6899 Male | 1923 | 27 | 3 | 6881 | 27 | 63A | 57798 |
| | 1924 | 47 | 68 | ? | .... | .... | ..... |
| | 1925 | 47 | 59 | 57799 | .... | .... | ..... |
| | | 53 | 68 | 153 | (Male died) | | ..... |
| 21212 Female | 1921 | 1 | 3 | 45963 | 10 | 63A | 45335 |
| | 1922 | 19 | 37 | 26512 | 19 | 37 | 26512? |
| | 1923 | 29 | 30 | 22995 | .... | .... | ..... |
| 21231 Male | 1921 | 5 | 37 | 21211 | 5 | 37 | 21211 |
| | 1922 | 17 | 30 | 45303 | .... | .... | ..... |
| 21264 Male | 1921 | 8 | 53 | 21234 | 8 | 49 | 21234 |
| | 1922 | 24 | 53 | 22987 | 24 | 53 | 22988 |
| 22995 Male | 1922 | 12 | 6, 25 | Bachelor | .... | .... | ..... |
| | 1923 | 29 | 30 | 21212 | .... | .... | ..... |
| | | 29 | 25 | 6885 | .... | .... | ..... |
| 26523 Male | 1922 | 13 | 6, 3 | Bachelor | .... | .... | ..... |
| | 1923 | .... | .... | ..... | .... | .... | ..... |
| | 1924 | .... | .... | ..... | .... | .... | ..... |
| | 1925 | 55 | 51 | 26551 | 55 | 9 | 26551 |
| 26546 Male | 1922 | 20 | 47 | 22988 | .... | .... | ..... |
| | 1923 | 34 | 40 | 6891 | .... | .... | ..... |
| | 1924 | 44 | 43A | A10 | 44 | 75 | A10 |
| 26551 Female | 1922 | 20 | 47 | Nestling | .... | .... | ..... |
| | | (Father 26546, Mother 22988) | | | | | |
| | 1923 | .... | .... | ..... | 32 | 25 | 57783 |
| | 1924 | 39 | 6 | 58023 | 39 | 6 | 58023 |
| | 1925 | 55 | 51 | 26523 | 55 | 9 | 26523 |
| 26600 Male | 1922 | .... | .... | ..... | 14 | 6 | 26595 |
| | 1923 | 36 | 51 | 6882 | 36 | 59 | 6882 |
| 26601 Male | 1922 | .... | .... | ..... | 21 | 47 | 22989 |
| | 1923 | 37 | 59 | 6892 | .... | .... | ..... |
| 27739 Female? | 1915 | .... | 9 | 27740 | .... | 49 | ? |
| | 1916 | .... | 49 | 38491 | .... | .... | ..... |
| 44008 Sex? | 1917 | .... | 51 | 44009 | .... | .... | ..... |
| | 1918 | .... | 51 | 44100 | .... | .... | ..... |
| | 1919 | .... | 9 | 44100 | .... | .... | ..... |
| 44100 Sex? | 1918 | .... | 51 | 44008 | .... | .... | ..... |
| | 1919 | .... | 9 | 44008 | .... | .... | ..... |
| 44526 Sex? | 1918 | .... | 40 | 44525 | .... | .... | ..... |
| | 1919 | .... | 40 | ? | .... | .... | ..... |
| 45206 Male | 1918 | .... | .... | ..... | .... | 47 | 45205 |
| | 1919 | .... | 26 | 45311 | .... | .... | ..... |
| 45303 Female | 1919 | .... | 25 | 45302 | .... | 53 | 45349 |
| | 1920 | .... | 25 | 45342 | .... | 25 | 45342 |
| | 1921 | 2 | 25 | 45342 | 1 | 6 | 45963 |
| | 1922 | 17 | 30 | 21231 | 16 | 25 | 26638 |
| 45325 Female | 1919 | .... | 3 | Nestling | .... | .... | ..... |
| | | (Father 45324, Mother 45322) | | | | | |
| | 1920 | .... | .... | ..... | .... | 59, 53 | 45968 |
| 45335 Male | 1919 | .... | 63 | 45334 | .... | .... | Bachelor |
| | 1920 | .... | 63 | 45988 | .... | 49 | 45955 |
| | 1921 | 10 | 63 | 21206 | 10 | 63A | 21212 |
| | 1922 | 11 | 3 | ? | (Male killed) | | ..... |

