

COMPARATIVE STUDY OF THE NESTING BEHAVIOR OF
CHESTNUT-SIDED AND NASHVILLE WARBLERS

BY LOUISE DE KIRILINE LAWRENCE

THE study of the Chestnut-sided Warbler (*Dendroica pensylvanica*) was made during May, June and July, 1945, and that of the Nashville Warbler (*Vermivora ruficapilla*), during June, 1946. Both nests were in my study area on the west side of Pimisi Bay, just south of the Mattawa River which flows into the Ottawa River at the town of Mattawa fifteen miles farther east. The place is situated in the township of Calvin, District of Nipissing, Ontario.

For invaluable encouragement as well as assistance with the correction of this manuscript and helpful suggestions about charts and diagrams, I am particularly indebted to Dr. J. Murray Speirs and Doris Huestis Speirs. Further, I wish to acknowledge the kindness of Mr. James Baillie, Jr., who arranged for me the loan of certain literature from the library of the Royal Ontario Museum of Zoology, and of Mrs. Hugh M. Halliday, who found the nest of the Nashville Warbler and allowed me the free use of her notes.

The instruments used in both studies were an ordinary clock with large dial and a pair of 8 x 30 Zeiss marine binoculars.

THE NESTS

The Chestnut-sided Warbler's nest was discovered in the forenoon of May 27, 1945. The female was just engaged in fastening the bottom to converging stalks of a raspberry bush, about 18 inches from the ground. Two hours later the nest was half finished and the female was sitting in it moulding it into shape with breast and body. Still later a white string was observed lying across the nest and this was eventually woven into the structure. The male was not seen during the building. However, continuous observation was not possible at the time, but Kendeigh (1945) spoke of the males as being "somewhat attentive to the females during the nest-building . . ." After a day of rainy and cold weather (temp. 54-62 degrees Fahrenheit), during which little or no work was done on the nest, it was finally completed on May 29. During the next four and a half days the nest was seemingly abandoned until, at 4:50 a. m. on June 4, the first egg was laid.

The location of the nest was at the northeastern edge of a fairly open space in the woods, overgrown by what later would become a thick covering of tall bracken. In the middle of this space stood a lone poplar tree. For the rest, the area harbored little else than a few sapling white birches and aspen trees, and a couple of red maples and

hazelbushes. On all sides this open woodland was surrounded by mature second growth such as aspens, white birches, red and white pines, balsam firs and a few cedars. About 100 feet southeast of the nest there was a thick stand of firs covering a moist, mossy place in which small pools of water remained from the spring thaw. The territory of the Chestnut-sided pair comprised about three-quarters of an acre with the nest about in the center. An American Robin (*Turdus migratorius*), was incubating in a red pine 12 feet north of the nest and, later, a Least Flycatcher (*Empidonax minimus*), and a Mourning Warbler (*Oporornis philadelphia*), occupied adjoining and somewhat overlapping territories.

The nest of the Nashville Warblers was fully completed and incubation in progress when discovered during the afternoon of May 31, 1946. Mrs. Halliday, looking for nests, came upon the female as the bird fluttered amongst the underbrush "feigning injury." But it was not until she had patiently trailed the bird for more than an hour and it finally returned to the nest, that she literally unearthed its exact location. The nest was placed on the open ground but well hidden under a cluster of dead bracken leaves. At first glance it looked surprisingly like an Oven-bird's nest with the entrance on the southeast side. The site was on a dry and sandy plateau gently sloping southwards, which was overgrown with a thicket of sapling aspen trees, white birches and red maple bushes, here and there interspersed by tall balsam firs and red and white pines. To the north this thicket gave place to a stand of older mixed woods with a dense undergrowth of a variety of shrubs, such as hazel, raspberry, salix, etc., which in places was made impenetrable by criss-crossing windfalls. The Nashville territory, involving about a half acre, apparently was of oblong shape, stretching well into the above-described mixed woods to the north with the nest located in the opposite south corner. Territories adjoining the Nashville Warblers' were occupied by a pair of American Redstarts (*Setophaga ruticilla*), Mourning Warblers, Chipping Sparrows (*Spizella passerina*), Veerys (*Hylocichla fuscescens*), and a pair of Ruby-throated Hummingbirds (*Archilochus colubris*).

