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THE NATURAL HISTORY OF THE LONG-BILLED MARSH WREN*

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In recent years there has been a noticeable trend toward the intimate study of various animals. In 1914 Allen (1) published his report on the Red-winged Blackbird and, since that time, numerous other workers have carried on investigations of a similar nature in the field of ornithology. With the appearance of Howard's works (16, 17) new interpretations of bird behavior, previously hinted at, became established, lending impetus to the growing interest in this field of study. The surface has hardly been scratched, however, as each species presents new problems which can be answered only by intensive study.

Much attention has been devoted recently to certain phases of the House Wren's life history and much novel information has been uncovered by various workers in the Baldwin Research Laboratory. Allen (1) has completed a very careful and detailed life history of the Red-winged Blackbird and a parallel study of a breeding associate of this species is considered worth while as environmental factors affecting the species can be better studied. The Long-billed Marsh Wren (*Telmatodytes palustris*) which is very abundant in certain localities affords a wealth of material for a comparable study. This species, due to its secretive habits and its more or less inaccessible habitat, is not particularly well known and many phases of its life history have not been worked out.

Most of the field work was carried on during the year 1931. From the time of arrival in the spring until the birds had departed in the fall some time was spent in the field nearly every day, and from May to September the greater part of each day was thus engaged.

The first brood of *T. p. dissaëptus* was studied in the Renwick Marshes at Ithaca, New York, while the second brood of *T. p. iliacus*¹

*A portion of a thesis presented to the graduate school of Cornell University for the Ph.D. degree.

The writer wishes to acknowledge his indebtedness to Dr. A. A. Allen for his valuable counsel during the course of this investigation.

was studied at Staples, Minnesota, later in the year. Additional notes were obtained from the Montezuma and North Spencer marshes in the Ithaca region.

The observations recorded in the subsequent pages have been obtained from the intensive study of approximately forty pairs of birds and their nestlings. Many hours were spent in an umbrella blind studying and photographing the birds at close range. During the earlier part of the season much of the time was spent at a slight elevation above the marsh to enable the writer to keep a large number of birds in sight at a given time in order to figure out the limits of the various territories. Each new territory was investigated as often as possible and each newly-built nest was tagged and its position was plotted on a map. Records of the beginning of egg laying, completion of each clutch, and the time of hatching of the young were recorded. Each nestling was marked with a colored thread about its leg to enable identification when the daily weights were taken. Full notes were kept upon the activities of the adults and their offspring so that a fairly complete picture of the life of the species in its summer home has been obtained.

A series of adults and nestlings was collected in order to study growth of feathers, wear, molts, winter and nuptial plumages, and food habits. Skins were also borrowed from several museums to augment the Cornell collection in the study of the eastern subspecies.

MIGRATION

Surprisingly little has been written on the migration of this species. Early and late records are few and in many cases quite misleading due to the fact that marsh habitats are not particularly inviting early in the season. Only a single reference concerning the manner of migration has come to the writer's attention. Eaton (11), in his *Birds of New York*, made the statement that the Marsh Wren migrates at night high in the air. Another indication of night migration was the discovery, by Mr. George B. Saunders, of a skeleton of a member of this species beneath the lighthouse at Cape May Point during the fall of 1931.

The average date of arrival, both at Ithaca, New York, and at Minneapolis, Minnesota, approximates May 10. The variation in time

¹*T. p. iliacus* is readily distinguishable from *dissaëptus* and should unquestionably be recognized. While almost of the same size as *dissaëptus*, the lighter color of the upper parts and the much brighter cinnamon-buff to cinnamon flanks and sides separate this form. In winter plumage the underparts make a very good distinguishing character as this "foxy" brown is distinctly different from the russet and wood brown of *dissaëptus*.



FIG. 1. The Marsh Wren at its nest. Carrying a dragon-fly to feed young, upper left; female arriving with insect food, upper right; searching for excreta-sac, lower left; excreta-sac in bill, lower right.

of arrival between regions of this latitude and farther south is very slight, due perhaps to a lack of accurate dates for early migrants. The records for time of departure, on the other hand, are less numerous. According to the data obtained from the files at Cornell University and the University of Minnesota, it would seem that the average time of leaving for the latest individuals is between October 15 and 25. A few young birds remain much longer than the vast majority.

During the spring of 1931 daily trips were made to the marsh from April 20 to July 10. A close count of the number of birds and their locations in the marsh was kept each day and, in this way, a knowledge of the order of arrival was obtained. During the period of migration it is easy to locate the various individuals of the species because the growing marsh vegetation projects only a few inches above the water. As a resident male arrives he establishes himself almost immediately in a particular area of the marsh, and in this way the new arrivals are easily distinguished from the earlier birds by their locations.

The first arrivals in the spring are male birds. The migrant males arrive with the residents and may tarry for a day before continuing their northward flight. On May 10 the vanguard of the birds arrived. Five birds were observed on this day; two remained in the marsh while the other three went on. At this time the testes are enlarged to their full extent, as no birds taken later in the season showed greater development. A few more males put in an appearance on May 13, and a large number came in on May 16. Many of these established themselves in the marsh while a few again went on to more northerly locations.

Between May 20 and May 28 the females appeared in the breeding territory. Only a few were observed on the first day but many more came in during the week, so that nearly all the males obtained mates.

On June 4 a few more males took up residence, while on June 16 a very noticeable increase was observed, together with an additional number of females. These birds, together with several stragglers which arrived later in the summer, were perhaps young of the preceding year.

The order of migration might be summarized as follows:

1. Arrival of resident and migrant males.
2. Arrival of resident and migrant females.
3. Arrival of young males.
4. Arrival of young males and females.

There is no marked exodus of birds from the marsh at a given time in the fall. At first the young of the year remain in family groups but, as the time of departure approaches, there is an apparent flocking together of young birds, usually near the water's edge. At this time twenty-five or thirty birds may be observed together feeding near the surface of the water. The next day the numbers may be greatly reduced and in a short time only a few birds remain.

From the birds collected and from observations made at Ithaca, New York, and at Staples, Minnesota, during the fall of 1931, the fall migration might be divided into two sections. The first birds to leave are the adults and some of the young of the first brood. No adult birds were included in the collections made after September 10, and none were observed after this time as a special effort was made to collect any specimen which might prove to be an old bird. The wrens which remain after September 10 are either in juvenile plumage or are in the process of acquiring the winter plumage. These birds were, for the most part, young of the second brood, as the earlier birds had acquired their winter dress by September 1. As these birds complete the molt they, too, depart for their winter homes so that, by October 20, only a few scattered individuals remain. By the first of November these, also, have departed.

There are occasional winter records for the species in this latitude. Whether these stragglers are young or old I am unable to say, but certainly they are only unusual instances and not a part of the normal cycle of the species.

TERRITORY

Since Howard (16) published his "Territory in Bird Life", much information has been obtained on the relationships between a given species of bird and the nesting area. Most birds have been found to live during the reproductive period in a small isolated territory from which all other members of the species are ejected. The Long-billed Marsh Wren is no exception to this rule, showing a very strong attachment to his chosen spot and fighting relentlessly but harmlessly to keep others of his kind from intruding.

Continuous work with a given group of birds enables one to recognize each member as an individual. A variation from the usual song in one instance, a broken tail feather in another, and many other minor variations aid tremendously in following individuals from the time of arrival through the nesting cycle. While it was impossible to mark each individual, the writer was enabled by these minor differences and continuous work with a selected group to distinguish one

bird from another and thus work out the rôle of territory in their lives.