TABLE 5.—LIFE RECORD OF INDIVIDUAL BIRDS (*Continued*)

| Band Number and Sex | Year | First Breeding Period | | | Second Breeding Period | | |
|---|---|---|---|---|---|---|---|
| | | Territory | Box | Mate | Territory | Box | Mate |
| 45342 Male | 1919 | .... | 25 | Bachelor | .... | .... | ..... |
| | 1920 | .... | 25 | 45303 | .... | 25 | 45303 |
| | 1921 | 2 | 25 | 45303 | 2 | 3 | 21206 |
| | 1922 | 23 | 52 | 22989 | 23 | 63A | 22989 |
| 45349 Male | 1919 | .... | .... | ..... | .... | 53 | 45303 |
| | 1920 | .... | .... | ..... | .... | 47 | 46006 |
| 45963 Male | 1920 | .... | 49 | Nestling | .... | .... | ..... |
| | | (Father 45335, Mother 45955) | | | | | |
| | 1921 | 1 | 3 | 21212 | 1 | 6 | 45303 |
| 45968 Male | 1920 | .... | .... | ..... | .... | 59, 53 | 45325 |
| | 1921 | 6 | 47, 75 | 46006 | 6 | 47 | 21294 |
| 46006 Female | 1920 | .... | .... | ..... | .... | 47 | 45349 |
| | 1921 | 6 | 47, 75 | 45968 | 9 | 68 | 48775 |
| 48775 Male | 1921 | 9 | 59 | 21213 | 9 | 68 | 46006 |
| | 1922 | 25 | 59 | 26502 | .... | .... | ..... |
| 48785 Male | 1921 | 2 | 25 | Nestling | .... | .... | ..... |
| | | (Father 45342, Mother 45303) | | | | | |
| | 1922 | 15 | 23 | 26520 | 15 | 26 | 22987 |
| | 1923 | 35 | 47 | 6884 | 35 | 47 | 6885 |
| | 1924 | 41 | 25 | 58024 | 41 | 23 | A87 |
| 57759 Male | 1923 | .... | .... | ..... | 38 | 53 | 57799 |
| | 1924 | 45 | 47 | A27 | 45 | .... | ..... |
| | 1925 | 56 | 43 | A167 | 56 | 43A | A167 |
| | | 56 | 47 | 6891 | .... | .... | ..... |
| | 1926 | 58 | 25 | (Died) | 58 | 11 | 38446 |
| 57799 Female | 1923 | .... | .... | ..... | 38 | 53 | 57759 |
| | 1924 | 47 | 59 | 6899 | 48 | 63 | A15 |
| 58023 Male | 1924 | 39 | 3 | A28 | .... | .... | ..... |
| | | 39 | 6 | 26551 | 39 | 6 | 26551 |
| | 1925 | 49 | 3 | 6892 | 49 | 6 | 31917 |
| 63810 Female | 1926 | 59 | 49 | A34236 | 59 | 51 | A34236 |
| | 1927 | 64 | 59 | A34236 | .... | .... | ..... |
| 664708 Female | 1928 | 80 | 37 | ? | 81 | 75 | ? |
| | 1929 | 82 | 37 | B97101 | .... | .... | ..... |
| 664751 Female | 1928 | 75 | 6 | A94249 | 75 | 10 | B94249 |
| | 1929 | 91 | 63 | A93433 | .... | .... | ..... |
| A20 Male | 1924 | 46 | 51 | 6882 | 46 | 68 | 6882 |
| | 1925 | 54 | 59 | A183 | 54 | 63 | A183 |
| A50 Male | 1924 | .... | .... | ..... | 43 | 37 | Bachelor |
| | 1925 | .... | .... | ..... | .... | .... | ..... |
| | 1926 | Outfield | A5 | 63774 | .... | .... | ..... |
| A61 Male | 1924 | 45 | 47 | Nestling | .... | .... | ..... |
| | | (Father 57759, Mother A27) | | | | | |
| | 1925 | 52 | .... | Bachelor | .... | .... | ..... |
| A34236 Male | 1926 | 59 | 49 | 63810 | 59 | 9 | ? |
| | | .... | .... | ..... | 59 | 69 | ? |
| | | .... | .... | ..... | 59 | 51 | 63810 |
| | 1927 | 64 | 59 | 63810 | 64 | .... | ? |
| A38398 Male | 1926 | Outfield | A71 | Nestling | .... | .... | ..... |
| | | (Father 38386, Mother 63811) | | | | | |
| | 1927 | 63 | 6 | A93420 | .... | .... | ..... |
| | 1928 | 78 | .... | Bachelor | 78 | 51 | B45348 |
| | 1929 | 89 | 51 | B45348 | .... | .... | ..... |
| | 1930 | 98 | 51 | B45348 | 98 | 50, 51 | ..... |
| A93433 Male | 1927 | 61 | 80 | A94233 | .... | .... | ..... |
| | 1928 | 73 | 74 | B45349 | 73 | 70 | B45321? |
| | 1929 | 91 | 63 | 664751 | 91 | 59 | ? |
| | 1930 | 102 | 74 | C68257? | 102 | 70 | ..... |

