

LIFE HISTORY OF THE CACTUS WREN PART V: FLEDGING TO INDEPENDENCE

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Our earlier papers on the life history of the Cactus Wren (*Campylorhynchus brunneicapillus*) in the vicinity of Tucson, Arizona (1957, 1959, 1960, and 1961), covered the nesting cycle up to the time the young left the nest. The present paper describes the activities of the young wrens from fledging to attainment of independence.

We have divided the first year of a Cactus Wren's life into four periods which we define as follows: A nestling is a wren still in the nest. When it leaves the nest for the first time, it becomes a fledgling and it remains in this category until independence is reached. From then on it is termed a juvenal bird until the postjuvenal molt in the fall of the year is terminated. After the completion of this molt the wren is an immature, but it is indistinguishable in the field from its parents.

WEIGHTS OF FLEDGLINGS

In the days immediately following fledging the rate of gain in weight appears to be rather low. It may possibly fall to zero, or there may even be a loss of weight for several days due to delays and postponements of feeding which occurred often as the fledglings dispersed in the territory and became involved in dangerous man-caused situations. In addition, the efforts of the adults to direct their fledglings back to their nest in the evening were time consuming and frequently difficult because of human activities.

The low rate of gain in weight that we observed may not be typical. One might suspect that in the absence of disturbances in the original, natural habitat there would be a higher rate. However, the tendency to increase in weight could be offset by the greater difficulty of obtaining insect food in the open, waterless desert.

Wren H-32, which weighed 29.1 grams at the age of 11 or 12 days, was trapped when it was 25 or 26 days old (5 days after fledging); at that time it weighed only 30.1 grams. H-80, trapped at 37 days, weighed 36.8 grams; H-26, at 38 days, weighed 34.6 grams; and H-78, at 39 days, weighed 40.9 grams. At the age of 54 days, H-76 weighed 41.6 grams. Evidently at the age of about 38 days, two and one-half weeks after fledging, the weight attained is within the range of adult weights. Wing and tail length have also reached adult size by this time.

The mean weight of 42 fully grown Cactus Wrens, trapped from 1940 to 1960, including juvenal birds that were feeding independently of their parents, is 38.9 grams. More than half of these birds were weighed in the afternoon or evening; none of the remainder was weighed earlier than 8:50 a.m. About two-thirds of the wrens were weighed in the months of August, September, November, and December. The sample is too small to permit any safe analysis of weight variation in the course of the year, or of differences between the sexes. A range in weight of from 33.4 to 46.9 grams was observed.

Eleven Cactus Wrens, trapped at their roosting nests after dark, and then kept overnight, lost from 1.9 to 3.3 grams during their confinement, which lasted from 9 to 11.5 hours. The average loss of weight per hour was 0.25 gram. The percentage of body weight lost ranged from 4.6 to 8.1, with a mean of 6.4. This percentage of body weight lost, and subsequently regained, is somewhat higher than the percentage of daily increase of less than 5 per cent reported by Nice (1937:21) for several smaller passerines.

FLEDGLING AND JUVENAL ROOSTING BEHAVIOR

Fledging was usually accomplished in a single day. For the greater part of this day, in a normal, undisturbed desert habitat, the young wrens were probably never out of

sight of the nest in which they had spent the first three weeks of life. Those wrens which were fledged on our fenced one-acre lot seldom traveled more than fifty feet from their nest in the course of their first day. The wrens which nested in adjacent lots were subjected to frequent disturbances from human activities, especially in the early evening. Ordinarily, roosting and incubation were not seriously interrupted by the coming and going of people and automobiles. Adult wrens became accustomed to such interruptions. Once the nestlings were fledged, however, the situation changed quickly. Their first day out of the nest became one of extreme danger, if not disaster. The solicitous warning and danger call notes of the parents increased at every human disturbance, and the parents led their fledglings farther and farther away from their nest. Some of the fledglings were lost because of their failure to return to the nest before darkness.

The adult singing which accompanied the fledging was not reduced noticeably thereafter. It occurred chiefly when the adults were near the young, and usually singing followed feeding of fledglings by adults. The begging note of the fledglings changed from a weak *tek* to the normal *dzip* or *dzup*. Unless frightened, the fledglings were always found to be two or three feet above ground in a bush or cholla cactus. Ground travel did not take place until later, when they had learned to follow their parents about the territory as they searched for food. When well fed, the fledglings perched quietly and sometimes appeared to be asleep.

On May 5, 1947, the day they fledged, the three young from nest 19C climbed about in the mesquite tree in our front yard in a follow-the-leader fashion. Some of their movements could perhaps be called play antics; other movements suggested aggressiveness. Once when two of the fledglings moved upward on an inclined branch, the first one apparently lost its footing and fell. Immediately, its companion grasped the wing of the falling bird in its bill and held the bird dangling, while the adults set up a frantic commotion. Soon both fledglings fell into the flower bed beneath the tree and continued squealing from pain or fright. They separated when the parents flew down. A few minutes later, as the same two climbed upward to be fed, a similar encounter took place. This time it may have been a deliberate attack. The fledglings fell, screaming, to the ground and remained there so long that we felt it necessary to investigate. One of them lay on its back, looking up at the other, which was standing over it. This interruption brought on a demonstration of parental protest; the young squealed as they parted to seek safety in the tree. The male then sang once, after which he flew to his secondary nest to rearrange some straws. His behavior seemed to parallel the displacement activities that we recorded in the course of many territorial boundary disputes.