On the day of arrival the male is quiet but is busy moving about over a limited area in the marsh. It is at this time that he actually selects the territory which he will inhabit in raising his first brood. The preferred habitat is not, as one might suppose, a dense tangled mass of dried and broken cat-tails, remnants of the preceding season, but a comparatively open area with a few tattered stalks and an abundance of some species of *Carex*.

He soon forms a rather clear conception of the size of the territory that he wishes to hold, for an intrusion over an imaginary bound-

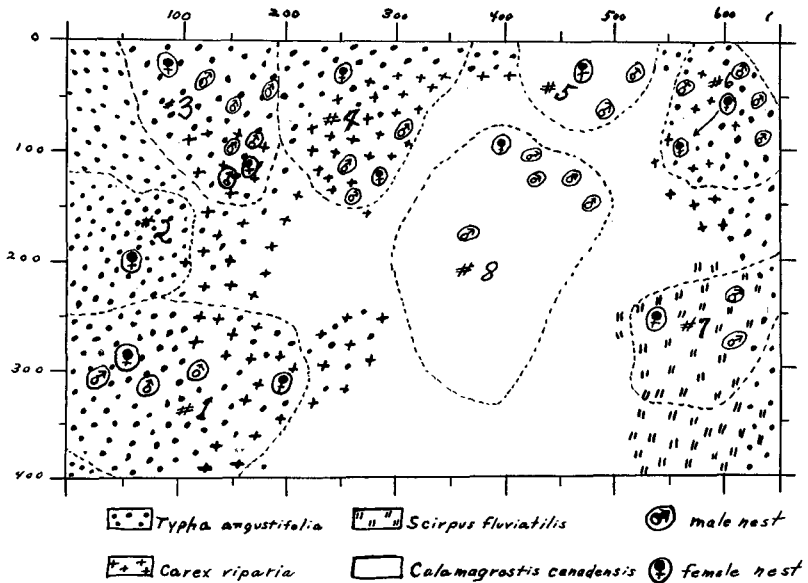


FIG. 2. Map of a portion of Renwick Marsh showing Marsh Wren territories in relation to the dominant plants.

ary by another male is quickly resented and a fight is apt to follow. Fighting over territorial rights between males is, to a large extent, a matter of outbluffing the opponent. A male approaching too closely to the boundary of another's area is challenged by the song of the rightful owner. This is usually sufficient for the intruder, but sometimes the challenge is accepted by the visitor giving voice to his emotions and continuing to transgress upon the area in question. The first male in this case fluffs out his feathers to impress the other and, if

necessary, flies at his opponent. The usurper usually reciprocates by flying at his neighbor a time or two and then, at least in all instances observed, becomes the vanquished and departs from the scene of battle.

On the second day the males are most concerned with holding the area they have selected. It is perhaps on this day that they sing more than at any other time up to the arrival of the females. Several song perches are selected in different parts of the territory and the owner continues to go from one to another singing enroute. If other males are about looking over prospective territories the occupant of a given area will sing almost continually.

The actual territory controlled by a single male is dependent upon several factors. In an area 400 by 650 feet in the Renwick Marsh at the head of Lake Cayuga eight males took up residence in the spring of 1931. The area was bounded on the east and southeast by water. A rather dense growth of cat-tails and sedges covered the north, east, and south sides while marsh grass, *Calamagrostis canadensis*, was the dominant plant in the middle area. The cat-tail-sedge association was greatly preferred to the grass association by the male birds in selecting territories. Allen (1) considered the sedge association the optimum condition for nesting of this species. *Typha angustifolia* is much preferred to *T. latifolia* as a nesting site. This observation is in accord with Saunders (27). The male territories in the favored area were noticeably smaller than in the grassy area. A single monogamous male occupied a territory of from 13,000 to 15,000 square feet, while in the grass association this was extended to approximately 30,000 square feet. The territory of a polygamous male, on the other hand, was considerably larger than that of a monogamous male nesting in the same sort of vegetation. For example, territory number one, occupied by two females, was almost twice as large as number two where one female nested. This difference in size can readily be accounted for by the fact that the female birds do not tolerate each other during the nesting season. As a result those males intent upon leading dual lives must separate the objects of their affection as widely as possible.

The boundaries of a territory, and even entire territories, are sometimes changed after the coming of a female. To illustrate, if a female entered the marsh and tentatively located in an area unclaimed by any male, one or perhaps several males in adjacent territories would immediately try to extend their boundaries to include the

avored spot. Many battles and much singing would follow until one of the birds had established his right to the plot and its tenant. Such performances have been observed even when one of the participants was already satisfactorily mated. Number one succeeded in obtaining the female which became his second mate by annexing some extra territory adjacent to number two even before the latter was mated.

Unusual weather conditions may lead to modifications of original territories. In the spring of 1931 a flood in late May led to many changes in boundaries. Male number two had occupied and successfully defended an area between numbers four and five, and including a part of four as now illustrated. With the coming of the flood his domain did not meet with his wholehearted approval and he moved completely to the new station. Numbers three and four extended their rights to include a portion of the marsh containing a considerable number of erect cat-tails of the previous year.

After incubation is well under way the territory instinct becomes somewhat weakened although the area is defended until the young have left the nest. At this time territorial boundaries no longer remain important as the young, lacking in a knowledge of the limits of the area defended by their parents, go where they will. The feeding instinct is strongly developed at this time so the adults forget the former barriers and follow their offspring and administer to their wants.

The parents usually take up a new territory in a more open area to rear the second brood. Nests at this time are located nearer the water's edge or in areas less given to dense growths of cat-tails. The territorial instinct is redeveloped but it is not as strong then as earlier in the year. After the second brood has left the nest all the birds live together harmoniously until time to depart for their winter homes in the south.

COURTSHIP

When a female wren arrives each male does his best to convince her to settle in his territory. Howard considers display as the chief way of winning a mate but, in the case of the Long-billed Marsh Wren, song is so closely associated with display that both will be considered under this category.

The display of the male is quite simple but interesting. When the female is near he will take his station a foot or two above her, fluff out his breast feathers and under tail coverts, and jauntily cock his tail over his back so that it almost touches. He now resembles a tiny ball of feathers perched among the reeds. As he becomes more animated he beats his partially folded wings up and down rapidly

and sways his head dizzily from side to side. The female probably will fail to notice him, or at least she will not indicate any interest, and, after pursuing her and displaying for several minutes, he will burst into song and fly to another portion of the territory. This same sort of display is often used to impress another male in disputes over territorial rights.

Song does not seem to be as important in attracting the female as display. Of course the song originally attracts the prospective mate into the territory and then display becomes first in importance. When the females begin to arrive from the south the males sing almost constantly. It is then that they sing at night as recorded by Hunt (18). The early morning is the time when the male sings the optimum number of songs per minute. During the period of strife between males contending for desirable sites, the songs average about twenty-five per minute. When the females first arrive this number is again often reached. After the nest is under construction, however, the songs become less numerous and the intervals between singing periods become longer. On May 31, during the period of greatest song for the day, a male sang an average of 6.4 times per minute. The female in this instance had almost completed her nest. On June 5, the songs of this same male had been reduced to less than five per minute. On June 7, a male sang approximately five songs per minute while his mate was incubating and eight songs while she was off the nest. The number of songs per minute becomes less and less as incubation becomes more advanced until the males seldom are heard at mid-day and infrequently in the morning and evening. As the young leave the nest the males sing a bit more often but a week later have ceased almost entirely.