TABLE 5.—LIFE RECORD OF INDIVIDUAL BIRDS (*Continued*)

| Band Number and Sex | Year | First Breeding Period | | | Second Breeding Period | | |
|---|---|---|---|---|---|---|---|
| | | Territory | Box | Mate | Territory | Box | Mate |
| A93526 Female | 1927 | Outfield | A38 | A93697 | .... | .... | ..... |
| | 1928 | 76 | 25 | 664601 | (Female killed) | | ..... |
| A93573 Male | 1927 | Outfield | A15 | Nestling | .... | .... | ..... |
| | | (Father 93504, Mother 93452) | | | | | |
| | 1928 | 79 | 47 | B45350 | 79 | 47 | B45349 |
| A94249 Male | 1927 | 65 | .... | Bachelor | 65 | 51 | A93513 |
| | | .... | .... | ..... | 65 | 9 | A94247 |
| | 1928 | 75 | 6, 11 | 664751 | 75 | 11 | B45350 |
| | | .... | .... | ..... | 75 | 10 | 664751 |
| | 1929 | 86 | 25 | B56490 | 86 | 21 | B56490 |
| B5640 Female | 1927 | Outfield | X12 | Nestling | .... | .... | ..... |
| | | (Father 93692, Mother 93641) | | | | | |
| | 1928 | .... | .... | ..... | .... | .... | ..... |
| | 1929 | 92 | 74 | B96418 | 92 | 70 | B96418 |
| | 1930 | 100 | 59 | C68910 | .... | .... | ..... |
| | 1931 | 109 | 74 | B97203 | 112 | 80A | ? |
| | 1932 | 124 | 74 | B97203 | .... | .... | ..... |
| B45348 Female | 1928 | .... | .... | ..... | 78 | 51 | A38398 |
| | 1929 | 89 | 51 | A38398 | 90 | 51 | B97018 |
| | 1930 | 98 | 51 | A38398 | .... | .... | ..... |
| B45350 Female | 1928 | 79 | 47 | A93573 | 75 | 11 | A94249 |
| | 1929 | Outfield | A178 | ? | .... | .... | ..... |
| | | Outfield | A235 | B96328 | .... | .... | ..... |
| B56487 Male | 1929 | 83 | 78 | B96433 | 83 | 75 | B96900 |
| | 1930 | 93 | 43A | B96433 | 93 | 43 | C68705 |
| | 1931 | 113 | 47 | C94217 | 113 | 54A | ..... |
| B96282 Female | 1929 | Outfield | A58 | Nestling | .... | .... | ..... |
| | | (Father ?, Mother A93448) | | | | | |
| | 1930 | 101 | 80 | C68252 | Outfield | A8 | B68424 |
| B96433 Female | 1929 | 83 | 78 | B56487 | 85 | 30 | B97007 |
| | 1930 | 93 | 43A | B56487 | .... | .... | ..... |
| B96446 Male | 1929 | Outfield | X19 | Nestling | .... | .... | ..... |
| | | (Father ?, Mother ?) | | | | | |
| | 1930 | 104 | 72A | C68563 | 104 | 72B | C68563 |
| B97018 Male | 1929 | 90 | 9 | Bachelor | 90 | 51 | B45348 |
| | 1930 | 97 | 53 | C68254 | .... | .... | ..... |
| | | 97 | 49 | C68257 | 97 | 49 | Bachelor |
| B97203 Male | 1929 | (Caught at banding station on August 11; probably a nestling) | | | | | |
| | 1930 | .... | .... | ..... | .... | .... | ..... |
| | 1931 | 109 | 74 | B5640 | 109 | 59 | Bachelor |
| | 1932 | 124 | 74 | B5640 | .... | .... | ..... |
| C68252 Male | 1930 | 101 | 80 | B96282 | .... | .... | ..... |
| | 1931 | 111 | 80A | C94331 | 111 | 74 | ? |
| | 1932 | 122 | 80 | C94219 | 122 | 59 | ? |
| C68253 Female | 1930 | 96 | 25 | C68911 | .... | .... | ..... |
| | 1931 | 106 | 25 | C68801 | .... | .... | ..... |
| C68418 Male | 1930 | Outfield | A163 | Nestling | .... | .... | ..... |
| | | (Father B96338, Mother B97451) | | | | | |
| | 1931 | 114 | 34A | C94219 | 114 | 37 | F45565 |
| C68681 Female | 1930 | Outfield | A51 | C68611 | .... | .... | ..... |
| | 1931 | .... | .... | ..... | 110 | 59 | F45857 |
| C68801 Male | 1930 | 95 | 47? | B96433 | 95 | 54A | C68257 |
| | 1931 | 106 | 25 | C68253 | 106 | 25 | Bachelor |
| C68910 Male | 1930 | 100 | 59 | B5640 | .... | .... | ..... |
| | 1931 | 108 | 54A | F45359 | 108 | .... | Bachelor |
| | 1932 | 119 | 49 | F45947 | .... | .... | ..... |
| | 1933 | 129 | 49 | H18566 | 129 | 53 | H18820 |
| | | 129 | 49 | F58248 | 129 | 51 | F58248? |

