

LIFE HISTORY OF THE SOUTHERN HOUSE WREN

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From Canada to the Strait of Magellan, House Wrens are so widely distributed over the American continents that scarcely anyone who has given attention to ornithology anywhere within this vast area will need an introduction to them. Wherever he meets them, the bird-watcher finds these active small birds so similar in their brown plumage, barred on wings and tail, and so much alike in voice and mannerisms, that he is inclined to question why systematists should place the House Wrens of temperate North America in one species (*Troglodytes aëdon*), and those spreading over the extensive region from southern México to Patagonia in another (*T. musculus*). The modern classification of birds includes in the same species many wrens whose coloration differs far more strikingly than does that of the two House Wrens. Differences in the lengths of wings and tail are now used to keep *Troglodytes aëdon* distinct from *T. musculus* despite the many reasons which might be adduced for joining them more closely in our systems of taxonomy.

In Central America, Southern House Wrens are found almost everywhere, from sea-level up to 9000 feet in both Guatemala and Costa Rica, and in arid no less than in excessively rainy districts. As with a number of other species, a wide latitudinal distribution is matched by a wide altitudinal one. These wrens seem to be somewhat more abundant in the interior than on the coasts, probably because at moderate elevations in Central America man has more thoroughly cleared the land and raised more buildings. The House Wren occurs near rural houses and in plantations, pastures, cornfields, and other clearings where dead trunks and decaying stumps provide sites for their nests. I have never once seen the bird in the unbroken forest, or even amid the heavier second growth vegetation. It prefers the open conditions created for it by the activities of man. It is never gregarious. As a rule the young separate from their parents soon after they can take care of themselves, while the adults remain paired throughout the year. I have never known two pairs of House Wrens to share the same house and dooryard. In the tropics, at least, the Southern House Wren appears to be permanently resident wherever it occurs.

FOOD AND FORAGING

So far as I have seen, the House Wren takes only animal food. It enters rustic buildings where everything is quiet, to flit and hop over the exposed beams and rafters, plucking spiders from their webs and brown cockroaches from dark crannies. Wood piles, stone piles, and heaps of brush are attractive to these secretive birds, which hop and creep through all their interstices in search of food. Gardens, weedy fields, low thickets, and patches of tall grass are explored, the wrens usually hunting out of sight amid the dense herbage, often upon the ground, over which they hop or advance with a few slow walking steps. Sometimes they climb up the trunks of trees with rough bark, ascending somewhat sideways rather than with the body quite upright like a woodpecker or a creeper, and plucking out the small invertebrates from the crevices. Important in the diet of the House Wrens are small grasshoppers, spiders, cockroaches, and hairless caterpillars. A complete list of species eaten by them would be long. It is significant that not once in ten years have I seen a House Wren visit the feeding shelf close beside my house in Costa Rica, where birds of many other kinds come to eat bananas.

VOICE

Except while molting, the House Wrens of Central America sing more or less throughout the year, but most freely during their long breeding season. The song of the male is a bright, swift outpouring of liquid notes. It takes a number of forms and

is always so rapid that I have never been able to paraphrase it in syllables adapted to the human tongue. Chapman (1929:67) considered the song of this House Wren, as he heard it on Barro Colorado Island in the Panamá Canal Zone, superior to that of its North American counterpart; he states that the song of the former is "louder, more musical, more varied, and longer than that of the northern bird. Sometimes I hear in it a suggestion of the Song Sparrow's song; at others it has a trace of the lyrical quality of the lay of the Vesper Sparrow." Other ornithologists, however, have held the Southern House Wren's song to be inferior to that of its North American relative. Since the songs of both species vary a good deal with locality and with individuals, both judgments may be correct in relation to the particular wrens which one has heard. At times, especially after the close of the breeding season, Southern House Wrens sing softly in an undertone, employing all the figures of their usual song, but in a voice so low that they can be heard only when close at hand.

With a number of tropical wrens, the song of the female is nearly or quite as rich and varied as that of the male. In the House Wren, the voices of the two sexes differ more strikingly than in any other tropical wren that I know well. Although the female has no vocal expression comparable to the full song of the male, she does—in some individuals at least—possess a little utterance which I believe must be dignified with the name of song. This is a low, rapid *twitting*, following at times by a slight, clear trill. Exceptionally the female has a rich, full, resonant trill; one individual with such a trill did not use the preliminary twitter. As other wrens of which the female is vocally more gifted perform either synchronous or antiphonal duets, so the female House Wren sings her little song chiefly in response to the richer, fuller verses of her mate, rarely when alone. Chapman's observations on the song of the female House Wren in the Canal Zone are in agreement with my own made both there and in Costa Rica. He writes (1929: 67, 68): "She is not a soloist and, as a rule, gives voice only when she hears the song of her mate. He may be with her or a hundred feet or more away. When he sings she sits with fluttering wings uttering a *twit-twit-twit-twit-tee-tee-tee* with enough musical quality and volume to deserve the name of song. Generally she keeps time with her mate, sometimes she is a little ahead, reacting perhaps to his opening notes that I may not have heard; sometimes she is a little behind him."

The House Wren's expression of alarm is well written by Chapman as "a grating *cloudy-ditch, cloudy-ditch*, quite unlike, therefore, the northern bird's more simple *cacking*." It gives voice also to a variety of churring, burbling and rattling notes, which become harshly grating when its nest is molested. Older nestlings raise a loud sizzling noise when food is brought to them. Fledglings utter nervous little *tuc* and *churr* notes.

SLEEPING

Many if not most of the wrens of tropical America, and at least some of those which inhabit the temperate regions, roost in sheltered places, either in nooks and crannies which they find ready-made or, more often, in roofed nests of their own construction. The Southern House Wren takes shelter for the night in holes such as it uses as sites for its nest. Adults as a rule sleep singly, although I have known a male to roost in a gourd where his mate was brooding nestlings, and another whose mate vigorously resisted his attempt to join her in the evening in the nest-box which their young had just left. Young newly emerged from the nest are led by their parents to pass the night in some sheltered nook, sometimes back into the nest-cavity itself, but more often elsewhere. Here they may sleep either in company with the female parent or alone. Occasionally the fledglings are taken to sleep in a fairly exposed position, as in the open, cup-shaped nest of some other bird, or in a thick crotch in the midst of clustering foliage.

I have known House Wrens to continue for a number of months, until long after they were full grown and independent of parental care, the habit of sleeping exposed to the rain, to which they had been early accustomed under parental guidance.

Some of the places where I have found Southern House Wrens lodging are old woodpecker holes high in dead trees; natural cavities in trees and posts; niches or short burrows in vertical banks (not made by wrens); in the eaves of a house; between the tiles of a roof and the wooden supporting strips; in pockets among the leaves of thatched roofs; in the hollow end of a bamboo cross-piece of a garden trellis; in the center of a bunch of green bananas hanging from the plant. House Wrens are weak flyers, and when going to roost in a high woodpecker hole they seem unable to reach the doorway by a single direct ascent but must work their way up the long trunk in stages, clinging to the side after each short upward flight. This I have often watched them do in the evening twilight. As a rule, holes used for sleeping contain no lining taken in by the wrens.

In many of the situations listed above, it was not practicable to visit the wrens during the night and see how they slept. Those which I could examine took shelter in shallow niches in the cut banks of a private roadway winding among open pastures and woods of oak and pine, in the Guatemalan highlands nearly 9000 feet above sea-level. In March, 1933, walking along the unpaved road, I found nine House Wrens sleeping in such niches, illuminating them with an electric torch. The tenant of each niche slept with its head at the end of the short tunnel, its tail toward the outside. All the body feathers stood on end, revealing light spots toward their bases that were ordinarily concealed. These made the little bird's back appear to be mottled with white. It was impossible to distinguish any trace of a head in the little ball of downy feathers; the barred brown tail alone was well defined, projecting on the side toward me. The tuft of feather-down pulsed with the rapid breathing of the little body as its center. Williams (1941: 278) described and figured similar light spots in the plumage of sleeping Bewick Wrens (*Thryomanes bewickii*).

In the morning, the male House Wren usually arises a little earlier than his mate and begins his day with song. The female may emerge from her separate niche near by as soon as she hears his voice, or she may linger a few minutes longer, rarely as many as ten, whereas in the evening she retires a little earlier than the male. These statements refer to periods when she is neither incubating eggs nor brooding nestlings. Only rarely is the order of arising and retiring reversed. In a number of other species of diurnal birds, earlier arising and later retiring by the male of the pair have been recorded (Nice, 1943:111).

NEST-BUILDING

The breeding season of the House Wren is remarkably long, even for a tropical bird. Writing of *T. musculus clarus* in Trinidad, Belcher and Smooker (1937:508) state: "The nesting season for this, almost alone of local birds, may fairly be said to be the whole year; but no doubt its height, as for most passerines, is in May." On Barro Colorado Island, Chapman (1929:68) found a nest which in early January contained four eggs. In the valley of El General in Costa Rica, I have known the House Wren to build during the second half of December, and to complete a set of four eggs before the end of the month. This is unusually early; but I have a record of a nest from Pejivalle on the Caribbean slope of Costa Rica which must have been begun in January (it contained newly hatched young on February 6) and a number of records of building and even laying in February. These early nests were active during the drier months. By March, when the short dry season of southern Costa Rica draws to a close, the nesting operations of the House Wren have reached their height, and they continue for the next six or seven rainy months. I have several records of August nests and one of laying in

mid-September, which was not a successful nesting. October and November are the only months in the year in which I have seen no evidence of breeding in Costa Rica, but Richmond (1893) observed them building in Nicaragua in November.

The House Wren's wide range, both latitudinal and altitudinal, and long breeding season are matched by its amazing variety of nest-sites—three marks of a highly successful species. Almost any nook or cranny of the proper size, above or below the ground, in natural objects or the artifacts of man, may be chosen to contain the nest, as described above.

Although the nests are usually situated where sheltered from the rain, I have found them in the deep central cavities of decaying palm or hardwood stumps, and in the central hollow of a timber bamboo, open to the sky although completely walled about the sides. Nests are rarely very high, about 15 feet above the ground, in a roof, bird-box, or bunch of bananas being the loftiest I have seen, although Harrower (1936) records a nest 30 feet above the ground in a steel railroad signal tower. I have known wrens to sleep in woodpecker holes far higher than I have ever found them nesting. Doubtless the difficulty in carrying up the multitude of sticks they use in building sets a limit to the height of the nest.