Improvement in flying ability was rapid, for the adults led their fledglings in flights from bush to bush in their territory. After the first day or two of waiting near their nest, fledglings seemed to learn that food could be obtained oftener if they followed their providers. The dangers of landing too abruptly were soon overcome. Branches of mesquite and creosote bushes offered few challenges. The fledglings landed, teetered, hung on, and then relaxed with decreasing awkwardness each day. Incredibly, the long, vicious spines of the jumping cholla (*Opuntia fulgida*) and the shorter spines of the cane cholla (*O. spinosior*) were quickly taken in stride as though needles were of no consequence. We never saw a fledgling impaled or even disturbed by these obstructions. Landing, climbing, or walking on a cholla branch seemed to be no more difficult than threading one's way through a short stubble field.

In all instances where we had the opportunity to watch the fledglings on the evening of their first day out of the nest, the parents endeavored to lead them back to roost, either to their old nest or to another one close by. Apparently the habit of roosting in

a nest is not inherited, but learned. The fledglings did not return to their nest without parental urging and assistance.

The evening retirement ritual usually began about half an hour before sunset and required from eight to ten minutes for completion. At first the adults flew to the nest in which the fledglings were to roost. Singing increased in frequency as they waited on the doorstep. As if to indicate what was wanted, the parents went in and out of the nest several times, singing rapidly when they came out. Finally one of the fledglings flew waveringly to the cholla, landing in the vicinity of the nest, or sometimes even upon it. Then the other fledglings came, one after another. If they found a footing below the nest, they had little difficulty in climbing upward and squeezing between their parents into the nest. Those on top of the nest, however, appeared unable to muster sufficient courage to move downward. Time after time the parents climbed up to the fledglings and down again into the nest. Eventually, after much coaxing, the descent was accomplished. Sometimes the fledgling actually fell down to the doorstep; not infrequently it tumbled upon the back of the adult bird. By this time, one or more of the other fledglings could be seen crowded into the enlarged entrance, where they faced outward. The last fledgling often had to lower its head and crawl under the other fledglings to reach the inside of the nest. A moment later, its bill and eyes found an opening from which to point outward. Then the male or the female followed the last fledgling into the nest, by pushing an opening between two others. The entire brood remained in the entrance, while the parents resumed their regular schedule of feeding. Not until late dusk did the fledglings turn about and huddle in the dark interior of the nest.

The blocking of the nest entrance by the adults is difficult to interpret. We have seen many a fledgling come to a sprawling stop upon the back of one of its parents. After disentanglement, it had to "elbow" its way inside the nest.

The retirement technique of the fledglings gradually improved. They soon learned to fly accurately, so that they alighted on the doorstep of the nest. Later, from more distant parts of the territory, they were led to their roosting nest in short flights from one bush, cholla, or fence post to another. It seems probable, that for the first few evenings, it was not necessarily the nest but the song of the adults that attracted the young. When the adults stationed themselves at the nest entrance, the nest became the destination; and when the fledglings arrived, they recognized the familiar surroundings. It was only a step further to enter a grass-lined opening in which they had formerly found safety in darkness. At this early age, recognition or memory of a nest probably consisted of a mental image of an opening or a tunnel into which to retreat when feeding ceased and darkness began.

Evidently the fledglings learned rapidly that they were to roost in a nest, for, once they were led near one, they crawled in quickly. Nevertheless, the process of daily parental instruction and assistance continued for at least 17 to 25 days. Even after the young became independent, as long as the group remained together, the juvenal wrens returned with their parents to the roosting area. At first the young wrens appeared to have no memory at all of the location of their recent home, or at least no inclination to return to it. Any nest was entered in the evening if the adult wrens sang from the doorstep.

How do Cactus Wrens know when all of their brood has been assembled at the roosting nest? Can they count? Probably not. In the course of the first day or two out of the nest, the fledglings were within sight of their roosting nest, and no difficulty should have been experienced by their parents in seeing them. Later, as the area of dispersal increased, a visual, inclusive count of fledglings by adults might become impossible. Perhaps the adults could sense that more than one fledgling should be in the nest; but after

two or three fledglings entered the nest, the adults might not know for sure if there were others, unless the fledglings were heard begging. As long as the fledglings could be heard in the vicinity, the work of leading them to roost continued, provided darkness did not intervene.

Retirement before dark is evidently essential. The adults waited for the fledglings only a short time after sunset, for twilight at this latitude is relatively short. If the fledglings were still out of the nest at that time, only a few more attempts were made to call them in. If these attempts were unsuccessful, the adults retired into their own roosting nests, abandoning the fledglings wherever they happened to be. In May, 1940, on the evening of their first day out of the nest, three fledglings from nest 32A were found to be 400 feet northeast of their nest. Apparently they had been disturbed so severely that their parents were unable to direct them to their roosting nest before dark. The fledglings spent the night in a mistletoe clump in the top of a catclaw bush. On the following day the adults located them and resumed feeding, but in the evening the adults again failed in attempts to lead the fledglings back to their nest. We never saw the three fledglings again.