TABLE 5.—LIFE RECORD OF INDIVIDUAL BIRDS (*Continued*)

| Band Number and Sex | Year | First Breeding Period | | | Second Breeding Period | | |
|---|---|---|---|---|---|---|---|
| | | Territory | Box | Mate | Territory | Box | Mate |
| C94219 Female | 1931 | 114 | 34A | C68418 | .... | .... | ..... |
| | 1932 | 122 | 80 | C68252 | .... | .... | ..... |
| | | 120 | 53 | F45994 | (Female died) | | ..... |
| F45359 Female | 1931 | 108 | 54A | C68910 | .... | .... | ..... |
| | 1932 | 116 | 40A | F58648 | .... | .... | ..... |
| | 1933 | Outfield | A164 | F45764 | Outfield | A164 | F45764 |
| F45763 Male | 1931 | .... | .... | ..... | Outfield | A260 | Nestling |
| | | | | | (Father 45764, Mother C68978) | | |
| | 1932 | .... | .... | ..... | 121 | 49 | F45947 |
| F45942 Female | 1932 | 117 | 25 | F45946 | 117 | 26? | F45946 |
| | 1933 | 128 | 25 | H18582 | .... | .... | ..... |
| F45946 Male | 1932 | 117 | 25 | F45942 | 117 | 26 | F45942? |
| | 1933 | 130 | 21A | H18566 | 130 | 92 | ..... |
| F45987 Male | 1932 | 118 | 54A | F45992 | 118 | 54A | F45992? |
| | 1933 | 134 | 54A | H18587 | 134 | 54A | H18587 |
| | 1934 | 144 | 43A | L24955 | 144 | 75 | L24955 |
| | 1935 | 157 | 75 | L24955 | 157 | 43A | L24955 |
| | 1936 | 169 | 47 | L73248 | 169 | 37 | L73248 |
| | | .... | .... | ..... | 169 | 34A | 34-86014 |
| | 1937 | 177 | 34 | 36-38389 | (Leg broken, amputated) | | |
| F58248 Female | 1932 | Outfield | A7 | Nestling | .... | .... | ..... |
| | | (Father ?, Mother F58244) | | | | | |
| | 1933 | 129 | 49 | C68910 | 129 | 51? | C68910 |
| F58493 Female | 1932 | Outfield | A310 | Nestling | .... | .... | ..... |
| | | (Father F58302, Mother F45477) | | | | | |
| | 1933 | 132 | 74 | H18570 | Outfield | A7 | F58309 |
| F58648 Male | 1932 | 116 | 40A | F45359 | .... | .... | ..... |
| | 1933 | 136 | 43 | H18584 | .... | .... | ..... |
| | | 136 | 40A | H18900 | 136 | 34A | A18900 |
| | 1934 | 142 | 37 | L24950 | .... | .... | ..... |
| F58955 Female | 1932 | Outfield | A201 | Nestling | .... | .... | ..... |
| | | (Father C94427, Mother F58103) | | | | | |
| | 1933 | 127 | 11 | H18600 | .... | .... | ..... |
| H18600 Male | 1933 | 127 | 11 | F58955 | 127 | 11, 6 | Bachelor |
| | 1934 | 141 | 25 | L24101 | 141 | 21A | Bachelor |
| L24101 Female | 1933 | 135 | 43A | L24102 | .... | .... | ..... |
| | 1934 | 141 | 25 | H18600 | 146 | 49 | L24996 |
| | 1935 | 153 | 25 | L24956 | 160 | 49 | L24996 |
| | 1936 | 166 | 21A | L24949 | 170 | 75 | 35-13603 |
| L24102 Male | 1933 | 135 | 43A | L24101 | .... | .... | ..... |
| | 1934 | 138 | 3A | L24948 | .... | .... | ..... |
| L24944 Female | 1934 | 148 | 73 | L24946 | 149 | 73 | ? |
| | 1935 | 161 | 63 | 34-4020 | Outfield | A8 | ? |
| L24946 Male | 1934 | 148 | 73 | L24944 | Outfield | A7 | 34-3502 |
| | 1935 | Outfield | A10 | 34-4919 | .... | .... | ..... |
| | 1936 | 165 | 10, 11 | Bachelor | 165 | 3A | Bachelor |
| L24949 Male | 1934 | 150 | 91 | L24951 | 150 | 54A, 47 | Bachelor |
| | 1935 | 158 | 72 | ? | 158 | 75 | Bachelor |
| | 1936 | 166 | 21A | L24101 | 166 | 11 | 35-13604 |
| | 1937 | 178 | 40A | 36-38381 | 178 | 37 | 36-38381 |
| | | .... | .... | ..... | 178 | 34 | 36-38389 |
| L24951 Female | 1934 | 150 | 91 | L24949 | .... | .... | ..... |
| | 1935 | .... | .... | ..... | .... | .... | ..... |
| | 1936 | 171 | 79 | 34-86997 | 168 | 47 | 34-86015 |
| | 1937 | 180 | 43A | 35-13603 | .... | .... | ..... |
| L24955 Female | 1934 | 144 | 43A | F45987 | 144 | 75 | F45987 |
| | 1935 | 157 | 75 | F45987 | 157 | 43A | F45987 |