The space chosen for the nest is filled almost to capacity with coarse twiglets, straws, and similar materials. Male and female share this labor about equally, although the former is often the most energetic when the task of carrying in coarse material begins but leaves to his mate most of the finer work of applying the lining. While building he sings frequently, doing so even as he carries a stick in his bill. If the cavity to be filled is spacious, a great bulk of this material is brought. In the difficult feat of passing long sticks through a narrow aperture already partially blocked by the protruding ends of earlier acquisitions, the female of one pair was somewhat more dexterous than her mate; but another male displayed much skill in this fussy business. The trouble is that the wrens try to pass through the doorway while grasping the stiff pieces near the middle and both ends are stopped by the surrounding rim. Sometimes while struggling with the stick they get a hold toward an end and it slips through, but often the piece slips from their bills and drops to the ground. As a rule, the birds fail to retrieve this fallen material; but its loss affects the male little and he continues to sing, flying off to search for new pieces. Often when he brings nothing himself he goes to the doorway, always singing, to look in when his mate is inside.

While one female built her nest on a shelf formed by the foundation beams beneath a cabin set on posts on Barro Colorado Island, her mate busied himself in piling sticks on the top of a round tobacco tin standing on the beam at the opposite side of the house. Here he placed all the material that the narrow lid would hold, which was not nearly enough to complete a nest. Rarely he carried a stick to his mate's accumulation. Such divergence of activity of the male and female House Wrens is most exceptional in my experience.

At the top and back of the mass of sticks that serves as a foundation, the wrens leave a deep hollow, to be lined with fine grasses, fibrous rootlets, pine needles where available, vegetable fibers, horse hairs, and innermost of all, downy feathers, pieces of snake-skin, and, at times, even scraps of cellophane or paper. The lining is applied chiefly if not wholly by the female, while her mate continues to sing and to fetch superfluous sticks that get in her way. She struggles to arrange these unwanted contributions of her partner, and at times she may deliberately carry some of them away. One female drove off her mate whenever he approached with unwanted sticks and even pulled a feather from his back when he entered the box while she lined it. At other times the male may fetch flexible material for the lining, yet his inclination to bring stiff sticks at all stages of the building process is strong.

A large gourd, from which I had removed all material after a first nesting, was in less than four days filled to above the level of the door sill by both sexes working together. Then the female devoted four or five days more to lining the nest, making a total of about eight days for the whole construction. But another pair filled a nest-box and applied the feather lining in only four days. Even while she incubates, the female gathers downy feathers or fragments of snakeskin and brings them to the nest when she returns to her eggs. Before the nestlings hatch most nests are profusely lined with feathers, the innermost placed so that their distal ends curve inward over the eggs and make them hard to see.

THE EGGS

The earliest set of eggs for which I have a record was laid in El General between December 27 and 30, 1936, but sets before late February or March are not common in Costa Rica. Even when she sleeps in the nest before or during the period of laying, the female seems to leave at dawn, but soon returns to deposit her eggs, which are laid early in the morning on consecutive days. Nineteen eggs, of which I determined approximately the hour of laying, appeared before 7:00, and at least 13 of these before 6:30. The interval in which the eggs are laid extends from a little before to a little after sunrise. Although with the domestic hen and some other birds each succeeding egg in a series is laid a little later in the day, this is not true of the House Wren, which tends to lay all the eggs of a set at about the same hour of the morning (see Skutch, 1952:53). In Central America the usual set consists of four eggs, with three frequent and five very rare. From Costa Rica, Guatemala and Panamá I have records of one set of two (perhaps incomplete, although no more appeared in the nest), 13 sets of three, 22 sets of four, and two sets of five (both laid apparently by the same female in consecutive years). In Trinidad the usual set of the House Wren consists of four or five eggs, and there is a record of one nest with "eight eggs of equal incubation, which might all have been laid by one bird" (Belcher and Smooker, 1937:509). Beyond the tropics, in Argentina, this wren is said by Hudson (1920:18) to lay sets of nine eggs, a surprisingly large number.

Although in Costa Rica the House Wren may rear four broods in a year, the size of the set bears no relation to its order in the sequence of nests. On several occasions sets of four were followed by sets of three; and the two sets of five were both found in late nests. Chapman (1929:70) tells of a bird-box with two nests of the House Wren each containing eggs. There had been two pairs of wrens in the vicinity, but no study was made to determine whether both nested in the same box. House Wrens are so strongly territorial and so intolerant of trespassers, that this would be a most unusual situation.

The eggs of the House Wren are rather short and blunt. They have a whitish ground color which is densely flecked all over with fine markings of brown, reddish-brown, cinnamon, or pinkish-cinnamon. On some the pigmentation is heaviest on the thicker end; on others it is nearly uniform over the entire surface and almost obscures the ground color. Thirty-nine eggs measured at the nest in Central America average 17.8 by 13.4 millimeters. Those showing the four extremes measured 19.4×13.5 , 17.9×13.9 , 16.7×13.5 , and 17.1×12.7 millimeters.

My only considerable number of nests from a single locality are from the Basin of El General in southern Costa Rica, between 2000 and 3000 feet above sea-level, and were found during the years 1936 to 1951, inclusive. Eggs were laid in 44 nests as follows: December, 1; February, 4; March, 7; April, 9; May, 6; June, 5; July, 7; August, 4; September, 1.

INCUBATION

The eggs are incubated by the female alone. Although similar in appearance, it is easy to distinguish the sexes during the nesting season by their voices, and at one nest

favorably situated for observation from my window, I could often distinguish the two by their bills, the lower mandible of the male being extensively yellowish or horn-color, that of the female largely black.

Attendance at the nest by night may start before or after laying begins but, in my experience, always before the set is completed. Sometimes the female wren uses the nest cavity as a dormitory even before she and her mate begin to build in it. At Nest 30 she slept in the nest-box for at least three weeks before the pair began to take in sticks for their first nest of the season and continued to do so during the period of building. Thrice I have known the female to sleep in the nest with fledglings before beginning to lay the eggs for the following brood; the family continued this custom during the period of laying and subsequent incubation. In all, I have recorded nine instances of the female's occupying the nest by night before beginning to lay. In four instances the female began to spend the night in the nest after laying her first egg. At one nest she did not begin to do so until after the second of the four eggs was laid. At one nest, the female's behavior was irregular: she slept in the nest-gourd on the night of June 3-4, but not on the two subsequent nights. On the morning of June 6 she laid her first egg, then resumed the practice of sleeping in the gourd. The warming which the early eggs receive before the set is complete is reflected in the time of hatching, which is sometimes spread over two days.

By day, the House Wren is an impatient sitter. I watched one wren while she incubated her first set of eggs. During six hours she took 12 sessions, ranging from 8 to 20 minutes in length and averaging 14.1 minutes; and 12 recesses, varying from 11 to 24 minutes in length and averaging 15.7 minutes. Thus she spent only 47.3 per cent of the six hours on the eggs.

This same wren, nesting in the same gourd, sat more closely while I watched her incubate her third set of eggs later in the year. Now, during 9.5 hours, she took 14 sessions, ranging from 14 to 44 minutes in length and averaging 25.8 minutes; and 14 recesses ranging from 8 to 29 minutes in length and averaging 14.4 minutes. She devoted 64.2 per cent of the 9.5 hours to incubation.

Some years later I watched another wren incubate the eggs of her third brood when they were on the point of hatching. During six hours of the morning she took 11 sessions, ranging from 5 to 26 minutes in length and averaging 19.6 minutes; and 11 recesses, ranging from 6 to 18 minutes and averaging 11.4 minutes. She was in the nest-box for 63.3 per cent of the 6 hours. During 21.5 hours of watching at three nests, the longest continuous session on the eggs was 44 minutes, the second longest 35 minutes.

Other species of *Troglodytes*, as the North American House Wren (Baldwin and Kendeigh, 1927:213) and the European Wren (*T. troglodytes*) (Armstrong, 1952:229) are equally restless sitters. A Highland Wood Wren (*Henicorhina leucophrys*) which I watched for nine hours took sessions ranging from 8 to 28 minutes, with an average of 16.4, and covered her eggs only 49.4 per cent of the time. But wrens of other species may incubate far more steadily. For the Lowland Wood Wren (*H. leucosticta*) and the Riverside Bay Wren (*Thryothorus nigricapillus*), which I watched for 7 and 3½ hours, respectively, the only sessions timed were in excess of one hour. Nice and Thomas (1948:142-146) found the Carolina Wren (*Thryothorus ludovicianus*) an extremely steadfast sitter, often remaining on the eggs for two hours or more without interruption.

While the female House Wren incubates, her mate is usually attentive, singing profusely in the vicinity, sometimes escorting his partner when she returns to the nest, driving off intruders, and from time to time entering the nest-cavity or at least putting his head through the doorway. But I have not seen him give food to his mate before the eggs hatched, as happened at one nest of the related Rufous-browed Wren (*Troglodytes rufociliatus*) in the Guatemalan highlands.

At one nest, an incubating female would leave the nest, pause a short distance away, and voice a fine resonant trill in answer to the mate, which was usually singing not far off, relaxing and fluttering her wings as she trilled. At another nest situated beneath the tiles of my roof, I would sometimes hear the female sing a little twittering song to herself while she incubated.

At a single nest at an altitude of 8500 feet in the Guatemalan highlands, I found the incubation period to be 17 days. At 13 Costa Rican nests, situated between 2500 and 3000 feet above sea-level, the incubation period varied from 14 days, 9 hours (± 3 hours) to 16 days, 2 hours (± 2 hours). At eight of these nests the period fell between $14\frac{1}{2}$ and $15\frac{1}{2}$ days, and the average length of the incubation period might be stated as 15 days. At nests where the eggs were not marked in the order of laying, I considered the incubation period to be the interval between the laying of the last egg to be laid and the hatching of the last egg to hatch. When the eggs were marked, the period was taken to be the time between the laying of the last egg and the hatching of this egg. At six nests where the eggs were marked as laid, the last to be deposited was also the last to hatch; and I have noted no exception to this rule.

The three or four eggs which constitute the set do not hatch simultaneously. When daily visits are made to the nest, some of the eggs will be found to have hatched on one day and the rest the following day. More rarely the hatching is spread over three days. At nest 25B, where visits were made more frequently, the first egg (of the set of four) hatched about 12:30 p.m. on July 24 and the last, as indicated above, between noon and nightfall of the following day. At nest 27, all three eggs hatched within a period of 21 hours or less. At nest 29A all three hatched between 8:15 a.m. and 5:00 p.m. on the fifteenth day after the last was laid—that is, within nine hours. The eggs may hatch at any hour of the day. With a single exception, eggs have hatched in the order of laying. Empty shells are carried away by the female wren.

CARE OF NESTLINGS

The nestlings begin to receive food soon after they hatch.

At 12:28 p.m. on July 24, 1944, I found the first egg hatching in a nest-box in my yard. The nestling was just squirming out of the broken shell, of which the cap had already been removed from the nest. At 12:42 the female flew off with the main part of the shell. The male, who during the course of the morning had thrice entered the box, went in again at 12:35 while the female was within, probably brooding. It is doubtful whether at this visit he saw the contents of the nest. He came out in less than a minute. At 12:43 he followed his mate into the box as she returned from another outing and stayed within for two minutes, probably viewing for the first time the first nestling. At 12:53 he returned with a very small insect, apparently passed it to his mate on the nest, and sang. Thus, food was brought for the young wren within about half an hour after it hatched. Four minutes later the male brought food the second time, then took in a number of morsels at intervals of a few minutes. No food was seen in the female's bill until 2:06, 73 minutes after the male first brought a morsel. Before this she had carried away the empty shell of the second egg, and the male had brought food seven times.