The fledglings did not always return to their former nest on the first night. In 8 out of 17 cases which we observed, fledglings were led to other nests in the vicinity. Twice the female gave up her roosting nest; three times we saw the male direct the young to his nest, while he sought sleeping quarters elsewhere. Breeding nests of a previous brood were sometimes used, and even a nest which a juvenal wren had built was used. Antevs (1947:42) reported that a secondary nest was used by fledglings. The reasons for these variations in nests used for roosting were not always evident. Some were, no doubt, brought on by disturbances, for the wrens moved from obviously hazardous locations into our lot for greater safety. Occasionally, at such times, especially when the fledglings became separated, the adults directed them into two or three nests in the vicinity instead of into one nest. On the following evening all of the young were usually sleeping together. A change to another nest only two feet away from the breeding nest in cholla 17 is unexplainable as is also a similar switch to a nest five feet away in cholla 5. In both instances the old nests were in perfect condition. A brood from the adjacent territory to the north in 1947 spent its first night in the male's nest, but the young returned to the old breeding nest the second night. Earlier in the same year a fledgling from the south half of our lot inadvertently strayed into the territory to the north and spent the night in the roosting nest of an older group of fledglings. The following morning it found its way back to its parents.

In the course of the first two to three weeks the adults sometimes shifted the fledglings to other roosting nests in the territory. The fledglings still slept together with no apparent difficulties from overcrowding. In fact, we never observed that there was any tendency to seek individual quarters up to the time the wrens had learned to go to roost unassisted. Even after their parents had ceased to help in retirement, the fledglings maintained their communal roosting group for a remarkably long time. Losses occurred frequently so that the brood was seldom intact when the time came to move into individual nests. The three fledglings of the second brood in 1959 did not separate until they were 52 days old; in 1958, the first brood remained together for the same length of time; the second brood remained together two days longer; the third brood of five fledglings all roosted together until they were at least 45 days old. This group finally dwindled to two wrens, which began roosting in separate nests at the age of 70 days, 50 days after fledging. The first brood of 1947 required an even longer time, 75 days, for serious antagonism to develop, but the lack of roosting nests in the constricted territory may have been responsible for the prolonged association.

None of the fledglings constructed roosting nests for their own use at this time. The change from communal roosting to single occupancy merely required a move to some unoccupied nest in the territory, such as an old roosting or breeding nest, or a secondary nest that had been built by the male while the female incubated.

The progressive deterioration of the communal roosting nest was evidently not a cause for the adoption of separate quarters. The nest cavity and its entrance, to be sure, expanded from the movements of the crowded occupants; the floor hardened into a rough, solid mass, and holes appeared in the top, sides, and rear of the nest, through which the wrens had squirmed their way outward. Nevertheless, they continued to use the nest. Indeed, we have found fledglings huddled together night after night in nests from which the tops had been torn completely away, leaving the floor exposed to the sky.

We have assumed that antagonism among the juvenal wrens is responsible for the break-up of communal roosting. The shift to individual nests was usually accomplished gradually at irregular intervals. One or two juvenal wrens moved into other nests; finally all were in separate roosts. Sometimes the change was erratic, as though from indecision. A wren that chose to roost alone for the first time could occasionally be found roosting with its mates again the following night.

The conflicts at roosting time have been difficult to observe, but there seems no doubt that changes to other roosting nests were not always voluntary. The time came when the first juvenal wrens to retire finally objected to further intrusions. The last one to seek shelter received a hostile response from the occupants of the nest. In this case we heard no sounds from the nest; we did not observe any defensive action at the entrance; yet, from the frustrated *buzz* note of the wren outside it was evident that it had been denied permission to enter. After climbing about in the cholla, buzzing repeatedly at its failure to gain entrance, this wren at last flew off in search of another roosting nest. Probably the most aggressive individual retained possession of the nest.

FEEDING

At first both adults shared the feeding duties. Later, when the female moved into a secondary nest for her next brood, the male took charge of the fledglings. However, it was not unusual to find the female assisting the male in feeding their brood. By the time the fledglings' exploratory pecking had led to some recognition of useful food items, the male had begun construction of his next secondary nest. He continued to feed the fledglings when they begged, but they were left unattended for longer periods of time while he worked on his nest.

We have observed exploratory pecking by Cactus Wrens at the age of 21 days, a day after fledging. It probably occurs as soon as the birds are fledged, perhaps even earlier at the nest entrance. At first this pecking appears rather aimless; it is not a deliberate sampling of possible food, for apparently nothing is tasted or picked up. Branches of trees and bushes and cholla joints are gently pecked; vines and grass stems are grasped and pulled and then released. Even nearby fledglings were occasionally pecked! These random probings were noted only when the adults were absent. They seemed to indicate a developing interest in the immediate environment.