TABLE 5.—LIFE RECORD OF INDIVIDUAL BIRDS (*Concluded*)

| Band Number and Sex | Year | First Breeding Period | | | Second Breeding Period | | |
|---|---|---|---|---|---|---|---|
| | | Territory | Box | Mate | Territory | Box | Mate |
| L24956 Male | 1934 | 139 | 10 | Bachelor | .... | .... | ..... |
| | 1935 | 153 | 25 | L24101 | 152 | 92 | 34-4201 |
| L24996 Male | 1934 | 146 | 53, 49 | Bachelor | 146 | 49 | L24101 |
| | 1935 | 160 | 53 | ? | 160 | 49 | L24101 |
| L73248 Female | (Banded elsewhere) | | .... | ..... | .... | .... | ..... |
| | 1936 | 169 | 47 | F45987 | 169 | 37 | F45987 |
| 34-4020 Male | 1934 | Outfield | A104 | 34-4021 | .... | .... | ..... |
| | 1935 | 161 | 63 | L24944 | 161 | 59 | Bachelor |
| 34-4201 Female | 1934 | Outfield | A66 | ? | .... | .... | ..... |
| | 1935 | Outfield | A10 | ? | 153 | 92 | L24956 |
| | 1936 | Outfield | A256 | ? | .... | .... | ..... |
| 34-4445 Female | 1934 | .... | .... | ..... | Outfield | 51 | Nestling |
| | | | | | (Father 34-4419, Mother 34-4405) | | |
| | 1935 | 159 | 47 | 34-86013 | 154 | 25 | 34-86085 |
| 34-86014 Female | 1935 | 155 | 40A | 34-86015 | 156 | 34A | 34-86088 |
| | 1936 | 168 | 40A | 34-86015 | 169 | 34A | F45987 |
| 34-86015 Male | 1935 | 155 | 40A | 34-86014 | .... | .... | ..... |
| | 1936 | 168 | 40A | 34-86014 | 168 | 47 | L24951 |
| | 1937 | 184 | 53 | 36-38811 | .... | .... | ..... |
| | 1938 | 197 | 43A | 38-1607 | .... | .... | ..... |
| 34-86767 Male | 1935 | .... | .... | ..... | Outfield | A142 | Nestling |
| | | | | | (Father F58297, Mother 34-3792) | | |
| | 1936 | .... | .... | ..... | .... | .... | ..... |
| | 1937 | .... | .... | ..... | 176 | 25 | 37-93972 |
| 34-86997 Male | 1936 | 171 | 79 | L24951 | 171 | 43 | 35-13653 |
| | 1937 | .... | .... | ..... | .... | .... | ..... |
| | 1938 | .... | .... | ..... | 200 | 40A | 36-38389 |
| 35-13603 Male | 1936 | 170 | 43A | 35-13604 | 170 | 75 | L24101 |
| | 1937 | 180 | 43A | L24951 | 180 | 43A | Bachelor |
| | 1938 | 201 | 34 | 36-38811 | 201 | 34 | 36-38811 |
| 35-13700 Male | 1937 | 186 | 72A | 36-38388 | Outfield | A9 | 35-13913 |
| | 1938 | 191 | 69 | 38-1662 | .... | .... | ..... |
| 36-38040 Female | 1936 | Outfield | A7 | Nestling | .... | .... | ..... |
| | | (Father ?, Mother 35-13528) | | | | | |
| | 1937 | 182 | 47 | 36-38856 | 182 | 47 | 36-38856 |
| | 1938 | 196 | 47 | 36-38856 | 196 | 47 | 36-38856? |
| | 1939 | 213 | 79 | 36-38856 | 213 | 43A | 36-38856 |
| 36-38389 Female | 1937 | 177 | 34 | F45987 | 178 | 34 | L24949 |
| | 1938 | 199 | 37 | 38-1654 | 200 | 40A | 34-86997 |
| 36-38426 Female | 1938 | .... | .... | ..... | 195 | 54A | 36-38427 |
| | 1939 | 208 | 49 | 36-38429 | .... | .... | ..... |
| 36-38427 Male | 1938 | .... | .... | ..... | 195 | 54A | 36-38426 |
| | 1939 | 205 | 11 | Bachelor | 205 | 11 | 36-38462 |