The construction of the nests showed all the dissimilarities inherent in one hanging in a bush and one tucked away on the ground. Rootlets, fine fibres and hairs went into the making of the ground-nest and its colors blended perfectly with those of the dead leaves and grass. The nest in the raspberry bush, on the other hand, was mainly composed of fine grasses and strips of birchbark, giving it a mottled appearance which, in the dappled light of sunlit green leaves, stalks and twigs, made it remarkably inconspicuous.

THE CLUTCHES

When discovered, the Nashville Warbler nest contained four eggs of its own and one Cowbird's egg. Friedmann (1929) listed the Nashville Warbler as "a decidedly uncommon victim" of Cowbird parasitism. He had but four records.

The Chestnut-sided Warbler began egg-laying on June 4 and thereafter laid one egg a day between 4:00 and 9:00 a. m. until there were four eggs in the nest on June 7. Several times around noon during this period, the female was observed sitting on the nest for a short while. The male was first seen on the second day of egg-laying when he sat singing in a tree above the nest.

INCUBATION

The Chestnut-sided Warbler was observed during the 1st, 2nd, 5th, 9th and 10th days of incubation in watches varying from 185 to 125 minutes. The earliest began at 6:55 a. m. and the latest one ended at 4:14 p. m.

The Nashville Warbler was observed only twice on, presumably, the 8th and 10th days of incubation. The watches lasted 250 and 160 minutes, respectively, and the earliest began at 7:35 a. m. and the latest ended at 4:40 p. m.

The accompanying chart (Text-figure 1) shows the attentiveness of both birds as observed during incubation.

On the nest, the Chestnut-sided female preferred to face south, and only occasionally turned around in the opposite direction for shorter periods. She was difficult to flush, apparently trusting implicitly in her blending coloration to escape detection. She allowed the observer within two feet before she disappeared over the edge of the nest through a screen of leaves. Possibly because she became used to my visits, this bird was never seen "feigning injury," but if she found herself disturbed while within sight of the nest she flitted about and scolded vigorously until the object of her displeasure retired to appropriate distance.

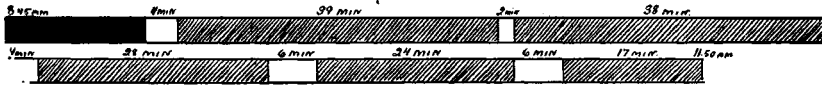
A few minutes before the female was ready to leave after a period of incubating, she became markedly restless. She would shift about, shake herself, look around, as if she were debating with herself the exact instant when she ought to go. Then she hopped up on the rim of the nest and ducked through the screen of leaves on the east side. She flew low through the underbrush, generally to her favourite haunt, the mossy place under the fir trees.

The west side of the nest was open, but only three times was she seen leaving by this exit. On the first occasion she was apparently

CHESTNUT-SIDED WARBLER

ATTENTIVITY DURING INCUBATION

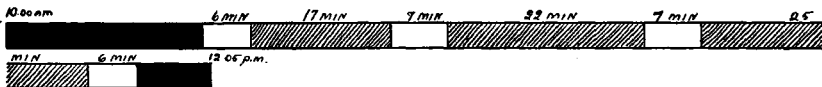
JUNE 8 1st Day. OB. TIME 185 MIN. Temp 60°-66° F



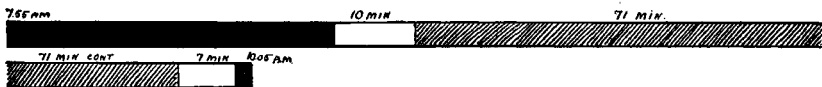
JUNE 9 2nd Day OB. TIME 136 MIN. Temp 76° F