Self-feeding is established slowly. Some fledglings were observed picking up food at the age of 35 days (15 days after fledging), but begging is frequent at that time. Food is not recognized as such for some time, even when it is provided by a parent. On February 20, 1958, three fledglings, then 29 days old, gathered close to the male as he fed them dog food from a small pan on the lawn. In its impatience to be served, one of the fledglings stepped into the middle of the pan, its feet sinking into the soft mash. It stood there, bill wide open, begging, waiting to be fed. Again, on April 4, 1959, three fledg-

lings, 25 days old, were seen on the ground beneath some creosote bushes. They poked here and there on the ground, occasionally pulling at a Bermuda grass stem trailing on the lawn. A short distance away, a male House Sparrow (*Passer domesticus*) was eating a small piece of potato which we had supplied. Suddenly H-90 dashed at the sparrow and drove it aside. The sparrow soon returned and again the fledgling dashed at it. This time the wren stopped upon the potato as though to defy any further trespass. Then, when it stepped down, it ignored the food. Sometime later it pecked at the potato, but even though some of it adhered to its bill, the food was not swallowed.

Opportunities for learning to find and recognize food increased rapidly as the fledglings followed their parents on the ground. Often they stood behind or around the male as he searched the ground or lower branches of shrubs for insects. This would appear to be a perfect situation for the acquisition of food gathering habits. Yet, exploratory pecking came first, without parental instruction, and it continued to expand as more energy was acquired. Less time was spent in resting and waiting to be fed. Evidently curiosity led the fledglings to explore and investigate everything in their vicinity. Some, if not all of their behavior at this time may come from a normal development, as regular and predictable and as stereotyped as the growth of their bodies. Rand (1941:222) found that fledgling Curve-billed Thrashers (*Toxostoma curvirostre*) which he raised in captivity, started digging at the age of 19 days. He concluded that "the manner in which these birds sought for, picked up and ate food appeared to be rather rigidly determined innately." Judging from our field experience, we feel that the same conclusion could be demonstrated with hand-raised Cactus Wrens.

The transition to self-feeding began on the ground. Fledglings did not forage in trees or bushes at first. Exploratory pecking soon led to the picking up of various irregular objects from the ground. When H-94 was 38 days old, we saw it turning over stones an inch or so in length. At this age fledglings peered under flat objects, such as pieces of paper and leaves, by poking their bills beneath the object and lifting. It is typical adult procedure to push aside or raise up, by means of the bill, the dead cholla joints that litter the ground, in order to find the insects beneath them. At the age of 41 days, a fledgling pecked at and ate from a dried slice of white bread on the lawn. Then it poked its bill under the slice and raised it to peer beneath it. When the slice suddenly fell flat, the wren jumped into the air in alarm. As with Rand's thrashers, our Cactus Wrens no doubt learned from experience what to eat and what to reject.

The stimulus which elicits begging appears to lie in the attitude of an approaching wren. Food does not have to be present and in view. It is doubtful if the parents are recognized at first; a fledgling will sometimes beg with wide open bill when suddenly confronted by another fledgling. One of a brood, which had just gone to roost, begged from a juvenal wren that came to the entrance of the nest in search of a place to sleep.

Independence is attained at about the age of 50 days, but even 10 to 14 days later the young wren may beg when its parent approaches. It continues to utter the begging note as it feeds itself. The gradual cessation of this innate begging pattern, and its replacement by exploratory pecking is perhaps partly governed by internal conditions as Rand has suggested (*op. cit.*:221). As the frequency of begging diminishes, irregularities in behavior can be observed. Begging may occur, although food is not desired. On March 3, 1958, two fledglings, 40 days old, in company with their male parent, HM-73, were begging occasionally while they searched for food on the lawn. HM-73 fed one of them; then he turned to feed the other. Although this fledgling appeared to be begging as it stretched forward with open bill, it now moved its head to one side, evidently to reject the food which the male extended toward it. Again the male stepped nearer, and

again the fledgling, with open bill, turned aside in a quarter circle as before. The male gave up.

The adult wren responds to the begging note and the gaping bill of the fledgling. Sometimes in the strenuous hurry of simultaneously feeding the young and constructing a secondary nest, the begging stimulus produced a startling effect. At the sight of the open mouth, the immediate, automatic reaction of the adult wren was to place something in it. Thus the unsuspecting fledgling received a mouth full of cotton, grasses, or other nest material instead of food. Meanwhile the puzzled parent stood by watching the equally puzzled fledgling chew the unpalatable morsel until it was dropped from its bill. Evidently taste and not sight at this stage determined whether an object was eaten or discarded.

SONG

The opportunities for learning adult vocalizations are so numerous and so frequent that it is virtually impossible in the field to determine what is innate and what is learned. For nearly three weeks the nestling is subjected to the complete adult repertoire. The standard song is repeated over and over; the warning *tek* note, the danger *buzz* note, and the location *rack* note are all uttered so frequently in the vicinity of the nest that it would seem to be only a question of learning the meaning of each sound. We have heard the *buzz* note from day-old fledglings, perhaps uttered in annoyance or surprise at our too close approach. The *tek* note has been heard two days after fledging, but this sound is not often used by fledglings.

Lanyon (1960) has defined three phases of song development in passerines, which he terms subsong, rehearsed song, and primary song. The first subsong in the Cactus Wren may begin at the early age of 30 days, only 10 days after fledging. At first the subsong is a weird, up and down, rambling jumble of low, grating, rough notes, a ragged imitation of the adult primary song, and it is short in duration. In a few days it lengthens to two or three times the length of the adult song; then it is interspersed with and often ends with *scri* notes. These *scri* sounds which we have heard so frequently in the subsong are similar to the adult territorial warning and dispute vocalizations. No call notes of fledglings are incorporated in the subsong; the fledgling has only one distinctive call note, the begging *dzip* note. One could describe the subsong as conversational, for the fledgling appears to be talking to itself. The song is not uttered from any elevated point but is produced while the wren is prowling around in the shrubbery or on the ground. There may be from 6 to 11 songs per minute.