The following March 24 I watched events attending the hatching of the nestlings at this same nest-box, presumably with the same pair of House Wrens. The eggs began to hatch during the night, and before sunrise the female had carried out at least three pieces of shell. She first brought food at 5:50, 20 minutes after she became active in the morning. By 10:40 that morning the male had not yet taken a morsel into the nest, where there were now three nestlings. The delay in bringing food did not arise from any lack of attention to the nest, for during the first four hours of the morning he entered the nest-box seven times. On six of these visits he found his mate within, presumably covering the nestlings. (Female passerine birds, as I have seen at nests of a number of kinds, do not as a rule make any special effort to "inform" their mates that their eggs have hatched.) But at 8:41 the male went into the box while the female was absent and remained for about two minutes. Then for two hours following this long visit he brought no food; this makes it seem probable that he was still unaware

that the nestlings had hatched, for with other birds that I have studied at this critical period in the history of the nest, the sight of the nestlings led more promptly to the bringing of food. During the latter part of the same day, or at latest early the next morning, the male wren learned of the existence of the nestlings; by seven o'clock on their second morning of life he was bringing food to them.

In my experience, the male House Wren, as a rule, begins to take a full share in feeding the nestlings by their second day, at the latest.

So far as I have seen, the nestlings are given only small invertebrate animals, conspicuous among which are spiders, hairless caterpillars, small grasshoppers, cockroaches, and moths. At times several insects are brought at once. Male and female take substantially equal shares in feeding the nestlings, sometimes one, sometimes the other making more numerous visits to the nest during a period of observation. The male often sings as he approaches with a full bill.

At times the parents are aided in attending the nestlings by youngsters of the preceding brood. I have seen this with only one pair, and in only one of the two years in which I studied this pair; but during the second year it was regular, juveniles of the first brood helping to feed the nestlings of the second, and these in turn, after they were grown, bringing food to the nestlings of the third brood.

Rates of feeding are rather variable. At one nest the male, in an initial spurt of activity, brought food seven times during his first hour of feeding. At the beginning of this hour there was one newly hatched nestling, at the end two. It is possible that the female, sitting on the nest, consumed part of this food herself. During the following hour, the male brought only two morsels to the two nestlings, the female only one. At another nest where the male was tardy in beginning to feed, the female brought food 17 times during the first five hours of the day. At the beginning of this period there were two newly hatched nestlings, but during the last three hours there were three.

Two nestlings three days old were fed ten times during two hours, or at the rate of 2.5 times per nestling per hour. Nestlings from 9 to 18 days old have been fed at rates varying from 4.3 to 8.4 times per nestling per hour, during observation periods of from three to four hours. These were in broods containing three or four nestlings.

In Surinam, Haverschmidt (1952:295) found feeding rates of the Southern House Wren to vary from 2.8 to 5.3 times per nestling per hour, with little change in rate as the young aged from 5 to 14 days. With my wrens, a single nestling attended by an older brother and sister as well as its parents was fed at greatly varying rates. During four hours on its eleventh and twelfth days, the four attendants brought food only 11 times, or 2.8 times per hour; but on the thirteenth day three attendants brought food 31 times in 2.5 hours, or 12.4 times per hour.

The female alone broods the nestlings. At one nest the female greatly increased her time on the nest just after her first egg hatched, when her mate was bringing food at a rapid rate, probably in excess of the nestling's needs. The first egg had hatched soon after noon. During the six hours preceding the hatching, the female had incubated 63.3 per cent of the time. But during the 2.25 hours following the hatching of the egg she brooded 90.4 per cent of the time, once for 35 and once for 29 minutes continuously. During the morning her longest session had been 26 minutes. Her longest absence was now only four minutes, although before the eggs hatched her recesses had varied from 6 to 18 minutes in length and averaged 11.4 minutes.

At a second nest, during the first five hours of the morning when the eggs hatched and when the male still brought no food, the female brooded 21 times, for periods ranging from 2 to 21 minutes and averaging 9.2 minutes. Her 21 absences varied from 1 to 16 minutes and averaged 5.4 minutes. She brooded 63 per cent of the five hours. Thus her total time on the nest was about the same as that observed at other nests during the

course of incubation; but she came and went much more frequently, both her sessions and recesses being from one-half to one-third as long as those recorded for incubating House Wrens.

The nestlings are brooded, by day, in decreasing amounts until they are 9 or 10 days old, when their feathering is well advanced. In one instance, the female brooded the nestlings by night only until they were 13 days old; but two other female House Wrens continued to keep their young company through the night until they were 18 days old.

Nearly all the House Wrens that I have studied nested in cavities with such narrow entrances that it was impossible actually to watch the nestlings. But in 1937 I had a nest in a gourd with a wide round doorway. While the young were growing up, I moved this to a position where from my window I could look right into the cavity and see the four little wrens resting in their dimly lighted nest. I wished to learn whether there was any arrangement to ensure the equal partition of food among the several youngsters.

The instant one of the attendants reached the doorway, four widely opened orange-yellow mouths were stretched eagerly forward to greet it. As soon as it alighted upon the door sill, the parent placed the insect or spider it had brought into one of the four mouths which gaped so prominently in front of it, probably the nearest, if there was any choice in this respect. There never seemed to be a moment's hesitation which might indicate a weighing of claims of the several young. Nor did the parent remove food from the mouth of a nestling who was sluggish in swallowing it, to place it in another's, as birds which rear their families in open nests commonly do. Probably because House Wrens so often nest in dark crannies where it is difficult to watch the food disappear, they have not adopted this method of equitable distribution among the members of the brood. With this same species in Surinam, Haverschmidt (*ibid.*:294) likewise found that at each feeding visit all the food was delivered to a single nestling.

Thus, when the nestlings were all very hungry, and all equally prompt in opening their mouths upon the arrival of food, it seemed largely a matter of chance which received the nourishment. But later in the day, when they were well fed and feeling drowsy, the one whose hunger happened to be the sharpest was usually the most alert, and the first to stretch forward its open mouth; and almost always this one was fed. It frequently happened that a second or two after the parent had reached the doorway, all of the nestlings had become aroused and clamorously pushed forward their open mouths; but by this time the wide-awake nestling had already swallowed the food brought. Thus the very rapidity with which the parents delivered the food tended to equalize its distribution among the members of the brood. The sizzling chorus of *cheeps* that issued from the gourd each time food arrived was made chiefly by those nestlings who failed to receive it; the one whose mouth was filled promptly became silent.

Only three of the four young wrens could find room in the front of the nest; and of these three one was usually forced to remain well to one side of the doorway. The fourth had to be content with a position in the rear, where it looked over the heads of its nest-mates. When hungry, it struggled from time to time to push into the front row; and in the end these periodic struggles would result in a shifting about of positions. In order to deliver a dropping into the bill of a parent, the nestling had to turn quite around. This was a frequent cause of rearrangement, because before the youngster could face forward again, it was likely to be pushed aside by an eager nest-mate.

At the age of twelve days, the young were well feathered and began to preen their fresh plumage. When fifteen days old, they would sometimes venture beyond their nest into the forward part of the gourd; and by the following morning some had become bold enough to push their heads through the doorway and look around for the approach of their attendants with food. They had begun to peck at spots, or perhaps small crawling

insects, which attracted their attention within the gourd. When an insect flew past their doorway, two which had been looking out made a move to snap it up in their bills, but were not quick enough to catch it. But it was interesting to see that even before leaving the nest they had begun to look for food for themselves. Now some of them perched on the rim of the nest to sleep, like grown birds, instead of crouching down in the hollow for the female to brood them, as they had done when younger. The female ceased to sleep in the gourd several days before the nestlings were old enough to leave it, but an older brother continued to keep them company during the night.

DEPARTURE OF YOUNG FROM THE NEST

Young House Wrens as a rule leave the nest on the eighteenth day after hatching. I have records of 26 nestlings in 11 nests that left at this age. Less frequently they depart on the nineteenth day; 12 nestlings in seven broods took leave at this age. One nestling left, in company with three older ones, on the seventeenth day. One exceptional youngster, in a nest where apparently only two eggs were laid, lingered until the twentieth day after hatching. If disturbed, however, the young may quit the nest sooner. From a nest which was molested by some school-children, the four young wrens were frightened into the open when 17, 16, 16, and 15 days old, respectively. As a rule, the fledglings leave the nest during the forenoon, usually rather early in the morning. The most common time of departure is around seven o'clock in the morning, after the young have been well fed by their parents; but from one nest all three flew before 6:06 a.m.

Despite their slightly varying ages, the members of a brood usually leave the nest more or less together. The three young wrens of nest 6B hopped out of the gourd within the space of five minutes. The following year, the three members of a brood left this gourd during the course of half an hour. Three youngsters flew from nest 26, in a bird-box, during the course of two minutes; and four left nest 34, in the same box, in five minutes. But the departure of four fledglings reared in this box some years earlier was spread over 4 hours and 37 minutes, the first going at 7:43, the second at 8:58, the last two at 12:20. One of these youngsters was under 18 days of age. Nest-leaving is a contagious process; it takes place when the majority of the brood are 18 or, less frequently, 19 days old; and younger members come out with their elder siblings.

There appears to be a rather widespread belief among ornithologists that young birds generally quit the nest in response to the urgings of their elders. Although there are well-documented records of such coaxing, most of them make it clear that the parents were alarmed or made uneasy by apparent danger, often by the presence of the observer. In the absence of all external disturbance, the departure of young from the nest in obedience to parental insistence is certainly exceptional rather than the rule; and some apparently good examples of such behavior are open to alternative explanations, or difficult to interpret. Thus Nice (1948:151) reported that a male Carolina Wren apparently tried to coax the nestlings out of the basket where they were hatched, while the female seemed to try to lead them back into it! According to Perry (1946:141, 178-189), Razor-bills (*Alca torda*) and Guillemots (*Uria aalge*) call and coax the older chicks to leave the nest-sites on the cliffs and take to the sea, but their departure seems to be determined chiefly by their own internal state. Although in the absence of external menace parent birds do not often lure their young from the nest, they are more frequently successful in enticing fledglings that have spontaneously departed to move on to a place of greater safety. This, according to Hann (1937:186), is the way of the Ovenbird (*Seiurus aurocapillus*).