JUNE 12 5th Day OB. TIME 125 MIN. Temp 70° F



JUNE 16. 9th Day OB. TIME 130 MIN. Temp 60°-67° F

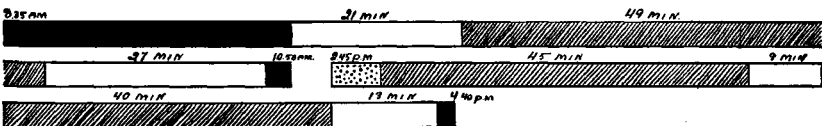


JUNE 17. 10th Day OB. TIME 135 MIN. Temp 74°-72° F

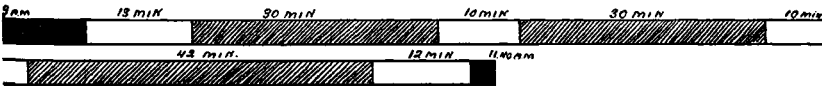


NASHVILLE WARBLER

JUNE 5th OB. TIME 250 MIN. Temp 65°-70° F



JUNE 7th OB. TIME 160 MIN. Temp 55° F



LEGEND SOLID - INTERRUPTED "ON" PERIODS. CLEAR - "OFF" PERIODS
SHADED - "ON" PERIODS. DOTTED - INTERRUPTED "OFF" PERIODS

TEXT-FIGURE 1.

excited by the male's presence in the west area, and she went off to where he was, cutting her attentive period short by about ten minutes. Similar behavior is described by Kendeigh (1945).

The bird always returned to the nest in the same way and from the same direction regardless of where she had been. She first flew into a sapling white birch east of the nest, from there to an elderberry bush and down into its lowest branches. Then, with tail spread and wings dropped, she ran sideways up a rod leaning towards the nest and with a light swoop settled on the eggs. Whether she approached silently like a shadow or chipping with head feathers on end, depended upon mood and circumstances, and the time it took her varied, accordingly, from half a minute to three minutes.

The eggs were seen to be turned once during each of the first watches, three times within an hour on the third watch (5th day), and once during the last two watches (9th and 10th days). The bird seemed to use both bill and feet, trampling with the feet and pushing with the bill.

The male took no part in the incubating but would mostly, although not always, be on guard, singing from some perch near by while the female was off the nest. Mousley (1924) spoke of the male feeding the female during incubation, but this was not observed during this study.

The Nashville Warbler female also incubated without being relieved by the male. She had no preferred way of sitting on the nest but would often turn around, facing any direction.

The female's plumage, olive-green on back and shoulders, and faintly bluish on the head, with lemon-yellow eye-rings and under parts, blended extraordinarily well into the colors of her surroundings. In fact, whether she was seen in the earth-brown entourage of the nest or amongst the spring-green foliage of the trees, her coloring seemed to possess chameleon-like properties. Mostly she appeared as a mere outline, guessed rather than defined, until the gleam of a lustrous bird's eye or a movement gave her away. Unlike the Chestnut-sided female, the first hint of a disturbance drove her off the nest. She moved swiftly along the ground with only the light quiver of grass and dead leaves to reveal the course of her passing body. Due to her shyness, her inattentive periods were therefore notably prolonged during the first day of observation, but she soon incorporated the observer with the rest of her natural surroundings and took no further notice.

Because the nest was completely screened in by the dead bracken leaves on all sides except to the southeast, the bird could fly out only in one direction. Undisturbed, she then rose quickly to the top foliage of the trees where she picked her food mostly from under the leaves. Her feeding expeditions seemed to follow a set course, from east and

south around to the north into the tangled woods beyond the aspen thicket. Upon return she invariably approached by flying into a young balsam fir, and down to its lower branches, which reached out towards the nest and along which she hopped, dainty and alert, before she swooped over a foot of open space into the nest.

The male was always in attendance and escorted the female on her rounds and back to the nest. Heard often, chipping or singing, but rarely seen, he moved through the sunlit trees as inconspicuously as his mate. He could be distinguished from her by his much brighter yellow on the breast, his more defined bluish hood and yellow eye-rings, and a darker bill. All his primaries and secondaries were edged with yellow, as if brushed by a beam of sunlight.

The eggs of the Nashville Warblers were bluish-white with cinnamon spots aggregating in a ring at the larger end. Apparently the female used the feet chiefly when turning the eggs, but because she moved so much on the nest it was hard to determine exactly when the operation took place. However, by observing the position of the Cowbird egg in relation to the others, the observer found the eggs changed around once during each of the two days. The last time the female was seen trampling about a great deal and finally she also resorted to pushing with her bill.