It is difficult to designate any later, intermediate phase of rehearsed song. There is only one adult song pattern. The fledgling subsong has this basic pattern, garbled and distorted to be sure, at the very beginning. The addition of the scratchy *scri* note to the subsong is very suggestive of imitation. At the start of a territorial dispute we found that the vigorous singing of the adults was always followed by sharp *scri* sounds as the excitement increased. In fact, the song and the dispute note actually combined into a single, uninterrupted series. With the lessening or cessation of disputes at the end of the nesting season, the adult song no longer ended on this note. The sequence of change in the subsong in the young Cactus Wren apparently followed the same course as in the adult. The *scri* notes were gradually dropped, and the rambling, grating sounds were smoothed out into an even, uniform series of adult *rar rar rar rar* syllables. The standard song pattern was, of course, the one most frequently heard by the young wrens. However, there is the possibility that the forceful impressions of a territorial dispute could contribute to the fixing of the additional scratchy note in the subsong.

It seems improbable that this aggressive or defensive scratchy note is an indication of a growing aggressiveness in the young wren. We observed little, if any, territorial aggressiveness in juvenal wrens. True, they became excited and took part in boundary disputes which the adults originated; they unintentionally caused disputes by penetrating into forbidden territory. The subsong began and continued while the family moved about as a unit of friendly, or at least tolerant, individuals; the fledglings slept together each night. In fact, the song appeared to be independent of and unrelated to any of the normal activities. We never observed that the juvenal song elicited any antagonistic response from the parents. Evidently the adults had no difficulty in distinguishing between the subsong of their offspring and the adult song of an adjacent territorial male. The *tirrup* variation of the adult *rack* location call note was often used by the juvenal wrens.

The rapid dispersal or loss of the banded juvenal wrens prevented us from determining the sex of the birds which sang. At least three or four months elapsed before the adult song was attained. By that time most of the young in our vicinity had vanished.

BATHING

Our hundreds of observations of dust bathing by adult Cactus Wrens indicate that this act is a ritual as regular and predictable as their nightly retirement. Each evening, a few minutes before going to the roosting nest, the adult wrens took a dust bath. The dusting place was usually less than 100 feet from the nest; in our lot the place chosen was sometimes a hole used by House Sparrows. From frequent use this hole reached a depth of an inch or so and a diameter of two or three inches. When this was not available, a few preliminary pecks on the bare ground were sufficient to loosen a little dust. Then the wren squatted down and spread its wings slightly, while it ruffled its body feathers and shook its wings until the dust penetrated the feathers. Sometimes the side of the head was rubbed into the dust and the tail was swished from side to side. This done, the wren resumed its slow movement toward its roosting nest. Occasionally it would return and repeat the dust bath before going to roost. In contrast to the House Sparrows, which could be found dust bathing practically any time of day, the Cactus Wrens dusted themselves almost entirely in the evening. We have only a few observations of this activity at other times. Woods (*in Bent*, 1948:229) failed to observe dust bathing, very probably, we believe, because he was not present at the roosting time. The act could very easily be missed, for it takes only a few seconds to perform.

There is some evidence that dust bathing may be an innate form of behavior, with learning assisting to perfect it. Fledglings do not ordinarily witness the act until they are able to go to roost without parental direction. This stage is reached in two or three weeks after fledging. Yet, we once observed a fledgling dust bathing only six days after it had left the nest. In this instance the wren pecked the ground and tried unsuccessfully to stir up some dust by squatting down and sliding in a half circle with wings held horizontally. Then it moved into a nearby hole made by a House Sparrow, with better results. This occurred at 5:00 p.m. in May. Perhaps the fledgling was imitating an adult, but at the time there were no other birds in the vicinity. Other fledglings, 12 to 14 days out of the nest, have also been noted dust bathing just before retiring. Later, when their retirement time began to coincide with that of the adults, the opportunities for learning increased. In late May, 1961, three juveniles of the first brood, at least 60 days old, now feeding independently, but still uttering their begging call note, took dust baths in our front yard. The first two merely dipped their heads to the ground and squatted quickly to touch the dust. The third one advanced to within an inch of its male parent and

watched as the latter thrashed around in a dusting hole. Soon the male moved aside, permitting the waiting wren to step in. In a thoroughly competent fashion the young bird stirred up a cloud of dust, even pecking more sand into the hole while it crouched inside. It was a perfect situation for learning.

On another evening, two fledglings, 18 days out of the nest, stopped at a dusting hole. One of them looked on in apparent surprise as the other stepped in and dusted itself. Perhaps the performance seemed a little aggressive, for the second wren leaned forward in an attempt to peck the first. It was repulsed, but it tried again. This peck was returned as the dust bath ended. No further conflict was observed while the two fledglings moved toward their roosting nest. Perhaps this was an instance of the tardy appearance of this innate behavior pattern in one of the fledglings.