One male bird in an area under investigation was heard singing very energetically after the other males had slowed down to a very few songs. A count on June 12 gave an average of 12.5 songs per minute during the optimum period for the day. A careful investigation of his territory upheld the suspicion that he was unmated. On June 16 he obtained a mate and his behavior now began to agree with that of the others in the colony. It seems possible that his territory, being composed almost entirely of *Calamagrostis canadensis*, *Lythrium salicaria*, and the like, was less desirable and, as a result, he received a mate only after all others were satisfactorily mated.

The song period of the adult birds seems to cease in early August. The writer has never heard one after the first of the month. Bicknell (7) states that the first song period ends in early August. He

reports that several birds were in full song in October and believes that this second period occurs subsequent to their departure. During the course of this investigation no adults were heard to sing after the original song period had come to a close. The young birds, however, begin to sing in late August. At Hayden Lake, Staples, Minnesota, the first song was heard on August 23. A series of singing males was collected throughout the fall and, in all cases, proved to be birds of the year. Jones (20) reported a male singing on November 19. The writer feels quite certain that this must have been a young bird.

The song of the adult male during the breeding season is often associated with a peculiar type of flight. The bird in going from one song perch to another flies along near the tops of the flags, singing enroute. Suddenly he rises six to fifteen feet into the air, and then flutters down upon the reeds. Perhaps this type of behavior is a part of the courtship performance, but the writer is inclined to believe that the altitude obtained enables the bird to check up on would-be intruders, and that this is the real reason for this interesting maneuver.

The male alone has the ability to sing. His song has been described in many ways, as pointed out by Shufeldt (28), but none seems to be quite adequate and most authorities are at variance with one another concerning his vocal powers. It is true that "as a musical composition, it does not rank high," but it certainly reflects the spirit of the singer and adds appreciably to the medley of sounds in the marsh.

The musical behavior of the male is aptly described by Allen (2) who says, "From a tangled mass of brown cat-tails comes a peculiar grinding sound as though someone were gritting his teeth. This is followed by a clicking noise much like an old-fashioned sewing machine, and then out of the flags bursts a little brown ball. Floating upward like a tuft of cotton, it breaks into vivacious music and then drops back into hiding to continue its scolding."

Taverner (29) describes the performance thus: "At a safe distance from the intruder it mounts a tall, solitary stalk to reconnoitre and then launches itself into the air some ten or fifteen feet and gurgles out a rippling melodious little song as it sinks on fluttering wings to another station."

Townsend (30) writes: "The song begins with a scrape like the tuning of a violin followed by a trill which bubbles, gurgles, or rattles, depending no doubt on the skill or mood of the performer; at times liquid and musical, at other times rattling and harsh, but always vigorous. It ends abruptly but is generally followed by a short musi-

cal whistle or a trill, as if the wren were drawing in its breath after its efforts. I have heard one sing fifteen times in a minute. The bird often reminds me of a mechanical musical toy wound up to go off at frequent intervals."

Considering the variety of descriptions and the differences in opinion among the various authorities, one is reluctant to enter still another description of the Long-billed Marsh Wren's song. The whole, however, can be dissected into three parts. The grinding sound mentioned by Allen is given first and may pass unnoticed unless the listener is near the bird. It has somewhat the quality of the call of the White-breasted Nuthatch. It might be described as *aac* or *ac* delivered in a grating manner with the emphasis on the first part. These notes are repeated various numbers of times from one to five. The warble-like part delivered next is no doubt the most musical section. It does remind one of a sewing machine of the older sort being run rapidly, but of course it is less metallic and more musical. It has much of the spontaneity of the House Wren's song but is otherwise quite distinct. This middle section begins at a low pitch, climbs upward, and then descends again. At the end a third section is given, perhaps as an afterthought. It is a trill which may be described as *ee ee ee ee* or *iii i i i*. It again is quite low but lacks the harshness of the beginning of the song.

This entire song is given during May and most of June. Toward the end of the month, however, the last part is often omitted and often neither the beginning nor the end is heard.

The songs of the young males which begin in late August are entirely different from those of the adult. Perhaps Langille (22) was listening to young birds when he described the song as "a sharp metallic twitter" as it is certainly more squeaky than that of the adult. The first time the writer listened to a bird of the year trying out his vocal apparatus he was reminded of the efforts of a not altogether successful Catbird. These early songs have the choppy notes of *Dumatella* but are given in a more rasping manner. The grating notes of the beginning and the trill at the end are usually omitted by young birds.

The alarm note has been described by Hoffman (15) as an energetic *tshuk*. During this investigation it was found possible to distinguish sexes by means of the call notes. The *kek kek* or *tshuk* is given by the female. The male's note sometimes resembles this also but can usually be distinguished by its more grating nature and may be described as *rrek*. A series of notes is usually given together so

the *rrek's* do not sound very distinct as they roll into each other producing a chattering. The *kek* notes, however, while also given together, maintain their identity. The female has a hissing sound that she gives if too closely pressed by the male. Preceding copulation the female has been heard to give a trill like that at the end of the male's song.

The call notes of the young are quite similar to those of the adult. The nestling, when the female arrives with food, gives a beady *peep* or *peet*. At first these notes are scarcely audible but as the young become older and stronger the *peet* is clearly heard. As the young leave the nest the *peet* gradually develops into a *queck*. It is much more squeaky than the adult *kek* and also lacks the woody quality. The notes of the juvenal become more and more like those of the adult until they are indistinguishable.

SEXUAL RELATIONS

The sexual organs of the male are well developed by the time he reaches the nesting marsh following his trip from the southland, but those of the female are not fully developed at her arrival. As a result she is often kept busy avoiding the male during the first week in her new home. If too badly tormented, she will squeeze between the cat-tails at the water's edge where the male can not reach her and hiss at him with the intention of driving him away.

During the period of nest construction she reaches the height of her development and is ready for the mating act. When the male approaches her at this time, singing, she climbs up a cat-tail stalk and gives the trill which has already been described. Then she beats her wings rapidly, points her bill toward the zenith, and places her tail well over her back. The male goes through the courtship display previously described. At the proper time he climbs upon the back of his mate, beats his wings rapidly as the cloacae come in contact and copulation is completed. The whole procedure takes but a few seconds. Both remain in the immediate vicinity for a short time, the male with feathers fluffed out and tail up, the female quiet and demure.

It is usually the male who tries to induce the female into copulation but on one occasion the female was observed going through the behavior leading to the mating act to entice the male. In this instance the act had been completed twenty-five minutes previously. The male, not giving the proper response, was chased by the female among the cat-tails and it is not known whether she was successful or not.

It is the belief of the writer that the male Long-billed Marsh Wren is essentially polygamous while the female is not. Between one-

fourth and one-third of the territories, which were carefully studied in this investigation, were inhabited by two females and one male. In these instances the two females occupied the two ends as far from each other as possible. A probable reason for this apparent lack of sociability, as previously stated, lies in the fact that the females do not get along during the nesting season. On several occasions fights have been witnessed between them. The first one in a territory does not wish to tolerate any newcomers. The polygamous male, on the other hand, is quite diplomatic. Approximately equal portions of his time are spent with his two mates. In this way suspicion is kept at a minimum and neither female is aware of his dual life. The feeding range of the female is rather small during incubation and the rearing of the young so that she never comes into contact with the third member of the triangle.