While watching from concealment, or at a good distance from the nest and using field glasses, I have witnessed the departure of young birds of a number of species, and

nearly always this has impressed me as being quite spontaneous. Even when parents did seem eager to have later members of a brood follow the first into the open, as with a pair of Inquisitive Tityras (*Tityra inquisitor*), their urgings appeared to have little or no effect upon the movements of the youngsters. There are accounts of parent birds withholding food from their little ones to make them quit the nest, or displaying a morsel in front of them without delivering it, to induce them to come out into the open and receive it. In instances where I have witnessed such conduct by the parents, it has seemed to me to result from the circumstance that a youngster, about to take its spontaneous departure, has occupied the position where the old birds have been in the habit of alighting in order to deliver food. When a young Black-chinned Jacamar (*Galbula melano-geria*) stood in the mouth of its burrow in a bank, the parents, arriving with insects, sometimes fluttered in front without delivering the food, not, I believe, in an attempt to lure the fledgling out, but simply because it rested in the only position where they could conveniently alight and deliver what they held in their bills. Often youngsters that remain in the nest are neglected while members of the brood that have flown receive nearly all the food; but it would be unwarrantable to assert that the parents give less to those in the nest with the intention of forcing them through hunger to quit the nest.

While watching from a distance, often through a window, I have witnessed the undisturbed departure of nine broods of House Wrens, and in every instance they seemed to leave as a result of inner promptings rather than of parental pressure. Often, as the time for their emergence from the nest approaches, the young wrens seem undecided whether to go or stay. A growing restlessness impels them to move from the dimly illuminated nest toward the outer light. They perch in the doorway of the box or gourd, voicing sharp little calls, and may even hop outward along a coarse stick which the parents, when they built, left projecting beyond it. As if fearing a fall, they draw back into the dim security of the familiar chamber, sometimes repeating this again and again before at last they leave. But at times they lean too far outward; strenuous efforts to pull themselves back into the cavity are vain; they lose their hold upon the door sill and flutter earthward.

Often the youngsters fly from the nest immediately after the visit of a parent bringing food, although the adult, so far as can be seen, has done nothing to encourage their departure. As the moment for quitting the nest draws near, a very slight disturbance can upset them and cause them to leave. While I watched a nest containing two well-feathered Guimet Hummingbirds (*Klais guimeti*), the passage close by of a bird so small and harmless as a Pipromorpha (*Pipromorpha oleaginea*) caused a youngster to fly out. With the wrens, the slight excitement attendant upon the presence of the parents, whom they associate with food, sometimes provides the stimulus to flutter from the nest.

How easy it is to misinterpret the actions of the parents while the young are leaving the nest, especially if observation is only casual, was brought home to me while I watched a brood of four House Wrens depart from a nest-box in my garden in 1943. Two of the youngsters had already flown away and two lingered in the box. As usual, the fledglings in the open received the greater share of the parents' attention; and by the middle of the morning the stay-at-homes were becoming hungry and called much. They stood in the doorway, then one climbed out to rest on the end of a projecting twig, which the adults had taken part way into the box. While the youngsters were in these positions, a parent twice brought a morsel of food, perched in front of the box, then carried the food away. After a while a parent returned with an insect and found one fledgling on the end of the projecting twig, but the other had gone back within the box. Brushing past the youngster in the open, the parent took the morsel to the one inside. Thereupon

the first young wren returned into the box, too. Several times more I saw a parent neglect a fledgling in the doorway and give food to the one inside. So long as both were within, the morsel was never carried away undelivered, as when both were in the doorway. During their final days in the hole, young woodpeckers of several species spend much time with their heads in the doorway, but they learn to draw back inside when a parent arrives, thereby facilitating the delivery of food.

A pair of House Wrens which occupied a gourd in an orange tree evinced considerable concern over the exit of their family. The main facts in the departure of a second brood from the gourd, witnessed from the window of my cabin close by, are as follows:

During the morning of the departure of the young, the male sang repeatedly, doing so more frequently than he had sung of late. The female was also excited, fluttering her wings as she approached the nest with food. After leaving, she frequently alighted on a nearby twig to quiver her relaxed wings. She also *churred* and rattled a good deal. Sometimes she entered the gourd and remained inside with the nestlings a few minutes, which the male never did. The nestlings were noisy and appeared frequently in the entrance, all three nestling heads occasionally visible in the doorway.

Later in the morning, when all three young were again at the doorway, one at the right side of the doorway tried to leave by climbing out on the side of the gourd. But the smooth, hard, bulging surface afforded no foothold and the young wren then tried to retain its perch on the sill, to which it still clung by one foot. But its stubby tail was already outside the entrance, its position was awkward, and its two nest-mates pushed from behind. After a few moments of struggle, it fluttered down among the thorny branches of the orange tree and managed to catch a foothold on a branch.

Almost as soon as the first fledgling left the gourd, the second fluttered forth weakly. The third hesitated two or three minutes, then launched forth in the same uncertain manner. Both second and third young also came to rest among spiny branches.

The greatest excitement now prevailed, with parents and young all calling. Both parents flew in and out of the gourd again and again, just as they did more than two months before when the fledglings of the first brood were coaxed to return to their nest for the night. They also entered, several times, a second gourd in the same tree, below the one used as a nest. Up to this time, this larger gourd had been ignored.

Aided largely by the thorns of the branches of the orange tree, the fledglings managed to flit, flutter and scramble up toward their parents, who continued to go in and out of the gourds, especially the one which the young had just left. It appeared for a while as though the old birds would indeed lead the young back to the nest; but just as they came close to it, the parents changed their tactics. Now both male and female parents flew down into low weeds about thirty feet from the orange tree, one singing and the other *churring*. They returned to the orange tree and again flew to the weeds, repeating this over and over. One young flew in the direction followed by the parents, and on its first flight covered a measured 50 feet, in a slightly descending course, to alight clinging to the rough trunk of a small guava tree. The other two young promptly followed, but covered somewhat shorter courses of only 33 feet. The young wrens then descended among the weeds, and for the remainder of the day, the family roamed about the weedy pasture.

THE YOUNG WRENS AFTER LEAVING THE NEST

When they leave the nest the young wrens closely resemble their parents in plumage, although if reared late in the season their colors may be brighter than those of the worn feathers of the adults. They are at first readily distinguished from the parents by their shorter bills, yellow corners of the mouth, and persistent tufts of natal down. Immediately upon quitting the nest, most fledglings can fly from ten to twenty yards at a stretch, but slowly and with poor control. During their first days in the open they follow their parents and are fed amid the grass or weeds or dooryard shrubbery.

As evening approaches they are led to a sleeping place by their parents. The lodging selected for the fledglings after their first days afield is usually not far distant from the nest. Sometimes they will be led back to sleep in the nest itself, if this is not infested by

vermin, or not too difficult of access. More often they are sheltered in some neighboring cranny. Four fledglings raised in a hole in a roadside bank in the Guatemalan highlands went to sleep in a niche in the same bank, ninety yards distant from the nest. A brood reared beneath the tiles of a roof—a situation most difficult for unpracticed wings to reach—were taken to sleep in a bird-box attached to the walls of the same house, and much more readily accessible. But they rested here only a few nights; and as soon as they were sufficiently strong, their parents showed them the difficult feat of slipping up under the tiles at the edge of the roof. Successive broods reared in a gourd in an orange tree were sometimes led back to sleep in the gourd itself, once in a hollow banana stump in a yard near by, and again in the thatch of the neighboring cabin. I have even known young fledglings to be taken to roost in the open nests of tanagers and finches, with close-set, sheltering foliage roundabout.

As night approaches, the parent wrens usually come alone to make a preliminary inspection of the sleeping nook before bringing up the young family. The young wrens have a strong inclination to follow their elders, who, when they wish to lead them to a certain point, fly back and forth between their offspring and the destination, until at length the fledglings reach it. The same procedure is used to bring the young wrens to their place of rest, the parents often going in and out, in and out, many times over, the male usually singing the while.

Sometimes the adults select a sleeping nook beyond the skill of the young to attain. Then they continue in the failing light to urge the young to reach the difficult site; but at last, as darkness falls, the adults fly off to their own roosting places, perforce leaving the fledglings in the foliage or the grass. Or at times one member of the brood, weaker than the others, is unable to follow its brothers and sisters to their lodging; it then falls asleep wherever it chances to be. As a rule, those young wrens which pass a night or two exposed to dew or rain suffer no ill effects from the exposure. If the first evening the adult wrens choose a sleeping place that proves impracticable for their fledglings, the next day they may hit upon something easier to reach.

I believe that, even without the example of their parents, House Wrens newly emerged from the nest would instinctively seek shelter at the approach of evening; but doubtless, as with the Red-crowned Woodpecker (*Centurus rubricapillus*) and the Hairy Woodpecker (*Dendrocopos villosus*), a number of nights may pass before they are successful in discovering a suitable lodging. Indeed, the instinct to find a closed place at nightfall develops in House Wrens even in advance of the age at which they normally quit the nest.

One brood of a pair that nested in a gourd beside my cabin was frightened prematurely from the nest by some children, when one was 15, two 16, and the fourth 17 days of age. At the end of their first day in the open, two of the young wrens entered a passageway between the kitchen and the main part of the cabin, and climbed up the rough boards of the wall, all quite spontaneously, it seemed to me. But they failed to reach the roof, or any sheltering cranny. Later, the parents tried to lead them from a point in the yard to the lowest part of the thatch and, this proving inaccessible, then to a conveniently situated low gourd. But the young wrens were by now too tired or drowsy to make much effort to follow. At length, they settled down in a low bush in the yard, pressed close together on their perch. From time to time, as darkness deepened, one youngster would hop upon the back of its neighbor, showing that it was more natural to them to sleep snuggled together than to perch—and at the same time upsetting the other fledgling wren and causing a general reshuffling of the group.

Different broods of House Wrens, even when they emerge from the nest at the normal age of eighteen days, vary considerably in strength and skill in flight; and there is likewise marked diversity in this respect between the members of the same brood. Once they have been led to their sleeping place in the evening, the parents usually but not invari-

ably carry in food to them and remove their droppings. Like fledgling Golden-naped Woodpeckers (*Tripsurus chrysauchen*) and Blue-and-White Swallows (*Pygochelidon cyanoleuca*), after being taken to roost they are treated exactly as though they were nestlings that had never used their wings. Finally, as the light wanes, the female may come to join the young for the night. On this point, female House Wrens differ; and even the same individual may vary her procedure with different broods. If the fledglings have been led back to the nest or taken to some well-sheltered nook, she is more likely to sleep with them than when perforce they spend the night in a more exposed situation. In the morning, the young wrens linger in their shelter for about half an hour after the adults become active; and their first food is brought to them there. As the days pass and the young birds grow stronger, their time for retiring in the evening and becoming active in the morning gradually approaches that of the adults.

The period over which young House Wrens receive attention from their parents and are allowed to reside in the parental territory varies greatly from brood to brood; but at best the tie between old and young is never so lasting as with Golden-naped Woodpeckers and Banded Cactus Wrens (*Campylorhynchus zonatus*). Some House Wrens find part of their own food after they have been out of the nest only ten days and are not more than four weeks old. Others, especially the last brood of the season, may receive some food from their parents until nearly two months of age.