We observed that both adults and immature wrens occasionally bathed in our sunken bird pool and in the saucers around the ornamental trees. Now and then, on the short grass of our recently sprinkled lawn, we have found them sliding about in an effort to wet their bodies or perhaps to cool off. Opportunities for these activities must be rare in the normal desert habitat.

THE FAMILY BREAK-UP

The family bond is broken gradually by the adults. As the fledgling approaches independence, begging decreases and the parents are confronted with fewer stimuli to feed their young. Begging is finally ignored. It seems like a mutual loosening of the bond between the two. Actually it is the adult which loses interest; another brood will soon be ready for parental supervision.

The juvenal wrens remain in the territory for some time. They may still follow their parents as they search for food, and they participate in territorial boundary disputes, siding with their parents. Pecking of fledglings by adults was rarely observed; when we did record it, it seemed to have little relation to the problem of dispersing the young. In 1946, 19 days after fledging, when the offspring were still roosting in a group, we saw the female approach one of the fledglings on the ground and peck it. The young wren crouched and tried to avoid the sharp blow on its head. There was no further attack.

In the days following fledging the young responded to the song of the adults. It led them to food and to their evening roosting nest. Later, when they were learning to shift for themselves, the need for a directional song gradually vanished. Its stimulus, however, still had some effect, and sometimes it led to confusing reactions. Once, as we observed three fledglings about to fly to their roosting nest, the adult male sang from the roof of our house. Immediately the three wrens turned and flew to the roof. As each one arrived, it received a vigorous peck. The last fledgling tumbled over the edge and clung upside down by one foot. Then the fledglings regrouped and proceeded to their roost, while the male remained at his station. Occasionally in the course of the day, juvenal wrens would fly to a singing male parent and climb up the post on which he perched. When they reached the top, they were repulsed with a vicious peck that sent them tumbling down.

Chases were noted now and then, but the juvenal birds were reluctant to fly more than a few feet. The most obvious conflicts occurred at roosting nests. Attempts by young wrens to enter roosting nests of adults in the evening were usually thwarted at once. Curious wrens which investigated nests under construction were pecked and driven off. Some were ejected from roosting nests. Generally this occurred shortly after a new brood had been fledged. Juvenal wrens which carried nest material seemed to be particularly subject to threatening drives by their parents.

NEST BUILDING BY JUVENAL CACTUS WRENS

The innate behavior pattern of building of roosting nests appears very early in the young Cactus Wren. We once observed a fledgling only twelve days out of its nest toying with a feather. At first feathers and short grass stems are picked up and then dropped. Later they are carried to cholla branches or into roosting nests. It is difficult to escape the conclusion that these acts are mere imitations, for the adults at these times were gathering nest materials in full view of the fledglings. Admittedly, much data have been missed here; the roosting behavior of the wrens becomes incredibly involved in the course of the most productive seasons. By the time the first brood approached independence, another brood arrived to confuse the daily routine and complicate the evening retirement.

The dates when 12 of our first-year banded Cactus Wrens of known age were first observed with nest materials are given in table 1. A nestling age of 20 days has been

TABLE 1
NEST CONSTRUCTION BY FIRST-YEAR CACTUS WRENS

Wren	Fledged	Carried nest material	Age in days	Began construction of new nest	Age in days
H-25	April 19, 1941	May 23, 1941	54		
H-33	June 5, 1941			August 15, 1941	91
H-42	May 5, 1944	Aug. 10, 1944	117	Oct. 17, 1944	185
H-51	May 5, 1947	July 1, 1947	77	July 16, 1947	92
H-52	May 5, 1947	June 19, 1947	65		
H-74	Feb. 11, 1958	Feb. 22, 1958	31		
H-78	March 25, 1958	May 3, 1958	59		
H-81	May 5, 1958	June 14, 1958	60		
H-82	May 5, 1958	June 14, 1958	60	July 22, 1958	98
H-83	May 5, 1958	June 15, 1958	61		
H-84	May 5, 1958	June 14, 1958	60		
H-85	May 5, 1958	June 1, 1958	47		

added in each instance. These dates may be far from representative, when one considers that over 100 wrens were fledged in our research area from 1939 to 1960. Five of these 12 wrens disappeared less than a month after being seen with nest material; two of these were gone the following day. The 117-day gap in the record of H-42 cannot be accounted for except by assuming that we failed to watch closely. This wren began carrying lining material in August to a nest which its male parent had constructed in June. H-42 occupied this nest and continued to bring lining material for several weeks. It was not until October, when H-42 was practically finished with the postjuvinal molt, that it constructed a new nest. H-52 finally obtained possession of nest 15C, the male's former roosting nest, by excluding its bedmates. H-52 and two other fledglings had roosted in this nest for some time. For ten days thereafter it carried lining material to this nest. In August, H-52 suddenly appropriated a nest which the female wren was building; then it began the task of finishing it. Later it returned to nest 15C, where it remained until we lost it in December. H-78 had a similar erratic history. It worked entirely on old nests. H-33, H-42, and H-82 (table 1) finished their new nests. These nests were indistinguishable in construction from nests built by adult wrens. H-51 disappeared two days after starting a new nest. The average age at which nest materials were carried by these young wrens was 62.8 days; the average age at which new nests were started was 116.5 days.