One doubtful case was investigated where it was thought possible that a single male might have three mates. Owing to the denseness of the vegetation and the fact that nesting was well under way when the area was discovered it was found impossible to ascertain this condition with certainty. Another unusual instance was observed in the same area. Two male wrens were frequently seen in the vicinity of a certain female. Her nest with eggs was located equidistant from the territories of the two males in question. It seems that she had no regular mate as both of the males observed in the area were successfully mated. The nest was later broken up so that it became impossible to complete observations proving the fickleness of the female. It seems reasonably certain that this was a matter of polyandry. It was the only instance of its kind observed and is not common among the members of this species.

NEST BUILDING

As a matter of convenience in the treatment of this section the nesting endeavors of the male and female will be treated separately. The nest used by the female for the rearing of the brood is given the designation *female nest* while the incomplete ones variously known as "false nests", "cock nests", "mock nests", and "dummy nests", will be called *male nests*.

The male nests of the Long-billed Marsh Wren have been a much discussed question in ornithological literature. The earlier writers, not realizing that these were unused, remarked concerning the abundance of nests. Almost any paper dealing with the species has some notes upon this prolific nest-building activity.

Various theories have been advanced to explain the function or purpose of these extra structures. Norris (25) suggests that many nests are built because meadow mice get into them and the wren will not continue to use one if it is disturbed in any way. These dummies have been built for practice, according to Hunter (19), while Allen has suggested that they may be a means of outlining territorial boundaries. Shufeldt (28) says, "I am convinced that these 'mock nests' are built as lures, to induce their enemies to believe that the wrens were not yet laying, or that the eggs had been stolen, so it was not worth while to continue any further search for them." Forbush (12) states that "most of these nests are never used unless the males sleep in them, but their construction gives the birds an outlet for their superabundant energies."

Many of these reasons do not seem to bear investigation. From my own experience the birds do not desert if the nest or contents are handled, for I have visited nests from the first day of construction until the young had left and the adults in no case deserted. The eggs were counted from day to day, the complete clutches were weighed in some instances, and daily weights were taken of the young. Certainly the combination of all these things would have been sufficient to cause desertion if the birds were easily disturbed. The "practice" idea hardly seems reasonable as the male builds the dummies and the female builds the good nest. It may be that the males sometimes sleep in these extra structures but in no case has this been observed. Evening observations indicated that the males went to roost on some reed stalk. Furthermore these nests become so bedraggled in a short time, due to faulty construction, that it would be almost impossible for the birds to enter them. If the territory theory were to be considered, one would expect the nests to roughly outline the boundaries, but this is not the case as often all of the dummies are grouped in one end of the area.

The Long-billed Marsh Wren is not the only member of the *Troglodytidae* that exhibits this peculiar but interesting habit of multiple nest construction, as the European Wren (*Troglodytes troglodytes*), the House Wren (*Troglodytes aedon*), the Short-billed Marsh Wren (*Cistothorus stellaris*), and the Cactus Wren (*Heleodytes brunneicapillus*) also engage in this activity. Other families have representatives that also exhibit the habit, among them the Red-shanks (*Totanus totanus*), the Little Grebe (*Podiceps fluviatilis*), the Florida Gallinule (*Gallinula chloropus*), the Herring Gull (*Larus argentatus*), and the White-throat (*Sylvia communis*). Owing to the wide separa-

tion of these species it can not be that this habit evolved at a single point in avian evolution.

These additional nests are put to some use by certain species of birds. The Cactus Wren repairs the nests as winter approaches (Bailey, 4) and uses them as sleeping quarters. The European Wren also has been known to utilize them during the cold nights of winter. The question naturally arises whether the male nests are not then built for this purpose. This hardly seems possible as these nests are built during the reproductive cycle, usually before the female arrives, in the case of the Long-billed Marsh Wren.

It is not the male bird in all species that is responsible for the additional nests. Howard (17) states that the White-throat female toys with nesting material and actually constructs platforms and shells before she has reached the physiological condition necessary for the completion of a nest. In the same manner many birds have been observed playing with nesting material before they are ready to build.

In the case of the Marsh Wren the male arrives in the nesting territory about ten days in advance of the female. At this time he has already reached his full sexual development and can complete the mating act. He begins to play with cat-tail down and other materials shortly after his arrival. The next stage is the actual construction of a nest shell. Many of these are hardly started before they are abandoned. If these shells had a purpose would they not be completed? Furthermore as the female appears on the scene nest building on the part of the male is tentatively replaced by interest in his mate. The female, on the other hand, has not reached the peak of development and avoids the male at every opportunity. The male then oscillates between carrying materials to the nests he is constructing and paying attention to the female. As the female reaches the stage in which she is ready to build she adds a few straws, in some cases to the nest the male is working on. Later she starts a nest of her own. At first she works slowly and for short periods but a change takes place and all of her time is then devoted to this activity. The male, during this period, loses interest in his work and pays more attention to his mate and shortly ceases building almost entirely.

The question now arises as to the reason for the presence of this activity in certain species when it is entirely absent in others. In the first place the very fact that the two sexes, in the case of the Marsh Wren, reach their full development at different times helps to explain the situation. If the two were to "mature" at the same time would the male still follow the same course of events? This, of course, can

not be answered but, in cases where the male was delayed in obtaining a mate, he built more nests than those birds which were mated earlier. In such instances nest building continued to be substituted for courtship, display, and copulation until a female arrived and reached the stage when mating could be completed.

Now it is logical to assume that male nests should be of common occurrence among a multitude of species as in most cases the male arrives some time ahead of the female. Let us take the case of the Red-winged Blackbird. The males arrive about the middle of March while the females do not appear until the second week in April in the Ithaca region (Allen, 1). Nesting does not begin until some time later. Allen figures a series of testes and ovaries showing their development. It is interesting to note that their maximum development is not reached until the tenth of May and that both sexes mature at the same time. In such cases the male would not find it necessary to substitute nest construction for the sexual relations as both sexes are prepared for these relations at the same time. Even if the two sexes of a given species should not reach the height of their sexual development at the same time the male might not enter into nest building. In different species other substitutes may take the place of this activity. The difficulty of obtaining food early in the season may, in certain instances, cause the birds to devote much of their time to this need. As an example the Red-wing during the latter part of March and the first two weeks in April goes to the uplands to feed and thus spends but a short period of each day in the marsh. Intensive studies of single species may bring many such characteristics to light. Furthermore, all birds are not as highly sexed as others and one would expect nest building and similar activities to be substituted for sexual relations more frequently in those which have an abundance of sexual energy. There can hardly be any question about the wrens as they are notably a group that is highly developed in this direction. Then again the mere difference in nervous energy varies among the species and a slow and comparatively inactive bird would hardly be expected to show the zeal in any endeavor exhibited by a more active species.