| 36-38429 Male | 1938 | .... | .... | ..... | 189 | 3A | 36-38428 |
| | 1939 | 208 | 49 | 36-38426 | .... | .... | ..... |
| 36-38804 Male | 1937 | 173 | 10 | Bachelor | Outfield | A8 | 35-13529 |
| | 1938 | .... | .... | ..... | Outfield | A14 | 38-1863 |
| 36-38811 Female | 1937 | 184 | 53 | 34-86015 | .... | .... | ..... |
| | 1938 | 201 | 34 | 35-13603 | 201 | 34 | 35-13603 |
| | | .... | .... | ..... | 202 | 9 | 38-1681 |
| 36-38856 Male | 1937 | 182 | 47 | 36-38040? | 182 | 47 | 36-38040 |
| | 1938 | 196 | 47 | 36-38040 | 196 | 47 | 36-38040 |
| | 1939 | 213 | 79 | 36-38040 | 213 | 43A | 36-38040 |
| 37-93876 Male | 1937 | .... | .... | ..... | Outfield | A302 | 36-38569 |
| | 1938 | .... | .... | ..... | 194 | 51A | 38-1642 |
| 38-1607 Female | 1938 | 197 | 43A | 34-86015 | 198 | 75 | 38-1684 |
| | 1939 | .... | .... | ..... | 204 | 10 | 36-38461 |

## X. SUMMARY

THE TERRITORIAL behavior of 142 male and 147 female house wrens over a period of nineteen years on a fifteen-acre estate is here described. Additional information obtained from nesting activities at approximately three hundred boxes on outlying estates is collated. Case histories of 215 territories are presented, along with maps of most of the territories to show variations in boundary and size. A condensed history of 98 birds in respect to territories, boxes, and mates is given to show changes between breeding periods and from one year to another.

Although first-year birds may be among the first to arrive in late April and early May, adults of two or more years of age make up a far greater percentage of the migratory population at this time than they do later in the season. Females arrive about nine days later than the males.

Adult males that have previously nested almost invariably return to the same territory that they formerly occupied, or they establish a new territory adjacent to it. The return of adult females to their former nesting areas is almost as regular.

With young birds hatched the preceding season, there is a marked tendency to scatter in all directions, although they occur in greatest relative numbers in the vicinity where they were hatched.

Only the male bird sings, and his songs are classified into three types. The "territory" song serves to notify other males that the area is occupied, to advertise the male's presence to the females, and to entice the female to enter his particular territory. The "mating" song expresses great sexual excitement and may be stimulating to the female for coition. The "nesting" song serves to remind other birds that the territory is occupied and aids in coordinating the activities of male and female around the nest. Both sexes have a variety of call-notes for expressing various emotional states and for intercommunication. Movements of wings and tail are used for the same purpose.