The three localities where I followed for the longest periods the behavior of young wrens after leaving the nest are as follows: above Tecpán in the highlands of west-central Guatemala, at an altitude of about 8500 feet; Rivas in the valley of El General in Costa Rica, at about 3000 feet; and Quizarrá in the same valley at about 2500 feet, about ten miles from Rivas. My observations at Tecpán covered a period of about eight months, from May to December, 1933; at Rivas, one and a half years in 1936 and 1937; at Quizarrá, the decade from 1942 to 1952, although not with equal thoroughness throughout this long period. After the foregoing general statement, based upon observations made at several localities in Central America in addition to those just mentioned, I shall describe briefly the variant behavior of these three groups of House Wrens.

In the high mountains of Guatemala, the House Wrens appeared to raise only a single brood, in April and May, when the great majority of birds of other kinds nested. One pair, indeed, began a second nest in June, as though to produce another brood; but although the female slept on the nest, she laid no more eggs. It was interesting to follow the gradual dispersal of the single brood of young wrens, without the complicating influence of subsequent broods. Their mode of sleeping, in niches in the roadside bank where they were easy to find, greatly facilitated the study. On the last day of May, four days after their departure from the nest in a burrow, I found the four fledglings sleeping in a shallow niche in the earthen bank, about 90 yards from the similar but deeper cavity in which they were reared. The female parent did not pass the night with them; apparently there was not room for her in the cranny, which was barely big enough to accommodate the four closely packed fledglings. Two nights later, the wrens lodged in a neighboring niche, 50 feet away. This was screened by vegetation drooping from the top of the bank, and also it was more capacious. I believe that five wrens—the female and her four fledglings—were cuddled together here; but to count them with accuracy was difficult.

But when they had been out of the nest for only nine days, the young wrens began to lodge apart. Three slept in one cranny in the bank, the other with a parent in a neighboring niche. Thirteen days after their departure from the nest, two fledglings slept together, one alone; the fourth had vanished; and the female slept on the new nest she never quite completed. But at the end of June, when they had been a month in the open,

I again found three wrens sleeping together, in the entrance to a burrow that a pair of Blue-throated Green Motmots (*Aspatha gularis*) were digging. The motmots had chosen as their starting point one of the niches where the wrens lodged. As soon as they completed their subterranean chamber and began to occupy it by night, they scattered the little brown wrens, who retired earlier and arose later than their bigger neighbors.

After this, I found the wrens sleeping always in solitude. By the end of July, two months after the departure of the young from the nest, four, including both parents and offspring, slept in as many niches spread out along 50 yards of roadway. I was no longer able to distinguish the adults from the young. Four wrens, apparently always the same individuals, continued to take shelter in the same stretch of bank where the nest had been, but not always in the same niches, until the end of the following November. But at the time of my last visit in mid-December, I could find only three. Although each member of the family lodged alone after the young had been out of the nest a little over a month, the latter remained in the parental home-area for at least half a year longer.

At Rivas in 1936, three young wrens of the first brood, hatched in April, were taken by their parents to sleep in the gourd where they grew up. Here they continued to roost beside the female while she incubated her second set of eggs. After the nestlings of the second brood were born, these full-grown older brothers and sisters were refused admittance by the female when they came to join her in the evening. The young wrens were persistent in their attempts to enter, and the male assisted in driving them away from the entrance. After their expulsion, he slept in the gourd with his mate and the nestlings. This is the only instance I have known of a male House Wren's sleeping in the nest with his mate, although the male of another pair tried to join his partner at nightfall but was repulsed by her. After their eviction from the gourd, the young wrens, now over two months old, promptly vanished from the vicinity. After the fledglings of the second brood left the gourd, they were taken to sleep in an old banana stump and other provisional quarters for a few nights, until they were strong enough to fly up and roost in the thatch of my roof. The young of the third brood were likewise led to sleep amid the sugar-cane leaves of the thatch.

The following year, 1937, the same pair of House Wrens nested in the same gourd and, after trying half-heartedly to evict the young of the first brood from the gourd, permitted them to sleep in it while the nestlings of the second brood were growing up. The two surviving wrens of the first brood then began to feed the one surviving nestling of the second brood. This unusual situation led to complications which are related in detail in the following section.

Until 1943, I had seen House Wrens lead their fledglings to sleep only in snug cranies where they were sheltered from the rain; or if at the end of their first day in the open the youngsters were not strong enough to reach an adequate shelter, they were allowed to sleep in an exposed position only until they could fly to a better one. But the House Wrens which nested beneath the newly laid tiles of my roof at Quizarrá in 1941, and each succeeding year have reared their broods either in this roof or in a bird-box that I provided for them in the garden, have behaved in a manner which invalidates some of my earlier generalizations.

In front of the house, at the edge of the high terrace on which it stands, is a row of calabash trees (*Crescentia cujete*) whose leathery foliage is borne in close clusters along the thicker branches as well as the terminal twigs. Amid this sheltering foliage, tanagers of three or four kinds and the Variable Seedeater (*Sporophila aurita*) each year built their open, cup-like nests. In August, 1943, one of the fledgling wrens of the third brood, who had emerged from beneath the tiles only two days earlier, was found sleeping in the abandoned nest of a Blue Tanager (*Thraupis episcopus*) in the calabash tree

with the fullest and most leafy crown. I believe that other members of the brood may have been led to rest in other open nests higher in the tree, where they could not be seen in the dense foliage. The young wren occupied the tanager's nest only a few nights, then moved to undiscovered quarters.

When the fourth brood of wrens left the bird-box in the middle of September, 1943, they were at first taken to sleep beneath the tiles of my roof; but for reasons unknown to me they did not continue to lodge here. A few nights later I found that at least two were roosting in an open nest built by a Song Tanager (*Ramphocelus passerinii*) in the top of the calabash tree, well screened by the foliage. A little later they shifted to what remained of a tiny nest of a Variable Seedeater, a structure originally slight, and now so dilapidated that it hardly deserved the name of nest. But the leaves clustered thickly about it afforded the young wrens some protection from the wind, if not from the rains which at this season fell almost every night. One of these wrens continued to make this frail remnant of a nest its nightly lodging for more than two months, or until early December. Then it changed to the well-weathered remains of the open nest built five months earlier in the crotch of a neighboring calabash tree by a pair of Golden-masked Tanagers (*Tangara nigro-cincta*). Here it was in an exposed position and partly visible from the ground as it slept. Each evening, as it went to roost, it would approach in silence, then voice a few slight, nervous-sounding notes when about to enter the nest. Sometimes, instead of in the tanager's nest, the wren slept in a crotch a foot higher, where it lacked even the vestige of a nest but enjoyed better concealment by the foliage. The bird continued to roost in the old tanager's nest until about the beginning of February, when it vanished from the vicinity, probably having been driven off by the parents as they prepared for the new season's nesting operations. This House Wren had followed, until at least five months of age, an unusual habit of sleeping formed, apparently under parental guidance, as a fledgling newly emerged from the nest.

The following April these same parents led their three newly emerged fledglings to sleep amid clusters of foliage at the very top of one of the calabash trees, at least 20 feet above the edge of a high bank that falls away to pastureland below. To my knowledge, there had never been a nest of any kind in this spot, and the sleeping fledglings were not wholly invisible from the ground. On subsequent evenings they made trial of neighboring leafy bowers, finally settling on a crotch between four thick, mossy boughs, well screened by foliage. Here two of them continued to lodge for at least a month, finally vanishing in May, while the female was incubating her second set of eggs in a bird-box.

The second and third broods of 1944 were treated like the first, the fledglings being taken to sleep in the calabash trees where they were exposed to the rain. Here some of the youngsters continued to roost during the worst of the wet season; these open crotches were occupied by two wrens until the following January and by one, probably the female parent, until nesting was resumed toward the end of February, 1945. In this year, too, these wrens adhered to the tradition of allowing their young to sleep in exposed places. The fledglings of the first brood were, it is true, taken to sleep in the nest-box after their first day in the open. But the box had been invaded by a colony of big, black, carrion-eating ants, and the young did not again return to it. Instead, they slept in a hillside pasture behind the house, creeping into fissures and crannies of the rotting stumps where they were not well shielded from the rain. After a few nights here, they went to roost in the calabash trees where five broods of their predecessors had slept during the two preceding years. The second brood of 1945 was a failure. Two fledglings of the third brood, reared beneath the tiles at the back of the house, at the end of their first day afield, went to roost on an exposed branch at the very top of a neighboring guava tree. Here they slept, pressed close together, through a rainy night.

In subsequent years, the pair of wrens about my house have varied their procedure, sometimes taking their fledglings to sleep in an open nest amid the foliage, sometimes into a bird-box or a snug cranny that provided shelter from the rain.

Although adult House Wrens often possess dry shelters, I have never known one to retire to its dormitory by day in order to avoid a wetting. Young wrens sometimes do so, at least if a rain falls late in the afternoon. When a shower started at about 5:15 on May 21, 1937, three 27-day old wrens, which had been hopping about in the vicinity of the gourd where they slept, went into this shelter and stayed until the rain stopped. Then they came out and did not retire for the night until considerably later. Two days after this, a shower at five o'clock drove only one of the youngsters to the sheltering gourd. Since none of its comrades followed, it promptly came out and took a wetting in company in preference to dryness in solitude!

YOUNG HELPERS

In describing the sleeping arrangements of young wrens, I mentioned the fact that when permitted to roost in the nest-cavity where the nestlings of the succeeding brood were growing up, they helped to attend these younger brothers and sisters. Such helpfulness by juvenal House Wrens is so closely associated with their manner of sleeping that the two subjects can be treated separately only at the expense of some repetition. Although with a few birds, as Banded Cactus Wrens and White-tipped Brown Jays (*Psilorhinus mexicanus*), nests appear to be regularly attended by juvenal or unmated helpers (Skutch, 1935), this situation is unusual among House Wrens. I have found it in only one family of the many that I have watched; but here it was of regular occurrence during one nesting season, when the young of two consecutive broods helped in turn to feed the nestlings of the subsequent broods. This helpfulness appeared to be dependent upon the close association between the young of two broods when they slept in the same nest-cavity. In only this single family have I known older young to roost in the nest-box or gourd for more than a few days after the subsequent brood hatched, and only in this family did I discover juvenal helpers.

This was the family of wrens which for two seasons nested in the gourd that I had placed in the orange tree beside my thatched cabin at Rivas in the valley of El General. In 1936, the three fledglings of the first brood were led by their parents to sleep in the gourd where they had been hatched. They continued this custom while the parents renovated the nest and during the whole period of hatching out the second set of eggs. But as the youngsters grew older their parents became increasingly opposed to their sleeping in the gourd, and this growing antagonism resulted in their eviction from it and disappearance from its vicinity during the ten days after the hatching of the second brood.