The males, in certain forms, continue to build nests even after their mates have begun to incubate. Thus the Marsh Wren may construct several nests during this period but these activities are not pursued with the vigor of the previous period. In like manner the Madagascar Yellow-headed Weaver Bird (*Foudia sakalava*) continues to adorn nests with fresh green materials during the period that his mate is incubating (Rand, MS). If the many nests of the male are de-

pendent upon the slowness of the female in reaching the height of her sexual development, why does this activity continue after her full development? The male continues at the peak sexually for a longer period while the female transfers all of her energy and time to the duties of incubation. This is noticeably the case in polygamy where a male is able to carry on sexual intercourse with a second mate some time after the first female has passed beyond that stage. During this interval, before the decline of sexual desire, the males of certain species continue to transfer their interest to building and as the cycle comes to an end nest construction also ceases. Others transfer their interest to incubation and so sexual intercourse or its substitutes wane. In like manner the males of some species, while not participating in the duties of incubation, spend much of their time on guard about the nest and show much concern over disturbances which might affect their potential offspring and so these duties serve as an outlet for their sexual energy.

Considering multiple nest construction from these angles, then, different species exhibit many modifications of this activity depending upon the factors influencing the reproductive cycle. The maximum development occurs in those species in which the male reaches the sexual peak in advance of the female and maintains this peak for a longer period. Coupled with these physiological conditions is the lack of interest on the part of the male in sharing the domestic duties and guarding the nesting site. The Long-billed Marsh Wren exhibits to a high degree these characters and is perhaps to be considered as one of the most prolific builders of male nests.

In all cases observed the male commences nest construction the day following his arrival at the marsh of his choice. From then on for the next three weeks building is at its height. The average time for completion of a single nest is two days. In many instances several are under construction at one time and often many are never finished. Many of those that are carried to completion are poorly done. Five nests is a fairly good average for a single male bird, during the rearing of the first brood, while several, of course, build as many as ten different nests.

The dummies are built, as previously mentioned, by the male. Sometimes, as the female reaches the nest building stage, she may add a few straws to a dummy on the day or two preceding the beginning of her own nest. She does very little of the work however, and this small part may be considered negligible.

The location of the male nests above the water is variable. Most of the earlier ones are built in the dead cat-tail stubs or among the new growth of sedges and so are between six and twenty-four inches above the water. Later nests, if built in the sedges, are also necessarily low, but, if built in the cat-tails, may be as much as six feet above the water. Most of the dummies are built in the sedges even though cat-tails are available for the purpose.

Because of the fact that the male and female nests are alike up to a certain point the actual description of nest structure will be treated with that of the female.

Between six and fifteen days after her arrival the female bird begins the construction of her nest. The earlier arrivals seem to spend more time before starting than the later ones. These first days are spent searching for food and avoiding the males.

The work on the nest is done almost entirely by the female. In a few cases the male added a little material, usually cat-tail down. It is possible to observe the bird at work if one remains perfectly still at a distance not closer than fifteen feet. The time required varies from five to eight days.

The nest is most often attached to cat-tails but sedges and grasses are sometimes used while Ridgway (26) and Bryant (9) report nests in bushes several feet above the water.

The initial effort in building consists of lashing the supporting plants together and in this way form a cup-like foundation upon which the remainder of the nest rests. *Carex* and *Calamagrostis* are the chief materials used in this part of the structure. The outer walls which are composed for the most part of long strips of cat-tail leaves and stems and leaves of sedges and grasses is the roughest part of the structure. Water-soaked materials, often more than a foot long, are used here as they are more pliable and can be more easily woven together. The first strands are woven around the long axis and others, as the nest assumes shape, are put in at various angles. Some of these strands are fastened to the supporting structure by actually weaving these stems into the nest. Some of the growing leaves are also woven into the outer walls. If the support is a sedge or a grass, leaves may form a good share of the periphery. An opening is left on one side about two-thirds of the distance from the bottom of the nest. At this stage a dummy would be complete. The walls average at least a half inch in thickness and the external measurements of the entire structure approximate seven and five inches for the vertical

and horizontal diameters, respectively. Inner diameters average five and three inches.

This outer shell is a small part of the completed structure, and only two days are required to build it. The remainder of the work is done from the inside and one must take a nest to pieces to get an idea of its arrangement. Grass and sedge leaves and small stems are used to form the second layer. This gives the walls firmness and tends to fill in the large air spaces which are necessarily present among the coarse materials of the outer walls.

The next layer to be added seems to function as an insulating region. Cat-tail down, feathers, small unidentified rootlets, entire



FIG. 3. Longitudinal section through male ("dummy") nest, left, and through female (occupied) nest, right.

plants of *Lemna*, and decayed fragments of *Typha* and *Carex* are the materials most often used. These also are placed into the structure in a wet condition so that, when dry, they form a compact and tight-fitting region which serves as a non-conductor of heat, cold, and moisture.

The innermost region is composed of finely shredded pieces of the vascular materials of the plants forming the outer layers. A large proportion of it is very fine strips of sedges and grasses of the preceding year. Feathers of almost any available sort are used here. Those from the following birds have been identified: Red-winged Blackbird, Virginia Rail, American Bittern, Pheasant, Ruffed Grouse,

and domestic chicken. The projection at the opening is a part of this inner lining. This "door-step" or sill is always present in the female nest but is lacking in the nests of the male. It is possible, therefore, to determine the sex which built a given nest by checking for the presence of this sill. This projection forms the floor of the opening and extends farther into the nest than any other part of the lining. The nest cavity is surprisingly small in relation to the bulky exterior. This cavity roughly resembles a sphere which has been compressed on the sides so that the vertical diameter has been increased at the expense of the horizontal. The opening into the nest, when viewed in longitudinal section, resembles a tunnel. Actual measurements of the cavity, together with external measurements, will be given later.

One wonders what the function of this door-step might be. Perhaps it serves as a protection to the eggs and young as the nest, owing to the uneven growth of the supporting plants, often assumes a distorted position which would allow the contents to roll out were it not for this structure. In like manner when the nests are placed in sedges or grasses winds alter the nests to such an extent that the young or eggs would be endangered if no sill were there to prevent the catastrophe.

Davie (10), Minot (24), Wilson (32), and others also report mud in the lining of nests of *T. palustris*. At no time was this found to be the case during the course of the present investigation. It is possible that a slight amount of mud adhered to the other materials in those instances and this was construed as an active desire on the part of the wren to add such material to the nest.

The outer dimensions are variable but average about seven by five inches. The wall at the widest part, at the door-step, averages about two and one-half inches while the remainder of that side and the bottom are one inch narrower. The back and the top vary from one-half to one inch in thickness. The opening is usually one and one-quarter inches in diameter. The depth from the innermost tip of the step to the bottom of the nest averages two inches while the width of the interior from front to back is also two inches.

Dummy nests are not usually used as a basis for a female nest. In one particular case, however, where a nest was broken up the day preceding the time of hatching, the female appropriated a partially constructed nest which the male had worked on earlier in the season and had abandoned. She completed the nest in four days and on the fifth laid the first egg. This is the only instance of its kind observed and is decidedly out of the ordinary.

Nests, if carelessly attached to growing plants, are sometimes ruined. One was observed that was completely turned over due to uneven growth of two different cat-tails. Those placed in a large expanse of sedges and grasses may be destroyed by heavy winds and rain. Four out of six nests containing eggs or young were demolished during a severe storm. All of those which were attached to cat-tails withstood the attack of the elements and none of the young suffered. It is possible that the mortality from this cause might be very large during certain seasons.