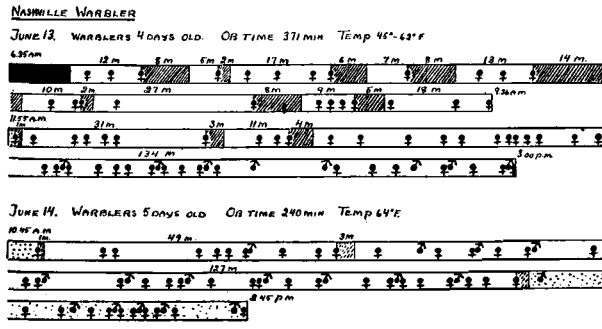
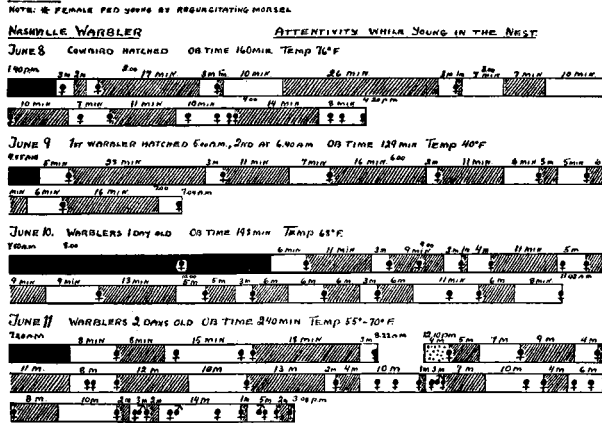
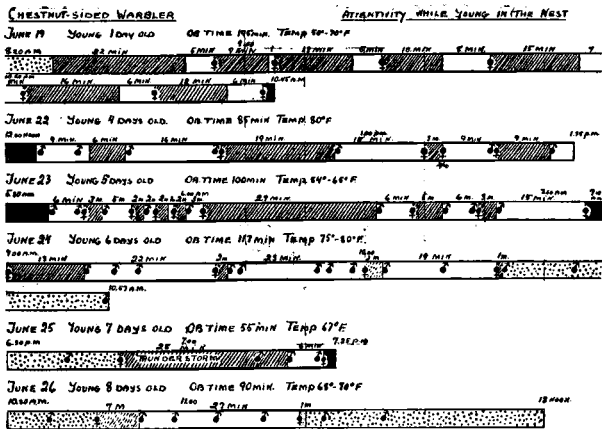
BEHAVIOR WHILE YOUNG WERE IN THE NEST

In the diagram (Text-figure 2), attentiveness and feedings are graphically recorded.

Three of the Chestnut-sided Warblers' eggs were hatched on June 19 at 7:20 a. m., 12 days after the last egg was laid. But the fourth egg was not hatched and remained in the nest until the young had left. Once the female made a valiant effort to throw out this egg so that her whole body shook, but without success.

During the first day's watch, which lasted from 8:20 to 10:45 a. m., the male was absent, apparently not yet aware of the existence of his offspring, and the female alone cared for the young. She was, however, decidedly restless and excited and when off the nest flitted about and chipped incessantly. The observer is inclined to interpret this behavior (especially after a somewhat analogous occurrence with the Nashville Warbler), as an effort to attract the attention of the inattentive male; and in the evening of the same day the male was seen sitting on the rim of the nest together with the female feeding the young (J. M. Speirs).

The female fed the young, one at a time, apparently by regurgitation. After feedings she yawned and smacked her mandibles in a



NOTE: FEEDINGS DURING ATTENTIVE PERIODS OF JUNE 10 W CONSISTED OF JAMA BLEND UNTIL CAUGHT ON MY

LEGEND SOLID = INTERRUPTED 'ON' PERIODS CLEAR = 'OFF' PERIODS ◻ = FEEDINGS BY ♂
 SHADED = 'ON' PERIODS DOTTED = INTERRUPTED 'OFF' PERIODS ◻ = FEEDINGS BY ♀

TEXT-FIGURE 2.

curious way, possibly a reaction following regurgitation. This ceased later after, it may be assumed, she became accustomed to this manner of feeding. She approached the nest in the same fashion as during incubation. She perched on the west rim of the nest as she offered food to the young.