In addition to the 12 wrens of known age, we have data on 16 other young wrens which strayed in from adjacent territories and endeavored to remain. Eight of these we succeeded in color banding (table 2). We trapped most of them shortly after they

TABLE 2
NEST CONSTRUCTION BY FIRST-YEAR CACTUS WRENS OF UNKNOWN AGE

Wren	Date banded	Repaired old nest	Began construction of new nest
H-7	Aug. 4, 1939		Oct. 13, 1939
H-20	June 28, 1940	July 3, 1940	July 25, 1940
H-21	June 28, 1940		Oct. 20, 1940
H-22	Sept. 8, 1940	Sept. 30, 1940	Dec. 27, 1940
H-30	May 18, 1941	Aug. 3, 1941	Oct. 20, 1941
H-56	Aug. 9, 1952		Aug. 10, 1952
H-66	July 25, 1954		July 25, 1954
H-95	Aug. 14, 1960		Aug. 14, 1960

were discovered to be roosting in our area. Eight other juvenal wrens, which we could not trap, started nests from July 15 to September 15. Five of these nests were new. Mid-July would thus seem to be the earliest that young wrens begin construction of new roosting nests. The availability of good nests is probably an important factor at this time. Why build a new home if the old is satisfactory?

RECOGNITION DISPLAY

We have observed the adult type of recognition display only twice from juvenal wrens. On August 12, 1956, a young wren *buzzed* in our front yard as it moved about carrying a grass stem. Suddenly another young bird landed three feet away. It spread its wings in display and growled in typical adult fashion. The first wren appeared startled, but it did not respond to the second wren or leave the yard. Soon both of them were searching for food on the ground. Five days later another display-growl occurred as two juvenal wrens flew to the top of an electric pole. One wren clung to the side of the pole about two feet below the other, but it did not advance toward the other wren. None of these wrens was banded; their fledging dates are unknown. Whatever the date of fledging, August seems to be an unbelievably early date for a young wren to begin to assert itself by means of the adult recognition display.

JUVENAL HELPERS

We had long been aware that "helpers" were a possibility among our Cactus Wrens. Skutch (1935:269-273) reported that the practice was common in the nesting activities of the southern relative, the Banded-backed Wren (*Campylorhynchus zonatus*). As early as 1947 we had noted that young of an earlier brood sometimes permitted a fledgling of the next brood to share the roosting nest. At one time two of the first brood and one of the second roosted together for several nights. In these instances, the young fledgling was directed to its nest by its parents. Then, when all was quiet, the older wrens crept in. This was probably only passive tolerance, or an inability to distinguish one from the other. Generally, we observed that juvenal wrens not infrequently pecked the fledglings of the following brood when they met.

The situation on May 11, 1958, was as follows: The female, HF-71 was incubating four eggs in nest 25H; the male, HM-73, had just begun construction of secondary nest 5M. In between work on the nest, he fed the fledglings H-81, H-82, H-83, H-84, and

H-85 of the third brood, which had left their nest on May 5. Two of the four wrens of the second brood, H-78 and another, not color banded, had survived, and remained in the territory. They had been fledged on March 25.

At 10:15 a.m. H-78 kept up a constant series of subsongs as it pecked on the ground and turned over small objects. Now and then it chased its sibling of the second brood, and frequently it seemed to be "shadow-boxing," for it snatched at objects on the ground and dashed around, changing direction abruptly. Once it came face to face with H-84, which opened its bill wide as though expecting to be fed. H-78 turned rapidly and ran back into the tangle of bushes.

At 3:45 p.m. H-78 came with a small insect, landing on the ground below one of the fledglings. When the latter begged, H-78 flew up and fed it. Again H-78 found some food and fed the other. For the third time, H-78 holding a thin green caterpillar, flew up toward H-81. Suddenly one of the wrens in the group began uttering the *buzz* alarm note at a round-tailed ground squirrel (*Citellus tereticaudus*) that was standing upright beneath the creosote bush. H-78 approached H-81, but the latter chimed in the general chorus of alarm. H-78 followed the *buzzing* H-81 upward. No begging action took place and H-78 stopped following H-81. Soon it fed another fledgling. Then, when H-78 flew down, two of the fledglings followed, begging. While H-78 searched the ground, finding nothing, HF-71 arrived and fed the two young. The other juvenal wren now appeared and looked on, but it had no food.

Later this same juvenal wren was confronted by a begging fledgling. Receiving no food, the fledgling crouched. The juvenal wren advanced and pecked it on the head. Then it ran to a second fledgling that was not begging and pecked it, too. Finally a third one received the same hostile greeting.

At 5:00 p.m. H-78 again fed H-81; on the next day it fed H-82; on May 18, we saw it feed H-82; on May 19 it fed H-81 and H-85; on May 25 it fed H-84. Very probably it had been feeding the entire brood while the male was absent. Our observations were not continuous. On the evening of May 19 we saw H-78 fly to cholla 5 with one of the fledglings. It watched while the fledgling squeezed into nest 5K, where three others had already retired.

An almost exact parallel in juvenal behavior occurred in 1960. H-93, of the first brood had been fledged on April 7. The next brood of three fledged on May 20. We saw H-93 feed a fledgling on the evening of May 23. Then both of the wrens flew to a roosting nest near our west fence. Soon the male arrived and induced two more fledglings to enter. Finally the female poked her head inside, causing H-93 to pop out quickly.