A peculiar nesting relationship was noted by Beard (6), who observed a compound nest, the lower half occupied by a Red-wing and the upper half by a Marsh Wren. Evidently the two species lived together in perfect harmony as both contained clutches of eggs.

EGG LAYING

The day following the completion of the nest the first egg is laid, and from then on until the clutch is complete one egg is laid each day. The time of oviposition is from five until eight o'clock in the morning. At Ithaca the first eggs are laid in late May but the largest number of clutches are not completed until the first week in June, and the later arrivals do not begin to lay until June 15 or 20. The egg laying period for the second brood begins in late July. This varies, naturally, with the degree of success in bringing off the first brood. At Ithaca a nest was reported as late as August 7, while at Staples, Minn., most of the clutches were complete by July 25.

Forbush (12) gives the number of eggs as five to ten, usually five. Harlow (14) reporting on 196 nests found numbers from three to seven with five also the average number. Of the forty nests studied during the summer of 1931, five was the most frequent while three and six were the extreme numbers. Aldrich (in a paper read before the A. O. U. at Detroit, 1931) reported six the usual number for the first and five for the second brood.

A series of sixteen eggs in the Cornell collection vary in size from 17.5 mm. by 13 mm. to 13.5 mm. by 10 mm. with an average of 16.5 mm. by 12.5 mm. One of these was a runt egg measuring 13.5 mm. by 10 mm. Two clutches were weighed immediately after the sets were complete. Individual eggs varied from 1.41 g. to 1.56 g. with an average weight of 1.48 g.

INCUBATION

The female often begins to incubate before the clutch is complete, but waits, in all cases observed by the writer, at least until the third

egg is laid. In most nests young of two and often three ages can be found. In all of the nests under observation the eggs hatched on the thirteenth day. Forbush (12) gives the period as ten to thirteen days. These earlier dates are, perhaps, the result of figuring the period from the completion of the clutch to the time of hatching of the first young. Bowles (8) reports the eggs of the Pacific form, *T. p. paludicola*, under incubation from the time the first is laid. Wheelock (31) gives the period of incubation of this form as twelve days.

The duties of incubation are assumed only by the female. The male seldom comes near the nest and then is driven away by his mate. Wheelock (31) agrees with the present study in finding that the male takes no part in incubation while Miller (23) is in disagreement with this observation.

The female is easily excited during incubation and will leave the nest on the slightest provocation. Even on the very day the young are to hatch she will flush at a distance greater than fifteen feet. She remains near the nest, however, and shows much concern at the disturbance. The male, on the other hand, may be in the vicinity of the disturbance, but shows no interest in the matter.

On the thirteenth day the egg is cut into approximately equal halves by the egg tooth of the hatching bird. This cut is so regular and precise that one must marvel at the mechanical perfection of the operation.

THE YOUNG IN THE NEST

At hatching the young are blind and helpless. The tender flesh-colored skin is partially covered on the capital and spinal tracts by a few pure white neossoptiles. The mouth lining is buff-yellow, the leg flesh-colored, and the skin covering the eye bluish-black. The slit which opens later is clearly discernible at this time.

The type of food delivered to the young by the female is determined to a certain extent by the age of the nestlings. At first this consists of very small juicy morsels such as mosquitoes and their larvae, larval Tipulids, midges, and other delicate forms. The mother brings a whole beakful of food to the nest at one time and parcels it out to the hungry occupants. Contrary to the opinion of Wheelock (31), the young at Ithaca were not fed by regurgitation for the food was not swallowed but crammed along the full length of the oesophagus. During the first days the young are so small and helpless that it is necessary for the female to reach far into the nest to feed them. During the morning and evening approximately ten trips are made per hour with food, but during mid-day this number is somewhat reduced.

As the nestlings grow the insects brought to the nest become appreciably larger in size. Ground, diving, and long-horned beetles, caterpillars of various assortments, saw-flies and other hymenoptera, and other accessible forms now constitute the diet of the ever-hungry young. Sometimes the insect is so large that the young bird experiences difficulties in swallowing it. In such instances the female takes the hexapod to the side of the nest, chops and tears it into several smaller morsels, and then brings it back for a second trial which is usually a success. In one particular case a medium-sized dragonfly was fed to a ten-day-old nestling. No attempt was made to break the insect into bits and no difficulty seemed to be encountered in swallowing the morsel.

After they have reached the age of eight or nine days, the nestlings stretch for their food so that the female now is not required to reach far into the nest. The nestlings crane their necks to such an extent that the parent often stands on the side of the nest and feeds the open mouths which appear at the opening.

There is much disagreement in the literature concerning the sexes of the parents which attend to the wants of the nestlings. Most writers seem to be of the opinion that the male assists in this duty. No male has been observed, in the nests studied by the writer, bringing food to the nest. This observation is in accord with Wheelock's studies (31). The young can be removed from the nest in the presence of the male without his showing the least concern while the female becomes greatly disturbed if one should approach even the vicinity of the nest.

Even when the nestlings are very young little time, during the day, is given to brooding. Usually after a feeding or two the young are brooded for a few minutes and then feeding is resumed. My records show a total brooding of eighteen minutes per hour when the young are two days old. As the nestlings increase in size the brooding periods become shorter and the intervals between such periods become longer, so that, after the first week, they are discontinued during the hours of daylight.

There is no need of protecting the nestlings from the sun's rays because of the peculiar type of nest construction. It is also possible that such nests aid in holding the heat given off by the birds so that brooding is reduced to a minimum.

The excreta, enclosed in their envelopes, are removed by the female after feeding. These droppings are usually carried some distance from the nest and deposited but occasionally the female has been observed eating them. Only one of these envelopes is removed at a time

and the parent will often hurry up the feeding trips in order to carry away the remaining ones.

When the young are small the faecal material is deposited in the bottom of the nest. As the nestlings increase in size, however, they maneuver about until they assume a position facing away from the entrance, and the dropping is ejected on the periphery of the nest. During the later period of nest life the young succeed in ejecting the excrement with such force that it is carried over the side of the nest and drops to the ground, relieving the female of the necessity of removing it.

Other materials are carried away in a similar manner. Egg shells have been observed twenty-five feet from the nest. Infertile eggs also disappear and it seems that the female must carry them away. No instance has been observed but the infertile eggs have often been found wanting after remaining in the nest several days beyond the normal period of incubation. It is entirely possible that the parent eats these infertile eggs but, if this is the case, they must certainly be removed first as no evidence ever remains at the bottom of the nest. Nestlings which have died from one cause or another are also removed.

The young Marsh Wren, as in the Cowbird in Friedmann's studies (13), soon establishes the power of orientation. When placed upon the back the newly-hatched bird will right itself. At first this is a difficult procedure due to weakness and a lack of co-ordination.

The food response is quickly acquired by the nestling. This response is usually accompanied by a faint *peet* scarcely audible at first. During early life contact seems to be the necessary stimulus but later merely a slight rustling of the leaves as the female approaches the nest is sufficient to cause the young to open wide their mouths and stretch forth their necks.

On the third day the eyes open. With the advent of sight fear begins to develop. At the least sign of danger the young assume a crouching position with the body flat and the neck drawn in. This position was often observed during the periods of weighing and seems to develop at about the fifth day, reaching its height during the second week of nest life.