Feeding by regurgitation was abandoned gradually and replaced by direct feeding. On the fourth day the female was seen regurgitating only once. Whether the male at any time fed by regurgitation could not be determined, as the nesting study was interrupted during the second and third days. The food was placed in the open bill of the young and if the small one had any difficulty, the parent birds often picked up the morsel again and replaced it, presumably in a manner more convenient for swallowing.

After the first day the male settled down to his parental duties with energy and efficiency. His rate of feeding, as the charts show, was considerably higher than the female's, partly because much of her time in the beginning was taken up with brooding. After the fifth day, however, the female spent a great deal of time during her increased inattentive periods preening and feeding herself, more and more rarely bringing food to the young.

The male did not help with the brooding. He approached the nest from the same direction as the female, through the elderberry bush, but being always in a hurry spent less time over it. He perched on the north rim of the nest and departed by the open west exit. The female's brooding periods usually ended with the arrival of the male. Sometimes both parents arrived at the nest simultaneously. On such occasions the male retired until the female finished feeding, whereupon he approached and fed while the female watched. Once both parents fed a young each at the nest together. The young were at first fed smaller insects, mosquitoes, and small moths, which gradually were increased in size—for instance, large green caterpillars and huge dragonflies. The latter sometimes proved quite a problem to dispose of both for parents and young.

On the fifth day the young began to show pinfeathers and on the sixth their eyes began to open and their wing-bars to show. On the eighth day the young were fully feathered.

During the last days the female merely sat on the rim of the nest in a quasi-brooding position during her much abbreviated attentive periods. On the seventh day, however, the nest was watched during a thunderstorm, at the height of which the female remained properly brooding for 28 minutes. Towards the end the male arrived with food, and the young, sensing or hearing him, stuck out their heads

from under the mother who lifted herself to allow one of them to be fed. She then settled down again until the downpour subsided.

In the Nashville Warbler nest, the Cowbird was hatched in the afternoon of June 8 and one of the warbler eggs was missing. The young Cowbird was naked except for some tufts of grey natal down. The giant lay draped over the small eggs of his host.

The female did all the feeding of the young Cowbird which she regaled with small moths and mosquitoes by direct feeding. During her attentive periods she cleaned the nest thoroughly, eating the droppings.

The first of the warbler young hatched at 4:55 a. m. on June 9, a tiny mite compared with the Cowbird. It was adorned with dark, almost black, natal down in patches; for the rest it was naked. After attending to the Cowbird, the female ten minutes later settled down to eat the eggshell. She did this in two portions, first one half, then the other, and it took her six minutes of much chewing and gasping to get it down. At 6:47 a. m. she began eating another eggshell from the second young just hatched. It took her exactly the same time to dispose of this shell as the first one.

Again this day the female was alone caring for the young. She fed the Cowbird six times and her own young twice. During the brooding she seldom sat quietly for any length of time but busied herself cleaning and rearranging the nest, after which she shook out her wings over the young and settled down only to begin all over again five minutes later.

When off the nest she, like the Chestnut-sided Warbler, chipped and flitted about notably more than usual, a behavior in which, it is interesting to point out, she did not indulge after the Cowbird was hatched. The male was heard singing in the north area and once he came close but flew away again. He was a nervous individual under all circumstances, and it is evident that my presence was a cause for his non-coöperation.

On June 10 the third warbler young had hatched. The female fed her own young six times and the Cowbird six times out of 16 feedings. All feedings were offered directly and consisted of small flies and small white caterpillars. Only one young was fed at a time. On one occasion she attempted to feed her own young but, receiving no response, she gave the morsel to the Cowbird.

Again this day the male kept himself at a distance. It became clear, however, that by now he was normally coöperating with the female which came and went without chipping or fuss. Once the male even came close to the nest with a caterpillar in the bill, but failing to master his nervousness, he ate it and departed.

On June 11 the nest was under observation for four hours in two periods—one in the morning and the other in the afternoon. During this time the young were fed five times by the male which was now beginning to overcome his shyness, and 31 times by the female. Of these feedings, 26 were given to unidentified young while, of the remaining ten, five were given the Cowbird and five to their own young. Once the Cowbird begged but was refused and the food was given to their own young. Another time the Cowbird refused and the food was again given to their own young.