In 1936 this pair of wrens did not begin to breed, so far as I know, until late March, when the great majority of small passerine birds in the region were also preparing to nest. But after molting in October and November, this pair resumed nesting at an exceptionally early date, laying the first egg of a new breeding season on December 27. Their offspring of the present season seemed more precocious than the broods reared by the same parents in the preceding year. They were stronger in flight and seemed more self-reliant, uttering fewer calls than the fledgling of the earlier broods at the same age. Because of their greater precocity, which made them better able to resist the parents' efforts to evict them from the gourd, and also, it seemed to me, because of greater indulgence by the parents themselves, one of these young wrens succeeded in remaining with the nestlings of the second brood during the whole of their period in the nest.

Two of the four eggs of this second brood vanished mysteriously during the period of incubation. The other two hatched on March 13, 16 days after the last of the nest was laid. When I watched the family retire on the evening of March 15, I judged from the hesitant approach of one of the young, and its sudden retreats, that the female, already brooding inside the gourd, was opposing its entry. Later, however, all three young wrens of the first brood went into the gourd for the night. Soon

after this one of this trio vanished. I believe that this was the one which for some days had been in the habit of remaining away from the gourd until after the male parent had gone to roost in the thatched roof of the cabin, although the other two young had already entered the gourd while he still sang close by it. This could have been the young male who had already, at the age of 46 days, given his first warbling juvenal song and was thereafter looked upon by his father as a rival.

Of the two youngsters who continued to sleep in the gourd, one had the lower mandible extensively yellowish or horn-color, as in the adult male; the other's bill was almost wholly black, as in the adult female. Hence I inferred that the first (Y) was a young male, the second (B), a young female. My belief that the black-billed youngster was a female was confirmed when later she voiced the typical weak song of the female wren. The young could still be distinguished in a good light from the parent of the same sex by the lingering yellow at the corners of their mouths and at other times by the immature notes they often voiced.

While the parents fed the newly hatched nestlings of the second brood, Y and B would from time to time visit the gourd during the day. If the parents coming with food caught them there, they tried to chase these self-supporting offspring away. However, the parents' opposition to these visits, especially that of the female parent, was on the whole relatively weak. Once I saw the male knock one of the youngsters to the ground. But after March 24, when I first saw a young wren of the first brood bring food to the one remaining nestling in the gourd, parental antagonism to their presence all but ceased. I am not certain how two eggs and one nestling had vanished from this well-enclosed nest, but surmise that the scuffles attending the attempted exclusion of the older youngsters were somehow responsible for their loss.

When I first saw a young wren take food into the gourd, on the afternoon of March 24, it was 69 days old. It lingered within for 23 minutes, during which the male thrice passed food to it through the doorway, the female once. Presumably the food was delivered by the young wren to the nestling. During 12 of these minutes the female was in the gourd with the young wren. The following day I saw the female peck at a young bird when, without bringing food, it tried to enter the gourd with her. But later the female and a youngster spent 16 minutes together in the gourd with a nestling.

On the morning of March 26, I watched for two and a half hours, during which the male took food to the single nestling 15 times, the female 9 times, and B 7 times—31 feedings in all. Y came twice to the gourd and each time lingered within for several minutes, once in company with B. Much of the food brought by the male and some of that brought by the female was passed to B for delivery to the nestling. With gaping mouth and quivering wings, she begged for the food like a hungry fledgling. Once, too, I saw her, again with vibrating wings, yield food to the female at the doorway. But when B, resting in the entrance of the gourd, begged for food from Y as she arrived, she refused to relinquish it, pushing past him into the chamber, where together the two remained for a minute.

With only one nestling, already nearly fledged, and two young assistants to help attend it, the parent wrens were far from fully occupied. In a guava tree about 60 feet from the orange tree that held their old nest was a smaller gourd chosen by the wrens for their next nest. Early in the morning of March 28 they went together to the guava tree and sang exuberantly, the male repeating again and again while his partner accompanied him with her simple *twitting* refrain ending in a musical little trill. Then the two set about to fill the new gourd with light twiglets picked up from the ground. At intervals they interrupted this activity long enough to take food to the nestling in the old gourd. With two nests in different stages simultaneously claiming their attention, it is not surprising that occasionally they brought an insect to the new gourd where only twigs were wanted, or offered a billful of twigs to the hungry nestling. This inedible material was usually deposited with the young who could not swallow it, but occasionally the parents discovered their error in time and carried it across to the new nest.

B, who early in the morning had been feeding the nestling quietly enough, began at about seven o'clock to behave queerly. Advancing to a small tree midway between the two gourds, she voiced a sharp, rapid *twitting*, much like the "song" of some adult female House Wrens, but a performance weaker than that of an adult. Thence she proceeded to the guava tree and tried to enter the gourd where her parents had just begun their new nest, while the adult female strove to drive her away. The excitement now became intense; the birds flitted around so rapidly that it was scarcely possible

to recognize them individually. B, perching in one spot in the guava tree, for a long time quivered her relaxed wings and twitted. The female flitted nervously about and threw up her wings with a rapid, twitching motion, while the male sang loudly and incessantly.

Soon after this preliminary bout the wrens took food to the nestling. B delivered food to the female parent, which had just brought food to the old gourd and remained to move sticks that she and her mate had carried in by mistake. But when the parents resumed work on the new nest, B again followed and started to enter the new gourd. Thereupon the adult female clinched with her, and the two tumbled to the ground. Thus began the longest and fiercest series of battles that I have ever witnessed among birds of any kind. The young female was clearly the aggressor. The adult female did not oppose B's attendance to the nestling in the old gourd but fought her intrusion into the new one. Yet B persisted in visiting the new gourd. At first the old gourd with the nestling was regarded as neutral territory; but before long B tried to keep the adult female out when the latter arrived with food; and when the adult female forced her way in, another fight began. The quarrelsome young wren even pecked savagely at Y as he came to the doorway without food; but Y withdrew tamely after two such rebuffs.

There was no actual skirmishing between B and the adult male, but when, in the absence of the female, B entered the new gourd, the male continued to dart at the doorway until she left. Between the adult female and B there were numerous severe struggles through a long day. Often the two grappled in a gourd for short periods, then rolled out and fell to the ground clutching each other. The male never entered a gourd where a battle was raging, but stood singing near the doorway and prevented Y from going in. The older female was clearly the stronger. In one unusually violent bout, the two tumbled about on the ground, then for a long while lay gripped together, scarcely moving, until one cried out. The adult female at last flew off without difficulty. B could only flutter up to a low weed stalk, where she hung upside down by one foot, the other, temporarily disabled, clutching helplessly at the empty air. Half her tail feathers were missing, and there was blood on her chin. But after a minute she could perch upright once more, and before five had passed she was again pursuing her parents, quivering her wings and *twitting*.

After these encounters, the female, showing no signs of battle or fatigue, would come to the gourd in the orange tree, look in, hear the calls of the nestling, then go off and in a minute or so return with food. The male, as the morning advanced, gave less attention to carrying sticks into the gourd and more to the nestling. Y, also, now began to bring food frequently. His specialty was long green larvae, while the others brought chiefly cockroaches captured in the thatch of my roof. As time passed, the female and B (its daughter) seemed to tire and fought less vigorously.

During the afternoon, all four of the grown wrens brought much food to the nestling. The female drowsed in the orange tree, closing her eyes for a few seconds at a time; while B, sitting in the doorway of the gourd only a few feet away, rested in similar fashion. Yet until evening B persisted in following the female about, *twitting* and quivering her wings, to which the older wren usually reacted by moving away.

That evening the female and Y retired early into the gourd with the nestling. B later joined her mother and brother (Y) in the gourd. The male delivered a final song in the twilight, then went to sleep in my roof.

Next morning B went off by herself and was absent most of the day. The male, completely occupied by singing and filling the new gourd, seemed to forget about the nestling. He built alone most of the time; for, with her most active helper gone, the female had to give more attention to the nestling. But Y assisted her, both in bringing food and cleaning the nest. When I went to look into the gourd, Y scolded with a harsh, sharp *churring* and dared to come closer to me than the female parent. In order to see what he would do, I put my hand over the doorway of the nest, whereupon he flitted wildly among the branches of the orange tree, scolding loudly, and approaching to within a yard of my hand. That night he alone took charge of the nestling, while the female slept in the new gourd and the male in the roof. Next morning the female again made the mistake of putting a sheaf of indigestible building material into the nestling's gaping mouth!

Early in the morning of March 31, the single nestling left the gourd, eighteen days after hatching. Since its lower mandible was wholly yellowish, I inferred that it was a male—a supposition later confirmed when I heard it singing. To distinguish it from its elder brother, I will refer to it as M.

Both of these young males, representing two broods, slept with their mother in the new gourd that night. The parents had now taken into this gourd all the sticks it could hold and were lining the hollow they had left at the rear to receive the eggs. Only six days after M left the old gourd, the first of another set of four eggs was laid in the new gourd. Before this happened, Y disappeared, leaving only M to sleep in the gourd while the female incubated this third set of eggs. Nest-building over, the male now attended the youngster (M) while the female incubated.

This time all four eggs hatched and all four young were fledged. M slept with them on most nights until they left the gourd. M also fed them, but not so frequently as their parents. During a sample period of two hours on the morning when the four nestlings were 13 days old, the male brought food 21 times, the female 18 times, and M (54 days old) 5 times. It was easy to distinguish him from the male, not only by the persisting yellow corners of his mouth, but by his manner of approaching the gourd. Both parents would fly up to the doorway from the front in a direct, efficient manner; but M usually first alighted in the lower part of the orange tree and advanced toward the gourd in a circuitous course, sometimes passing behind it, then doubling around to the entrance. As he fitted from twig to twig he betrayed his immaturity by voicing a few low *tics* or *tucs* or a little *churr*, just as the helpers of the first brood used to do when they came to feed a nestling. After delivering what he had brought to the young, M would often linger close by in order to beg with quivering wings for the food the parents brought. Sometimes his pleading was rewarded, and then he would pass the food to one of the nestlings. M was always eager to remove their droppings. Once when one was delivered to the female, M seized an end of the white pellet in his bill and pulled until part of it broke away. Then each of the two carried off a part. Sometimes M would carelessly drop a fecal pellet, which would lodge on a leaf below the doorway and later would be removed by the female.

A few days after the young of the third brood were driven prematurely from the nest by some children, M died while sleeping beside one of the fledglings in a gourd. I could discover no cause for his sudden death. I did not remain at Rivas long enough to learn whether the young wrens of the third brood would carry on the family tradition by helping to attend those of the fourth, which the female was hatching in the gourd when I left in June.

Four years later I returned to El General and built a house on my own land, which even before completion was claimed as a residence by the usual pair of House Wrens. But because these wrens, as already related, so often trained their fledglings to sleep in open nests of other birds rather than in their own nest-box, they lacked the close association with the nestlings of subsequent broods which seems necessary to induce them to feed these younger brothers and sisters. In 1947, however, a brood of fledglings was led to sleep in the nest-box just outside the dining-room window. After the female began to incubate her next set of eggs in this same box, the male repeatedly tried to drive the young off when they came to enter in the evening, but without success. Once the female pecked at one young as it came out of the doorway in the morning. Despite these rebuffs, one young wren of the first brood still slept in the nest-box when the eggs of the second brood hatched. Two days later the nestlings vanished mysteriously.