During the first three days the nestling lies flat on its belly, having no control over the legs, but on the fourth day it assumes a more erect position, placing the weight on the entire tarsus. It has no control over the toes, however, and keeps them doubled up until the ninth day. During this time the wings are an important factor in movement. Shifting about in the nest is a combination of wing and leg

exercises. Grasping with the toes becomes very noticeable on the tenth day and the legs appear well developed at this time.

During the last days of nest life, due to the increased activity of the young, the nest has become considerably worn and no longer has the neat compact appearance of its earlier days. The opening has

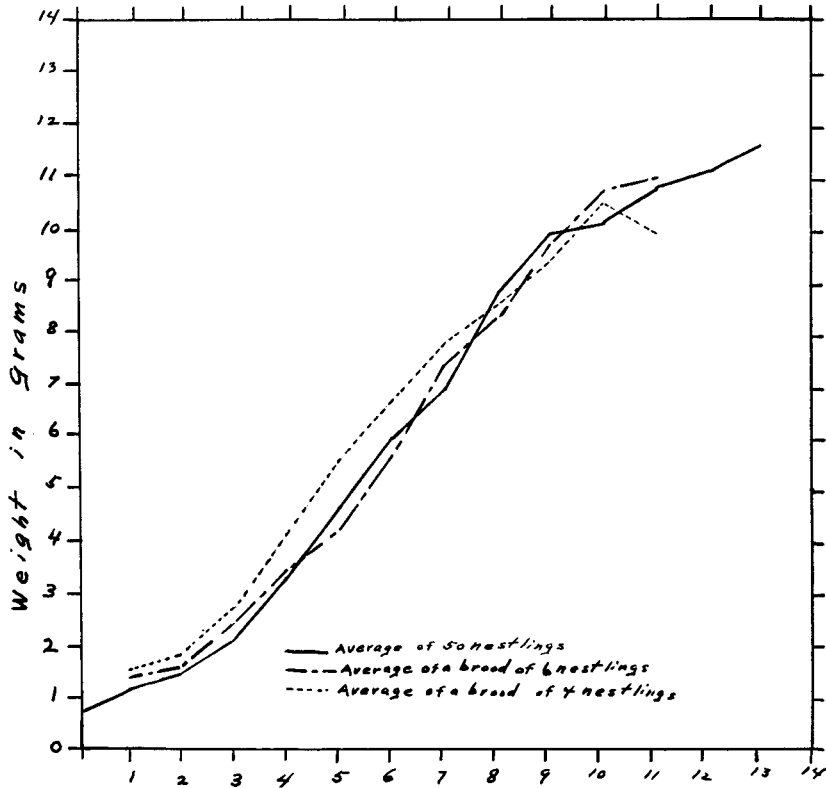


FIG. 4. Graph showing increases in weight of nestlings. Vertical scale shows weight in grams; horizontal scale shows number of days.

become greatly enlarged and the inner diameters have been increased by the young to compensate for their increase in size.

A series of nestlings from thirteen different nests was weighed at a definite time each day to determine the average rate of growth. More weights were obtained during the first seven days of nest life due to the fact that several nests and their contents were destroyed through one agency or another in the subsequent period.

In the first twelve days the young bird increases in weight approximately eleven times. The average weight for the newly arrived wren is .87 of a gram but by the end of the twelfth day this has been increased to an average of 11.08 grams. During this time the gain is from 1 to 1.7 grams a day. Due to the difficulty of being present at the time of hatching very few weights were obtained at that time. During the period of greatest feather growth the gain in weight drops off markedly (10th to 13th days).

In order to check on differences in gain in weight between broods with varying numbers of young, the nests selected for this particular study contained four, five, and six nestlings. No appreciable difference was observed so, no doubt, the females with large broods compensated for the additional members by working harder to supply the necessary food.

When the birds leave the nest they weigh between eleven and twelve grams. This is increased to approximately fourteen grams by the time they are ready to begin the southward journey.

On the twelfth day the young, if frightened or disturbed in any way, will leave the nest. In one particular instance all of the nestlings jumped from the nest and disappeared into the undergrowth at my approach. On the succeeding day, however, one of the birds was found back in the parental shelter. This was the only record of the kind observed but it would lead one to believe that the fledglings may return to the nest to spend the night or to seek protection during inclement weather. They usually spend the night perched upon the flags in the areas of dense rank growth.

The fourteenth day is the normal time of departure for all of the birds studied. At first they run along the ground or hop and half fly from one flag to another. This behavior is no doubt correlated with the fact that the tarsus is much better developed than the wings at this stage. The parents are very solicitous of the welfare of their progeny during this period and an approach to their near vicinity will call forth a series of scolding notes from both adults.

Observations at this season were quite difficult to make, due to the denseness of the vegetation and the fact that the young spend most of their time on or near the ground, and, as a result, are not altogether complete. The parents care for the young for at least two weeks. Wheelock (31) reported the young of the western form, *T. p. paludicola*, to be fed by the parents for twenty-six days. If this is true of *T. p. dissaëptus*, most of the work of the last ten days must be done by the male as the female then starts another brood.

In contrast to the period in the nest, both parents care for the fledglings. The male does little of the work at first but is usually in the near vicinity. At this time he seems to be more interested in the female than in his offspring. Gradually he assumes his share of these duties and toward the end of the second week after the young have left the nest seems to be doing more than his share. After the first ten days out of the nest the young are able to capture some of their food and so cut down to some extent the labors of their parents.

The family group remains together for some time and it is not unusual in mid-September to see four, five, and six birds of an age still keeping together. The young do not remain in the territory of their parents but wander from place to place. At first, as previously stated, they spend most of the time in dense matted and tangled places which offer the most protection. As they develop the power of flight and so no longer need to depend upon secure hiding places, they begin to frequent the more open areas near the water. These areas, usually nearest and farthest from the water, become the localities most favored by the young during the latter part of the summer.

THE SECOND BROOD

It is the general consensus of opinion of most writers that there are only two broods per year. It is extremely difficult to get accurate data on this subject but from the material on hand this seems to be the case. It is entirely possible that, with banded birds, more information could be obtained but the difficulty of locating these late nests due to the condition of the vegetation at that time would make the task considerably more complex. No instance which could be considered a third brood was observed by the writer. In some cases very late nests were located but these could be explained by abrupt and unsuccessful terminations to earlier attempts.

The second brood is not necessarily reared in the territory originally occupied by a pair of birds. It is usually the case for the birds to move into a more open area. At this time many of the nests are near the water's edge while for the earlier brood such locations are infrequent.

A new nest is built even though the original territory is used a second time. It is true that the former nest would not be useable because of its worn condition. The male does not enter into dummy nest construction with his former zeal, and in many instances none are constructed. One must not, of course, confuse late arrivals with second broods as the very latest birds often are just beginning to build at the time that the earlier birds are starting the second brood.

The initiation of the second brood naturally depends upon the success of the first. The female begins her second nest about two weeks after the young of the first have left the nest. The majority of the nests, then, in the regions studied would be started between July 15 and August 1, with the last week in July the most active period. Nests with eggs have been found at Ithaca up to August 5.

On the whole the second brood is much more matter-of-fact than the first. The males seldom indulge in song and long before the young are out of the nest they have ceased to sing entirely. By the first of September the adults have fulfilled their responsibilities as parents. As soon as they have completed the post-nuptial molt they begin their southern journey and usually leave the young to follow at a later period.