By this time the parent birds were collecting several insects (larvae) on one trip. The food was crammed down the throat of the young whereupon the parent sat back and watched. Should further help be required the adult bird thrust and pushed the food deeper down into the young one's gullet until the last gulp was managed, a rather awful-looking operation.

The approach of both birds was the same as the female's during incubation, through the balsam spruce. When leaving, both birds flew directly into the upper branches of the trees for their foraging.

During the brooding periods, in which the male took no part, the female was ever busy tidying the nest and cleaning herself and the young. On several occasions she was seen energetically tugging and pulling at a wing or a leg of her own young, which were often completely buried under the sprawling Cowbird and in acute danger of suffocation, until she seemed satisfied her weaker one once more got his periscope aloft.

On June 13, when the warbler young were four and the Cowbird five days old, the nest was under observation three hours in the morning and three hours and five minutes in the afternoon. During this time the young were fed 72 times, 8 times by the male and 64 times by the female. Of these feedings, 15 were seen to be given to the Cowbird and 17 to their own young. The parents were now feeding more than one young at a time and they often brought so much food back from one trip that it sufficed to divide between all four. On three occasions both the male and the female were seen to withdraw part of the food already given to the Cowbird to offer it to their own young and once the Cowbird begged but was refused.

When feeding, the female often went right into the nest and stood on the Cowbird while tending her own young. The male, which in the course of the day became all but oblivious of my presence, stood daintily on the rim while feeding. Both birds worked silently—the female very fast, darting in and out; the male slower. When they met at the nest, either one retired until the other finished feeding; there was no

room for both to feed at the same time although they often were at the nest together. During the morning, when the temperature was between 54 and 55 degrees Fahrenheit, the female brooded the young, but in the afternoon, when the temperature rose to 62 degrees, she gradually gave it up.

On June 14 the nest was observed continuously for four hours. The Cowbird measured $2\frac{11}{16}$ inches to the $1\frac{11}{16}$ inches of the Nashville young. On all, the pinfeathers were beginning to grow out of the skin on the wings though still in sheaths. The Cowbird's eyes were fully open, and it emitted a note when touched and clung strongly to the nest-lining with its feet. The eyes of the Nashville young were showing opening slits and one of them manifested a tendency to become a runt.

During the observation, the young were fed 62 times—17 times by the male and 45 times by the female. The Cowbird was seen being fed 33 times and their own young 31 times. (The discrepancy in the totals is due to both Cowbird and Nashville young quite often being fed at the same time.) The Cowbird made itself very prominent, stretching its long neck above the others and fluttering its wings. The young were mostly given large white and green larvae. As the parents came in with their bills full of food, they would put it in the open bill of one young, extract part and give it to the next, withdraw part of that again and give to a third, and so on.

The female did no brooding during this day, but she sometimes remained in the nest, once for three minutes, to arrange and clean and pull one of her young from under the Cowbird. On two occasions she picked up a stick that had become detached from the nest structure, and carried it away five to 15 feet from the nest where she dropped it from a tree.

On June 15 no continuous observation was done; only a short visit. The eyes of the young warblers were fully opened. The sheaths of their pinfeathers were also opening and the feathers showing. The Cowbird filled the nest and followed the movements of the observer with its eyes.

LEAVING THE NEST

The Chestnut-sided Warbler female and two of the young were banded on June 26 when the young were eight days old. Unfortunately the day chosen was a little too late and the third young left the nest and could not be found again. The young were put in a trap, and the female immediately entered and was banded. The suspicious male kept himself at a distance, scolding vigorously. The two banded

young stayed in the nest when replaced. The next morning, at 11:00 o'clock, the last of them left and was seen making a bold flight of approximately 20 to 25 feet. Both parents were in attendance and the young were heard giving food-calls, *chetiit, chetiit*.

After the young had flown, the parents seemed to divide the family between them so that each of them cared for certain individual fledglings. This conclusion is based on the observation that during this period the male and the female were no longer seen feeding the young together, and once when the male happened to approach the banded female she chased him off, and he returned to where his banded young sat waiting. Twenty-eight days after leaving the nest, the female and one young were seen for the last time about 300 feet from the nesting site. The young was still begging and occasionally being fed.