A male usually possesses two or three nest-sites in his territory and occasionally as many as seven. This gives incoming females a variety of choice for beginning a nest and aids the male in retaining her as his mate. Any one of the nest-sites may be used for a second brood later in the season or for two simultaneous nestings with different females. Their location helps to establish the outline and size of the territory.

Territories are established and defended by singing, by taking possession of nest-sites, by assuming threatening postures sometimes accompanied with scolding, by chasing, and by physical combat. This order is one of increasing exertion and energy demand and may represent the reverse order of steps through which the territorial behavior has developed in the course of evolution.

In the establishment of nest-sites, house wrens may destroy the nests, eggs, or young of the same or of different species, or even other adult birds. Although there is considerable individual variation in this aggressive behavior, it tends to be most intense during years when the total house wren population on the area is highest.

The female does not defend territory nor recognize the limits of territory as established by the male. When the female appears confined to a territory, it is due to her nest-box being centrally located within the territory, to her being chased out of neighboring territories, or to the male's adjustment of the outlines of his territory to coincide with her movements. The presence of an unmated female is a potent stimulus to the male for establishing territories or modifying their former boundaries or of competing with his neighbors.

Territorial boundaries are frequently in a state of flux and rarely remain uniform throughout the season. These changes are caused by early arriving males attempting to take possession of very large territories, parts of which they are forced later to yield, to the impact of new males arriving and carving out territories, to variations in the activity and feeding areas of the female mate, to the shifting population of both males and females between the first and second breeding periods and the necessity for remating, and in general, to variation in activities and relations of established males on adjacent territories.

Territories in the Hillcrest area average 1.0 acre (0.4 hectare) in size, but they vary all the way from less than 0.25 to 3.6 acres (0.1-1.44 hectares). The size of the territory varies inversely with the size of the house wren population and does not exert a limiting influence on the total numbers of the species in the area until it approaches the minimum compressible limit. The adult birds restrict their intensive daily activity to limited parts of the territory but eventually cover the entire area.

There is a non-breeding population of house wrens which in the males varies from 28 to 35 per cent of the total male population and in the female from 13 to 20 per cent of the total female population. Various levels of reproductive activity exist as represented in different birds: no attempt at breeding at all, temporary and unsuccessful splurges at nesting activities, maintenance by the male of a territory throughout a breeding period or the entire season but without obtaining a mate, securing a mate and a nest for one period only, the undertaking of a nesting during both breeding periods, and perhaps finally polygamy. Polygyny occurs in about six per cent of all matings, but multiple nesting by the female is rare. First-year birds on the average have a lower reproductive vigor than do birds that have nested before.

The successful mating of two birds of opposite sex appears to depend on their physiological and psychological readiness, their ability to stimulate each other sexually, the location and character of the territory, the location and character of the nest-site together with the nest foundation begun by the male, and finally their freedom from other activities.

Except for the fact that only the male sings, sex recognition is based on differences in behavior of the two sexes. Later, there may be recognition of each other as individuals through characteristic mannerisms.

Mating for a second brood follows the same pattern as for the first brood, even though 40 per cent of the second matings are with the same individuals. Remating of a pair for a second brood is aided by possibly their physiological condition and behavior patterns being already adjusted to each other, by the male aiding the female in the care of the first brood, which duty, however, he assumes only about half of the time, and by both birds returning to the same territory. Remating of a pair the following year occurred in 42 per cent of the cases where both birds of the pair survived and returned to the locality: this remating being dependent upon both birds returning to their former or to adjacent territories and to neither being already mated at the time the other arrives.

Territory is maintained throughout each breeding period and breeding season, although there may be some decrease in activity as nesting progresses. This continuance of territory may be correlated with the tendency toward polygyny manifest in the male, with the use of the same territory for later matings, and it may also involve the need for a constant and readily available source of food and for freedom from annoying intruders. Primarily, however, the territorial behavior is most closely linked with the acquiring of a first mate. There is no evidence that territory is maintained at any other than the breeding season of the year.

## XI. LITERATURE CITED


ALLEN, A. A.
1927. Jenny Wren's Diary. Bird-Lore, 29:290-301.
1934. Sex rhythm in the ruffed grouse (*Bonasa umbellus* Linn.) and other birds. Auk, 51:180-199.