FOOD STUDIES

Because the Marsh Wren is confined to the marshes and swamps and does not come into contact with human habitations and so provide an economic problem, its food habits have not been studied intensively. The most thorough work was done by Beal (5) who examined fifty-three stomachs of this species. He lists the Hemiptera as the group of insects most often preyed upon with the Coleoptera and Lepidoptera second and third. Judd (21) examined five stomachs and reported Coleoptera and Arachnida as the most important foods.

It has not been the intention of the writer to work out the economic status of the species but rather to try to understand and interpret the relationships between food supply and food eaten, and manner of feeding and adaptations and specializations brought about by continued existence in the marsh, in order to determine the effect these things might have upon the survival of the birds in a less moist habitat.

Due to the fact that all of the food is obtained in the marsh, forms which are aquatic for a part or all of their existence constitute a large portion of the diet. Much of the food is obtained near or from the surface of the water. The elongated bill and natural agility of the bird are important adjuncts to this mode of feeding. Feeding operations are also carried on upon the stems and leaves of the cattails and other plants. It is not unusual to observe the bird as he sights a juicy morsel fly into the air and capture it in the manner of a flycatcher. Insects as large as dragonflies are taken in this way.

There is no actual selection of types of insects by the species but the food taken depends upon its predominance and accessibility. By the time the birds arrive in the spring there is an abundance of insect food. Beetles of various sorts form an important part of the diet

during this early period, together with aquatic larvae that have passed the winter in that stage. As the season advances insect food becomes more plentiful and examinations of stomachs reveal a multitude of forms.

Coleoptera and Diptera assume the highest rank while various other orders are represented to a lesser degree. Carabidae and Dytiscidae occur more frequently among the beetles than any other forms while a large percentage of the Diptera belong to the Tipulidae.

With the limited number of stomachs included in the present study it is not possible to state definitely any important features concerning the food taken. Both beneficial and detrimental insects are consumed. It is wholly possible that the Marsh Wren first took up his present habitat because of the abundance of insect food rather than a distinct preference for certain forms that are found there, it is not a matter of kinds of species but numbers of individuals and all seem equally desirable, if obtainable.

RELATIONS OF THE MARSH WREN TO OTHER FORMS OF LIFE

The chief enemies of the Long-billed Marsh Wren are some of the smaller mammals that reside in the marsh. Approximately one-third of the nests containing eggs or young were destroyed in some manner and a very large proportion of this destruction can be attributed to molestation by some form of mammal. No specific case has been observed but the appearance of the nest leads one to this conclusion. Entrance in all cases save one was obtained through the opening at the front of the nest. The structure itself was never torn or ruined in any way. The smallness of the opening and the fact that the nest was not damaged restricts the size of the intruder considerably. It is the writer's opinion that the blame can be placed upon at least one of three mammals: Meadow Mouse (*Microtus pennsylvanicus*), Jumping Mouse (*Zapus hudsonicus*), and Bonaparte's Weasel (*Mustela cicognani*). According to Allen (1) all of these forms occur in numbers in the cat-tail and sedge associations. Meadow Mice were exceedingly abundant throughout the summer of 1931 in the Renwick Marshes.

The Marsh Wrens suffer to a lesser extent from the destruction wrought by other species. Dr. A. A. Allen has observed Bronzed Grackles during the late summer consuming the luckless young of the later nests of the second brood. Other birds are not important from this standpoint; hawks and owls have a poor chance of adding this species to their diet as they are never very conspicuous and can easily hide in the dense vegetation.

Bumble bees have on various occasions used Marsh Wren nests for their own purposes. Whether they ever actually drive out the rightful owner and assume possession I am unable to say. Nevertheless it is apparently not unusual to find a colony of these bees in a nest of this species as Dr. Allen has several cases on record.

The parasites recorded for this species are few. Dr. Eloise B. Cram kindly supplied records of the flea, *Ceratophyllus garei*, and the louse, *Philopterus mirinotatus mirinotatus*. Hippoboscid flies, evidently *Ornithomia avicularia*, have been observed several times but at no time was it possible to obtain specimens. The alimentary tracts of more than fifty birds were examined carefully without obtaining a single cestode or nematode.

The Long-billed Marsh Wren usually lives in harmony with its associates in the marsh. It practices to some extent the habit of puncturing the eggs of other birds in a manner similar to that of the House Wren. Allen (1) describes this practice in detail and gives the Marsh Wren the blame for breaking up fourteen out of fifty-one nests of the Red-winged Blackbird. From these records one would be led to believe that the habit is very common and that the percentage of prospective birds destroyed in this way is large. It is the opinion of the writer that these instances concern only a few of the birds and that the great majority do not enter into this pernicious practice. Many nests of other species of birds were under observation in the marsh and at no time were punctured eggs found or other indications of egg eating by the Marsh Wren observed.

DISCUSSION

Undoubtedly the Marsh Wren took up its present habitat a long time ago as denoted by its degree of specialization. Allen (1) considers the Redwing a comparatively recent addition to the avifauna of the marsh. Following his method of reasoning the Marsh Wren must have taken up its present residence at a much earlier period as indicated by certain factors. In the first place the species has become specialized as regards the elongation of the bill and the tendency toward reduction in use of the wings. At present the Marsh Wren is a relatively poor flyer with the female seldom taking wing. A continuation of life in the present habitat will most assuredly lead to further reduction of this ability. Secondly, all of its time is spent in a marsh environment. The Redwing takes up residence in this situation only long enough to bring about perpetuation of the species. Thirdly, it does not revert easily to dry land when conditions in the marsh be-

come unfavorable, even though the southern forms occasionally nest in bushes. At Ithaca a colony was located nesting in a dry marsh grown up to sedges and grasses. Of the four nests observed in this region all came to an untimely end due to the heaviness of the nest in proportion to the supporting plants. The nests were so badly mangled by a wind-storm that eggs and young fell to the ground. Nests in cat-tails during the same period easily withstood the onslaught of the storm. Nests constructed in the cat-tails have a much greater chance of success than others indicating that the birds, being most accustomed to this type of supporting plant have been marsh residents for a long period. Lastly, the Marsh Wren, unlike the Redwing, seeks shelter in the marsh rather than depending upon flight for safety.

Perhaps originally the Marsh Wren took to the marsh because of the abundance of food, lack of competition in this less favored environment, and the shelter afforded. Owing to continued existence in this habitat specializations of various sorts have developed making it almost mandatory for the species to continue its present mode of living. Were the species to gradually change its habitat to the more extensive but less moist meadows and semi-dry marshes of grasses and sedges the most necessary change, in my opinion, would be a less bulky nest placed lower on the supporting plants. The Short-billed Marsh Wren has adapted itself to this type of environment and its nesting activities are attended with success.

As the marshes become less extensive the Long-bills will find it necessary to adapt themselves to a life in a dryer situation. This change will come about gradually as certain members are forced to nest farther and farther from the center of the colony. These birds, in order to survive, must adapt their nest structure to the nature of the supporting plant and in this way bring about a gradual evolution which will permit the species to continue to exist even when marshes are no longer present. At the present time some of the nests around the border of the colony are somewhat modified due to the nature of the flora in which the birds find it necessary to build.

The Marsh Wren, while unequivocally a specialized species, is sufficiently adaptable to meet changing conditions and will, as necessity demands, gradually assume a place in an environment consisting of associations of grasses and sedges. It is a specialized species but not so specialized that it cannot live apart from its present habitat.

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