The Nashville young and the Cowbird were banded on June 16 when the Cowbird was eight and the warblers seven days old. None of the young left the nest and the female was afterwards seen continuing feeding. No attempt was made to capture the adults because of the generally nervous disposition of the male and for fear of interrupting the nesting in its last stages.

The Cowbird measured $3\frac{1}{8}$ inches. It was fully feathered and the tail feathers were beginning to grow out. It emitted loud cries while being banded. The commotion attracted the female which came fluttering along the ground 'feigning injury.' Of the warblers, No. 1 measured $1\frac{5}{16}$ inches; No. 2, $1\frac{7}{8}$ inches; and No. 3, $1\frac{3}{4}$ inches. All had the beginning of a tail showing and dark gray feathers on the wings, back and head, and yellow down on the breast. They emitted weak calls.

On June 17, at 10:30 a. m., all the young had left. This seemed very early for the still rather small and helpless warblers. But the nest was intact and there was nothing to indicate that their departure had not been normal. Furthermore, both adults were in the vicinity during the 20 minutes the observer remained. They chipped and scolded though no answering calls were heard from the young. It was the last time this particular pair was observed with certainty.

NEST DEFENSE

The Chestnut-sided male was once seen engaged in a territorial fight, on the first day of incubation. He then fought another male Chestnut-sided Warbler near the west boundary of his territory, about 50 feet from the nest. Apart from this, all other engagements were with other birds trespassing too closely to the nest, such as the Least Flycatcher and the Mourning Warbler. During incubation the male was the

most active defender while the female appeared rather to resort to 'freezing.' The male's tactics consisted of stalking the intruder; he flitted from twig to twig in silent pursuit until the other either departed peacefully or was chased off in a sudden burst of aggression. After the young were hatched, the female would take action under pressing circumstances when the male was absent.

During the two days of observation while the Nashville Warbler was incubating, occasion requiring nest defense was lacking. But on June 13, when the warbler young were four days old, there was a short and sharp *melée* above the head of the observer, in which a pair of Redstarts, a Chestnut-sided and a Canada Warbler male took part with both Nashville Warblers as defenders, the female acting with more nerve and dash than the male. The female was twice observed 'feigning injury,' the first time when the nest was discovered (M. Halliday) and the second time when the young were being banded.

SANITATION OF THE NESTS

The Chestnut-sided female was seen picking up droppings eight times in the period from the first to sixth days, all of which she ate. After that, although she might still be looking for them, her mate apparently relieved her of this chore. During the total time of observation the male was seen picking up droppings 12 times. Of these he carried away ten and, on the last day, he ate two. Most of the droppings he caught directly as the young expelled the fecal sacs.

The Nashville female took upon herself the greater part of the sanitary duties and was only occasionally helped by the male. During the total time of observation she picked up droppings 57 times to the male's seven. Of these seven, the male carried six away, carefully depositing two of them on a twig 15 to 25 feet from the nest, and one he gave to the female as both were sitting on the rim of the nest. Of the female's 57 droppings, 38 were eaten and 19 carried away including the one she received from the male. She ate droppings from the first to the last day but began carrying away some when the warbler young were two days old. Of those carried away she was seen depositing four on a twig 15 to 35 feet from the nest, carefully wiping her bill afterwards.

SONG

The Chestnut-sided male was observed singing from several favorite perches on preferably bare twigs high up in the trees surrounding the nest. Dr. Kendeigh's observation of the Chestnut-sided males singing "successively from one, then another [perch], until he completes the

round of his possessions" describes accurately the behavior also of this bird. The variations of the Chestnut-sided Warbler's songs have been so aptly rendered by writers such as Saunders (1935) and Lynds Jones (1900) that this observer will not attempt an interpretation of her own. Suffice it, therefore, to remark that the songs of the bird in question seemed typical of the three variations most commonly heard. This male's most vigorous singing was heard when he sat on guard at the nest. (But in making this statement it must be noted that the observer did not listen to any of the pre-nesting singing.) During such an occasion he was heard giving 20 songs in five minutes and at another time one song every three seconds. From the time the young hatched the male's singing declined. He would sing a song or two while foraging, perhaps announce his arrival with another song and his bill full of food, and then sing again after departure. But after the young left the nest he gradually ceased singing altogether.