Alfaro (1927:369) tells of a young House Wren which "under parental compulsion" helped to bring material to a new nest its parents were building in a box attached to a wall in his laboratory. No similar instance has come to my attention with wrens, although juvenal European Barn Swallows (*Hirundo rustica*) and other birds have been known to assist in nest-building (Nice, 1943:79).

FIRST SONGS OF YOUNG MALES

I have heard the first essays of song by a young male House Wren when it was only 34 days old. Although capable of finding a good deal of food for itself, it still followed the male parent, begging for additional nourishment. Another young wren was first heard to sing when 46 days old; its weak song was practiced while the male parent sang nearby. When this young wren flew he was closely pursued by the father. A young wren in another locality, one of a late brood hatched on August 30 was first heard singing

at the end of October, when two months old. This juvenile sang for a long while, giving low warble. The adult male was in the shrubbery in the yard and delivered scolding notes toward this juvenile. Soon both vanished.

The earliest song of the juvenal House Wren is an indefinite sequence of low notes with no set phrasing, often hardly more than a whisper song, and wholly different from the short, clear, sharp, structurally complex verses of the adult male. A similar contrast between the low, diffuse, vague song of the beginner and the short, loud, sharply stereotyped phrases of the adults is found in the Chinchirigüí Wren (*Thryothorus modestus*) and the Riverside Bay Wren (*T. nigricapillus*), as well as in finches and other birds.

NUMBER OF BROODS

We can now consider, in more detail than previously, the length of the breeding season of particular pairs, the interval between successive broods, and the number of broods undertaken in a year. My information on this subject is derived almost wholly from two groups of birds: the pair which in 1936 and 1937 nested in a gourd in an orange tree beside my cabin at Rivas; and the pair or pairs which for the last decade have nested at times beneath the tiles of the roof of my present residence at Quizarrá in the same valley, at other times in a bird-box provided for them in the garden (see table 1).

In 1936, the pair that nested in the gourd successfully reared three broods between April 1, the approximate date of laying the first egg of the first brood, and September 11, the date of the departure of the two fledglings of the third brood. These young received food from their parents until mid-October. Then, on December 27 of the same year, the female wren, after a rest from family cares of less than three months, laid the first egg of what I consider to be the first brood of a new breeding season. When I left this locality in mid-June of 1937, the wren was incubating her fourth set of four eggs for this season, having laid 16 eggs and successfully raised at least one fledgling in each of the three earlier broods. If she continued to breed as long in 1937 as she did in 1936, when she began to nest much later, she could have reared or attempted to rear five broods that year.

My information about the wrens at my present house contains certain gaps, because sometimes they build beneath the tiles of the roof where it is not feasible to visit the nest. However, even when the nest was inaccessible, I could calculate the approximate date of laying from the known date when the young emerged from beneath the roof. Table 1 gives a summary of the breeding activities of the wrens about my house for six years from 1943 to 1949, with the exception of 1946.

It will be noted in the table that in 1948 six broods were attempted, although only one was successfully fledged. This is the greatest number of nesting attempts by any single pair of House Wrens in one year that has come to my notice. In 1943, in a nesting season extending from the end of January, when building began, to September, four broods were fledged; but the exact number of young that left these four nests is not known, because some grew up beneath the tiles where they could not be counted. This is the greatest number of successful broods that I have recorded. In some years, as 1944 and 1949, only three broods were attempted. When the wrens use the same nest for a later brood, they throw out the old lining of feathers and add a new one.

The last column in table 1 gives the intervals in days between the departure of the fledglings of one brood and the beginning of laying for the subsequent brood. These intervals between broods ranged from 6 to 66 days. The last is so long that I suspect that the pair may have tried, unsuccessfully, to rear another brood, in some nook which escaped me, in the interval between the two recorded nestings. The exceptional circum-

stances attending the laying of the first of a new set of eggs only six days after the departure of the nestling of the preceding brood are recounted in some detail above in the section on "Young Helpers." Leaving aside these extremes, but including a 28-day interval that I recorded in another part of El General, 15 intervals between the emergence of one set of fledglings and the resumption of laying ranged from 14 to 36 days, with

Table 1

Summary of Nesting Records of House Wrens at Rivas (1936, 1937) and Quizarrá (1943-1949) in the Valley of El General, Costa Rica

Year	First egg laid	Size of set	Young left nest	Number fledged	Interval between broods
1936	ca. Apr. 1	?	ca. May 6	3	
	ca. June 9	3	July 14	3	ca. 34 days
	Aug. 6	4	ca. Sept. 11	2	23
1937	Dec. 27 ('36)	4	Feb. 1	3	
	Feb. 22	4	Mar. 31	1	21
	Apr. 6	4	May 10	4	6
	June 6	4			27
1943	ca. Feb. 6	?	Mar. 14	3	
	ca. Apr. 19	?	May 25	?	ca. 36
	ca. June 24	?	July 30	?	ca. 30
	Aug. 13	4	Sept. 17	4	14
1944	ca. Mar. 8	?	Apr. 13	2	
	May 10	3	June 14	2	27
	July 8	4	Aug. 12	4	24
1945	Mar. 6	4	Apr. 11	4	
	June 16	3	(lost)		?66
	ca. July 13	?	Aug. 18	3	
1947	Feb. 28	3	Apr. 5	3	
	Apr. 21	4	(lost May 11; aged 2 days)		16
	May 21	4	June 24	2	10*
	July 10	4	Aug. 14	3	16
1948	Mar. 6	3	(Eggs deserted by Mar. 11)		
	Mar. 26	3	(Eggs lost by Mar. 30)		15*
	Apr. 16	4	(Killed by ants)		17*
	May ?	?	(Lost in June)		
	July 9	5	Aug. 15	4	
	ca. Sept. 14	2	(Eggs lost Sept. 16)		ca. 30
1949	Mar. 23	4	Apr. 29	4	
	ca. May 24	4	ca. June 30	4	ca. 25
	ca. July 17	5	Aug. 20	?	ca. 17

* Interval between the loss of eggs or nestlings and laying the first egg of the next brood.

an average of 24.5 days. Those figures in the last column of table 1 that are marked with an asterisk are not intervals between successful broods, but between the loss of eggs or nestlings and the laying of the first egg of a new set. In one instance when newly hatched young disappeared from the nest, a new set of eggs was begun ten days later. In two cases when the eggs were lost a few days after laying, the first egg of the replacement set appeared 15 and 17 days later.

Only in the single instance of the pair which began to build a new nest while their older children helped to feed the one surviving fledgling have I known the Southern

House Wren to begin preparations for a new brood before the nestlings of the previous brood had taken wing. But with the North American House Wren, Kendeigh (1941:46) found six examples of this behavior, which he calls "multiple nesting," out of the great number of nests which he studied. The female of this species may even begin to lay again before she has finished caring for the first brood. At times the female North American House Wren actually abandons her first brood to start a second brood the sooner, but such desertion does not ordinarily occur without provocation. When the female neglects them, the male will as a rule take care of the young, but although he feeds them he does not brood or stay with them during the night. Sometimes the female's second nesting is in the territory of another male. With the non-migratory Southern House Wren, the bond between the sexes is stronger than with the migratory North American House Wren, and the male of my pair shared his mate's interest in both the new and the old nests.

Although I, myself, have never observed another instance of parent birds of any species preparing for a subsequent brood before the young of the earlier brood had left the nest, this practice, apparently uncommon, is by no means confined to wrens. Thomas (1946:159) records an instance of a Bluebird (*Sialia sialis*) which started to build a new nest two days before the one surviving nestling of the first brood had left the nest-box. With Cedar Waxwings (*Bombycilla cedrorum*) Putnam (1949:172) found that the pair commonly built their second nest while still attending their first brood, and that the female began to lay again in the interval extending from the day before the first brood was fledged to three days after, the male meanwhile feeding these earlier young. One Great Tit (*Parus major*) laid the first egg of her second set a full 24 hours before her first brood flew from the nest; and three other female tits resumed laying the day the first brood left the nest-box, presumably an hour or two before this event (Gibb, 1950:516). A female Ruby-throated Hummingbird (*Archilochus colubris*), which receives no assistance from a mate, built a second nest while attending her first, and incubated two eggs while she cared for the single nestling of the earlier brood (Nickell, 1948:242). Similar multiple nesting has been repeatedly observed in the related Black-chinned Hummingbird (*A. alexandri*) by Cogswell (1949:176-178). I watched a female White-eared Hummingbird (*Hylocharis leucotis*) feed a well-grown fledging of the previous brood in the intervals of warming her second set of eggs, but so far as I know she did not begin to build this second nest until this young had flown from the first nest. All the foregoing examples refer to nidicolous birds; but among nidifugous species an overlapping of broods fully comparable to any of the preceding cases was observed by Gross (1949:43), while studying the Antillean Grebe (*Colymbus dominicus*) in Cuba. While incubating their fifth set of eggs, the parents fed four young of the preceding brood, only three weeks old, and even found time to give a few morsels to youngsters of the second and third broods.

The great fecundity of the Southern House Wren, far exceeding that of any other passerine bird of Central America for which I have information, helps us to understand its great range and explains why, in a region where a rapidly expanding human population is constantly destroying the forest to make room for agriculture, there are always wrens to take possession of each new clearing and establish a territory at each new dwelling.

NESTING SUCCESS AND CAUSES OF LOSS

I know the history of 26 nests found before the eggs hatched—in all but a few cases before the set was complete. All but three of these nests were situated in the valley of El General. These nests contained a total of 90 eggs, of which 68 (76%) hatched, and

from which 51 (57%) young were fledged. Seventeen of the 26 nests produced at least one living fledgling. This overall nesting efficiency of 57 per cent may be compared with the success of 14 species of hole-nesting passerine birds in the Northern Hemisphere tabulated by Allen and Nice (1952:640). Results compiled from 32 separate studies of these 14 species show an efficiency of 66.2 per cent. Although this is better than the record of my House Wrens, some of the individual studies show nesting success to be far lower than these wrens'. Four separate studies of the North American House Wren, summarized in Nice's table (*loc. cit.*), show that nesting success ranged from 48.3 to 83.7 per cent. My own numerical result is based upon too few nests to be of much significance, but I give it because of the paucity of information of this sort recorded for tropical birds.