Three days later we saw H-93 pick up a leaf on our back lawn and then drop it. The wren then dashed rapidly in short spurts in various directions. One of the fledglings began following it. Again H-93 picked up objects and dropped them. The fledgling opened its bill and begged, but it was not fed. At 8:00 a.m. on May 28, we again saw H-93 feed a fledgling. Half an hour later we saw H-93 turn around to find a begging fledgling at its heels. The fledgling squatted; H-93 pecked at the ground but apparently found no food. Then it circled the fledgling and pecked it on the back. The latter crouched, turned to face the other, and continued begging. H-93 again pecked at the ground; then it placed its bill in the open bill of the fledgling. It held it there for a second or two, but no food could be seen. Suddenly H-93 began running erratically, a foot or so at a time, pecking at grass and stones; it even lifted up a tuft of grass and dropped it. Again it came upon the cowering, begging fledgling; again it circled and pecked it somewhat tentatively as though it expected some other response.

This apparently irrelevant behavior suggests that both H-93 and H-78 had encount-

ered a new situation and were unable to cope with it. Here was an unexpected request for food at a time when no food was available. Evidently in a short time they were able to learn to do something which they normally would not do for another year.

Intensive day-long observations of Cactus Wren families would probably reveal more of these interesting helper episodes. H-78 was 67 days old and H-93 was 66 days old when we first discovered that they were feeding the fledglings. We do not know when these wrens first began feeding fledglings, but the fledgling of 1958 had been out of its nest only seven days; the one in 1960 had been out of the nest four days. H-78 and H-93 could not have been feeding these fledglings very long. In 1960, at least, we may have witnessed the beginning of the feeding of fledglings by juvenal wrens, with all the frustrating problems and irrelevant solutions.

SUMMARY

Young Cactus Wrens attained the average adult weight of 38.9 grams at about the age of 38 days. The average loss of weight per hour in trapped adult wrens kept overnight was 0.25 gram.

The adult wrens always endeavored to lead their fledglings to a roosting nest in the evening. By singing frequently and flying to the nest, they induced their brood to follow them. At first the fledglings usually returned to their former nest; later they sometimes shifted to other nests. Those fledglings that failed to arrive at their roosting nest before dark were often lost.

Fledglings began moving into separate nests at ages from 52 to 70 days. Apparently individual aggressiveness caused them to seek new quarters.

The adults shared the feeding duties for a short while. Then, when the female began incubating her next clutch of eggs, the male took care of the brood.

Exploratory pecking occurred as soon as the wrens were fledged. Self-feeding began at about the age of 35 days. The fledglings begged from any wren which approached. They became independent of their parents at the age of 50 days, but they begged up to 14 days later.

The *buzz* danger note was heard from day-old fledglings. It seemed to indicate annoyance more than danger. The alarm note, the staccato *tek*, came soon afterwards. The subsong sometimes began at the age of 30 days, but usually it did not appear until some days later. It was a very ragged imitation of the adult primary song. Location notes, the *rack*, and especially the *tirrup* variation came after the subsong began. In three or four months the subsong, through constant practice, became adult in quality.

Dust bathing is apparently innate. It occurs at the early age of 26 days and is performed each evening before going to roost. Bathing in pools of water was not frequent.

The adults broke up the family bond by gradually ignoring the begging fledglings. Pecking and chasing were not common. Conflicts at roosting nests were more frequent, but, as a rule, the juvenal wrens were not driven out of the territory during the breeding season.

Nest materials were picked up by fledglings at the early age of 32 days. The average age at which they carried lining materials to old nests was 62.8 days. New nests were started at the average age of 116.5 days.

Adult-type recognition displays by juvenal wrens were observed only twice. They occurred in August and were probably abnormal.

Juvenal wrens sometimes permitted fledglings of the following brood to roost with them.

Two instances of juvenal wrens feeding fledglings of a latter brood were observed.

LITERATURE CITED

Anderson, A. H., and Anderson, A.

1957. Life history of the cactus wren. Part I: Winter and pre-nesting behavior. *Condor*, 59:274-296.

1959. Life history of the cactus wren. Part II: The beginning of nesting. *Condor*, 61:186-205.

1960. Life history of the cactus wren. Part III: The nesting cycle. *Condor*, 62:351-369.

1961. Life history of the cactus wren. Part IV: Development of nestlings. *Condor*, 63:87-94.

Antevis, A.

1947. Cactus wrens use "extra" nest. *Condor*, 49:42.

Bent, A. C.

1948. Life histories of North American nuthatches, wrens, thrashers and their allies. U. S. Nat. Mus. Bull. 195.

Lanyon, W. E.

1960. The ontogeny of vocalizations in birds. *Animal Sounds and Comm.*, 1960, publ. 7:321-347.

Nice, M. M.

1937. Studies in the life history of the song sparrow. I. A population study of the song sparrow. *Trans. Linn. Soc. N. Y.*, 4:vi + 1-247.

Rand, A. L.

1941. Development and enemy recognition of the curve-billed thrasher *Toxostoma curvirostre*. *Bull. Amer. Mus. Nat. Hist.*, 78:213-242.

Skutch, A. F.

1935. Helpers at the nest. *Auk*, 52:257-273.

Tucson, Arizona, August 19, 1961.