Before the Nashville Warbler's nest was discovered, the male was observed for about a week singing loudly and often in the territory surrounding the nest, particularly in the north area, during the mornings and early forenoons. On several occasions the bird was observed sitting in the tops of the scattered spruce trees, apparently his favorite singing perches. When continuous observation began during the latter part of incubation, it was noticed that the male sang both in the mornings and afternoons, though more frequently in the mornings. He would then give up to four songs a minute, but his periods of continuous singing were always rather short. His songs were of but one variation, corresponding to the second perch-song mentioned by Chapman (1940) as described by Thayer in 'Warblers of North America.' The flight-song, of which this writer also spoke, was not heard, at least not noticed as a flight-song. After the young were hatched, the male sang less often until the day the young were discovered to have left the nest, when he was heard singing more vigorously and sustainedly than at any other occasion.

The call-note of the Nashville Warblers was a short, sharp *tsik*. The female's seemed to the observer somewhat sharper in quality than the male's.

DISPLAYS

None of the courting and mating displays were observed in either species. The Chestnut-sided male was seen displaying a few times after incubation began and the female reacted by chasing him. Both the Chestnut-sided Warblers always approached the nest with spread tail and dropped wings.

The Nashville Warbler male was never seen displaying. The only way in which he was observed to betray emotion was by teetering his tail up and down. This was especially noticed at meetings with the female. She, on the other hand, was twice seen flying out to the male with spread tail and trembling wings, to which he reacted by wagging his tail up and down.

SUMMARY

The results of these two nesting studies show many points of dissimilarity in the behavior of a Chestnut-sided and a Nashville Warbler, some of which are:

1. The Chestnut-sided Warblers hang their nests in bushes at low elevations while the Nashville Warblers are ground-nesting birds.

2. During incubation, the male of the first species here studied sat on guard at the nest while the female was absent, and did not escort her on her foraging. With the Nashville Warblers the opposite occurred.

3. The attentive periods of the Chestnut-sided female during incubation showed a definite increase in length towards the end. In the case of the Nashville, observation did not evidence a similar trend. Its absence may, however, partly be accounted for by three circumstances, two of which obviously affected the normal course of events: (1) insufficient data for proper comparison; (2) the marked nervousness of the female at first; and (3) the hatching of the Cowbird earlier than the warbler young.

4. The Chestnut-sided female incubated and brooded almost motionless and facing one preferred direction, while the Nashville Warbler favored no special position and was constantly active on the nest, particularly when brooding.

5. When the young were hatched the Chestnut-sided male assumed the lion's share of their care, both in feeding and sanitation, with good assistance from the female up to the sixth day, after which she left the sanitation entirely to the male and also decreased her rate of feeding. At the Nashville nest, on the other hand, the female did the greater part of the work, both feeding and sanitation, with some help from the male.

6. In the matter of disposing of the fecal sacs, the Chestnut-sided male carried away most of them, only on occasion consuming a few, while the female ate all she was seen to pick up. The Nashville male also carried away the droppings but ate none, while his mate ate all droppings the first three days and thereafter continued to eat about half of them and carry the rest away. Both Nashville Warblers were

seen depositing droppings on twigs and it seems likely that most, if not all, of the droppings carried away were disposed of in this manner although it could not be ascertained by following the birds every time.

7. The Chestnut-sided Warblers apparently fed their young by regurgitation during the first days and then by direct feeding, never offering food to more than one young at a time. From the first the Nashville Warblers fed their young directly, adapting the morsels to the capacity of the young. During the first days they fed only one young at a time, but later fed several or all the young from food collected during one foraging trip.

8. The food of the Chestnut-sided young consisted mainly of winged insects while that of the Nashville young comprised chiefly larvae.

9. In the nest defense the Chestnut-sided male was most active, but with the Nashville Warblers, both birds took part and, in this particular case at least, the female was probably more energetic than the male.

10. The points in common of the two species are:

- (a) The females incubated and brooded without assistance of the males.
- (b) Both males sang from favorite singing perches during the early part of their vocal season.
- (c) As soon as the young were hatched, both females apparently sought to make the males aware of the existence of their offspring by intensified chipping.
- (d) The males and the females of both species always approached the nests in the same set manner.

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