Six of the 90 eggs, although remaining in the nest, failed to hatch. One of these contained a dead embryo, and others were apparently infertile. The only other known cause of losses of eggs and nestlings was ants. In three cases ants were definitely responsible for the destruction or desertion of nests, and in several additional instances they fell strongly under suspicion. Ants of a number of kinds establish their colonies in crevices in trees such as wrens use for sleeping and breeding, and even in bird-boxes and cranies about human dwellings. Some are carnivorous and destroy young birds. However, the discovery of dead nestlings being devoured by ants is not proof that these insects killed them. The ants might have begun to consume them after they died from other causes. Thus, the nestlings in a hollow stump, open to the sky in an unshaded field, might have died from excessive heat or drowned during a rainstorm, then have been found by the ants during the several days that elapsed between my visits. But ants of a variety of kinds are certainly one of the major enemies of nesting birds in the tropics, and they not infrequently attack nestlings at higher latitudes.

A bird which makes its nests in saddle-bags, bunches of bananas, and other objects of human use, must frequently be dispossessed when these things are needed by their owners. A friend of mine managed to get along without his saddle-bags until the young wrens in them were fledged; but not everybody is so considerate of birds. Domestic chickens sometimes catch weakly flying fledglings that have fluttered to the ground on emerging from the nest. Since the wrens so often nest in dooryards where poultry roam, this must be a not infrequent cause of loss. I personally have witnessed two instances of this. In some parts of its range, at least, House Wrens are subject to parasitism by cowbirds, as reported by Haverschmidt (1952:295) and others.

COMPARISONS WITH OTHER WRENS

It may be profitable briefly to compare the life history of the Southern House Wren with that of other wrens, particularly with its congeners in the genus *Troglodytes*, as known to us from the published accounts of Kendeigh (1941), Bent (1948), Armstrong (1952) and others. With the North American House Wren, Kendeigh (1941:47) found that about six per cent of the matings were polygynous, and with some populations of the European Wren the incidence of polygyny may approach 50 per cent, but no instance of a plurality of mates was noticed in my studies of the Southern House Wren. While it is true that the number of pairs that I observed with any care is small, the male's constant participation in nest-building and large share in feeding the young at all stages indicates a pattern of activities incompatible with polygamy. In remaining in pairs throughout the year, the Southern House Wren behaves in the fashion which appears to be typical of the non-migratory species of this predominantly Neotropical family (Skutch, 1940), but has perforce been modified by the few species of wrens which, as a consequence of extending their range far into the north, became wanderers or migrants during the cold winter months.

Among these far-northern species of *Troglodytes*, in both *T. troglodytes* and *T. aëdon*, the male starts or even finishes the foundation or shell of the nest before the female arrives on his territory. The presence of the coarser constituents of the nest in a suitable site is his invitation to potential partners. After inspecting the available nest-site, the female proceeds to line and finish the nest by herself. But pairs of Southern House Wrens, which have in many instances been long associated on their territory, build together from the start. The male may indeed be somewhat more active in bringing the first sticks, but in other instances it is the female; and always I have found that both participate in this preliminary part of nest construction. But in leaving to his mate the greater part of the task of lining, particularly the innermost lining of downy feathers, while he in some cases continues to fetch superfluous sticks, the male Southern House Wren shows an approach to the condition exemplified by his northern congeners.

The Southern House Wren is more prolific than many species of Central American wrens; yet even within the tropics its usual set of four eggs is equalled or exceeded by the sets of other genera, notably the wrens of the genus *Campylorhynchus*. As with other wide-ranging species, the clutch size of the Southern House Wren increases with latitude, until beyond the tropics, in Argentina, it may produce sets of nine eggs, a number which compares favorably with those known for the North American House Wren and the European Wren.

Like its northern congeners, the Southern House Wren guards a territory from which it zealously excludes rivals of its own species, and from which as a rule it drives its offspring after they can take care of themselves. I have never known two pairs to nest in or about the same house, or even in two buildings separated by as much as fifty yards, although crannies suitable for a number of their nests were not lacking. In the districts where my studies were chiefly made, pairs were so widely scattered that I could learn little about the extent of the territory claimed by each. I have seen little of territorial disputes between adults. Among tropical birds resident in the same area throughout the year, the acquisition of territories is effected with far less visible friction than among migratory species which must claim their home site and settle differences with neighbors in the course of a few weeks. Hence I directed my attention to the relations within the family rather than to those between neighboring families.

Both the incubation and nestling periods of the Southern House Wren are substantially longer than those of its North American counterpart, being normally 15 and 18 days, respectively, for the former, but only 13 and 15 for the latter. Thus the interval between the beginning of incubation and the departure of the young from the nest is typically 33 days for the Southern House Wren and 28 days for the North American House Wren. The difference of five days in favor of the northern species more than offsets the two to four additional days required to lay its larger sets of six to eight eggs; so that although the northern bird rears the bigger family, it does so in a shorter period. A similar acceleration in the rate of development of embryos and nestlings at higher latitudes, when compared with that of tropical members of the same family, is found in other groups of birds, including wood warblers, swallows, and finches. Young North American House Wrens become independent of their parents about 13 days after quitting the nest; whereas young Southern House Wrens, especially of the season's last brood, may receive some food from their parents five weeks after leaving the nest.

Not only is the development of embryos and young speeded up in the northern species, the interval between broods is likewise diminished. In 57 instances observed by Kendeigh (1951:54), the interval between the first brood's departure from the nest and the female's beginning the second nest ranged from three days before the first brood flew to 17 days after they flew. Forty, or 70 per cent of all the records, showed an

interval of 7 to 13 days, with the largest number, nine, falling at 11 days. My own records on the interval between broods are more explicit with respect to the time elapsed to the laying of the first egg of the second brood than to the beginning of the second nest, because in many instances the old nest was merely relined to receive the second set of eggs. The North American House Wren may complete a late nest in two days. Even if we make the liberal allowance of five days from the beginning of building to the laying of the first egg of the second set, and add this to the values for the interval between broods given by Kendeigh, it will be seen that it is still considerably shorter than that for the Southern House Wren, which in my studies averaged 24.5 days.

In northern United States, the House Wren's breeding season extends from May to late July or August; and despite the acceleration of all parts of the reproductive cycle, only two broods can be raised in this period. With its far longer nesting season stretching from February or March to July, August, or even September, the Southern House Wren, despite its more leisurely program, succeeds in rearing three or four broods, laying three or four eggs for each. Thus the total number of eggs laid in a season, 11 to 16 in the more fecund pairs, equals or exceeds the 11 to 14 of the North American House Wren's two broods (Bent, 1948:121-122). It is unusual for a Central American bird to exceed in productivity its near relatives at high latitudes. Most of the passerine birds in this valley, producing each year only two or three broods of two or, less often, three eggs each, have a reproductive potential lower than that of members of the same groups nesting well beyond the tropics. This seems to be correlated with the lower mortality of birds which live the year around in a region of constantly flourishing vegetation and abundant insect life, as compared with those which must face either the hazards of a long migration or the rigors of a period of low temperatures and paucity of food (Skutch, 1949:432).

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SUMMARY

This is a report of observations on the habits of the Southern House Wren (*Troglodytes musculus*) made in Central America and chiefly in Costa Rica, over a period of 20 years. In this region the species inhabits deforested lands ranging from sea-level to somewhat more than 9000 feet. The birds remain in pairs on their territories throughout the year.

The male sings more or less freely in all months, except while molting toward the end of the year. The female has a far simpler song, which she sings chiefly in response to her mate.

Adults when not nesting sleep singly in a great variety of nooks and crannies in trees, banks, houses, bunches of bananas, and other situations. The male commonly arises a little earlier, and retires a little later, than his mate.

At lower altitudes in Costa Rica, the breeding season sometimes begins at the end of December, more usually in February or March, and continues until August or September, thus including both dry and wet seasons, chiefly the latter. Cavities used for nesting are of the same great variety as those used for sleeping. Male and female together fill the chamber with many coarse sticks and straws. The lining of fibrous materials and then of feathers is applied chiefly by the female. The male sometimes helps with this, but may continue to bring sticks which get in his mate's way and are at times removed from the nest by her. Nest-building occupies about four to eight days. The female sometimes sleeps in the nest cavity before building begins.

Eggs are laid about sunrise on consecutive days. Central American sets consist usually of four eggs, often of three, very rarely of five, questionably of two. The size of the set bears no relation to the order of the season's broods.

Only the female incubates, taking many short sessions and recesses. She continues to bring feathers and bits of snakeskin during the period of incubation. The male comes from time to time to look into the nest. The incubation period is usually 14.5 to 15.5 days, rarely as much as 17. Eggs hatch at all hours of the day.

The male may begin to bring food to the nestlings within half an hour of hatching. The nestlings are fed small insects, spiders, and other invertebrates. The sexes take about equal shares in feeding, but the female alone broods.

The young remain in the nest about 18 days, often 19, seldom 17 or 20. They usually leave before eight in the morning, seldom after midday. Nine broods watched as they left took wing spontaneously, without parental urging.

As night approaches, newly emerged young are led by their parents to a dormitory, which is sometimes the nest itself but more often some sheltering cranny not far from it. Exceptionally the parents take the youngsters to roost in open nests of other birds. The parents go in and out of the chosen dormitory many times over, until at last the fledglings succeed in imitating them. After the young enter, the parents may feed them in the dormitory and remove droppings. The young may also be fed before leaving in the morning. The female may sleep with the fledglings or apart from them.

Young wrens find at least part of their food ten days after leaving the nest, but some, especially those of the season's last brood, may be given some food by the parents five weeks after leaving.

When the young are taken back to sleep in the nest space, they may continue this habit while the mother hatches out the next brood in the same cavity. From one nest they were forcibly evicted by the parents about the time the eggs hatched, and from another soon after hatching. At one nest, however, two young of the first brood persisted in sleeping with the nestlings despite parental opposition. After their parents began to tolerate them at the nest by day, these youngsters brought much food to the one nestling.

The young female who was feeding the nestling, when 73 days old, became antagonistic toward her female parent. After a day of fierce fighting, she was worsted and left the vicinity. The young male continued to attend its younger sibling until the latter was fledged. This fledgling of the second brood helped feed and otherwise attend nestlings of the third brood. This helper was feeding nestlings at the age of 54 days.

With two youngsters helping to feed a single nestling, the parents built a new nest in which the female started laying the season's third set of eggs six days after the one and only nestling left the second nest.

One young male was first heard singing when 34 days old, another at 46 days. The diffuse, rambling juvenile's song differs considerably from that of the adult's.

At lower altitudes in Costa Rica, a single pair may rear three or four broods in a year. One pair attempted six broods but raised only one. Leaving aside one extreme case mentioned above, the interval between the fledging of one brood and the resumption of laying ranged from 14 to 36 days, with an average of 24.5 days.

In 26 nests, 90 eggs were laid and 51 young fledged, giving a nesting success of 57 per cent. Ants were the only known cause of loss of nests.

The incubation period, nestling period, and interval between broods are substantially longer for the Southern House Wren than for the North American House Wren; but at lower altitudes its nesting season is so much longer that it produces three or four broods instead of the latter's two, and its annual production of eggs is the same or

greater. This is exceptional for birds of the humid tropics when compared with related species at high latitudes. The Southern House Wren has the highest reproductive potential of any passerine bird of Central America for which we possess adequate data.

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