BALDWIN, S. PRENTISS
1919. Bird-banding by means of systematic trapping. Proc. Linn. Soc. N. Y., 31:23-56.
1921. The marriage relations of the house wren. Auk, 38:237-244.

BALDWIN, S. P., and BOWEN, W. W.
1928. Nesting and local distribution of the house wren. Auk, 45:186-197.

BARROWS, WALTER B.
1889. The English sparrow in North America. U. S. Dept. Agr., Div. Econ. Ornith. and Mamm., Bull. 1:1-405.

BASKETT, J. N.
1896. Some notes on the nesting of the house wren. Osprey, 1:17-18.

BECKWITH, RAYMOND
1913. Our friend, the house wren. Bird-Lore, 15:244-245.

BURNS, FRANK L.
1937. The song periods of some common southeastern Pennsylvania birds in comparison with their seasonal reproductive cycles. Oologist, 54:114-130.

BUTLER, A. W.
1891. The birds of Indiana. Trans. Ind. Hort. Soc., 1-135.

CHRISTY, BAYARD H.
1924. Bewick's wren in Allegheny County. Cardinal, 3:12-15.

FROST, LULA E.
1925. A house wren tragedy. Bird-Lore, 27:181-182.

HANCOCK, J. L.
1911. Nature sketches in temperate America. Chicago, 1-451.

HARRISSON, T. H., and BUCHAN, JOHN N. S.
1934. A field study of the St. Kilda wren (*Troglodytes troglodytes hirtensis*), with especial reference to its numbers, territory and food habits. Jour. Animal Ecol., 3:133-145.

HOLTS, FRED L.
1907. The house wren. Bird-Lore, 9:198-200.

HOWARD, H. ELIOT
1920. Territory in bird life. London, 1-308.
1929. An introduction to the study of bird behaviour. Cambridge, 1-136.

HUXLEY, JULIAN S.
1934. A natural experiment on the territorial instinct. British Birds, 27:270-277.

JONES, LYNDS
1903. The birds of Ohio. Ohio State Acad. Sci., Special Paper 6:1-241.

KENDEIGH, S. CHARLES, and BALDWIN, S. PRENTISS
1937. Factors affecting yearly abundance of passerine birds. Ecol. Mono., 7:91-124.

KLUIJVER, H. N., LIGTVOET, J., VAN DEN OUWELANT, C., and ZEGWAARD, F.
1940. De levenswijze van den winterkoning, *Troglodytes tr. troglodytes* (L.). Limosa, 13:1-51.

LORENZ, KONRAD Z.
1937. The companion in the bird's world. Auk, 54:245-273.

METCALF, E. I.
1919. Is the house wren a bigamist? Bird-Lore, 21:303.

MILLER, EDWIN V.
1941. Behavior of the Bewick wren. Condor, 43:81-99.

MOREAU, R. E., and MOREAU, W. M.
1938. The comparative breeding ecology of two species of Euplectes (Bishop birds) in Usambara. Jour. Animal Ecol., 7:314-327.

NICE, M. M.
1930. Do birds usually change mates for the second brood? Bird-Banding, 1:70-72.

NOBLE, G. K., and VOGT, WILLIAM
1935. An experimental study of sex recognition in birds. Auk, 52:278-286.

OBERHOLSER, HARRY C.
1934. A revision of North American house wrens. Ohio Jour. Sci., 34:86-96.

PIERCE, FRED J.
1925. Nesting material which proved a wren death-trap. Bird-Lore, 27:130.

PRESCOTT, HERBERT
1916. A house wren record. Bird-Lore, 18:360.

SHERMAN, ALTHEA R.
1925. Down with the house wren boxes. Wilson Bull., 37:5-12.
1925. The problem of the house wren. Bird-Lore, 27:97-100.

SMITH, WILBUR F.
1911. The friendly house wrens. Bird-Lore, 13:135-140.
1911. A strange partnership. Bird-Lore, 13:303-304.

SUTTON, GEORGE M.
1930. The nesting wrens of Brooke County, West Virginia. Wilson Bull., 42:10-17.

TAYLOR, JOHN W.
1905. Incidents among birds. Bird-Lore, 7:209-210.

TINBERGEN, N.
1936. The function of sexual fighting in birds; and the problem of the origin of "territory." Bird-Banding, 7:1-8.

WELTER, WILFRED A.
1935. The natural history of the long-billed marsh wren. Wilson Bull., 47:3-34.

WRIGHT, MABLE OSGOOD
1909. The house wren. Bird-Lore, 11:183-186.