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NESTING OF THE BAY-BREASTED WARBLER

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IN most of the publications dealing with the avifauna of eastern United States, the Bay-breasted Warbler (*Dendroica castanea*) is considered a rare or at least an uncommon bird. Frequenting the coniferous forests of the Canadian Zone, it breeds within this country in only a few of the most northerly States in limited numbers. Maynard (1872) found it the most abundant warbler at Lake Umbagog, New Hampshire, but this appears to have been an exceptional and local concentration. The inauspicious musical talents of the Bay-breasted Warbler, its fondness for dense tracts of young conifers, and its tendency to feed primarily among the middle and upper branches of such trees, have placed the bird somewhat beyond the limits of accessible study. Consequently, papers dealing with specific or detailed observations of its habits have been few. In Maine, I have found this species most commonly near the coast in regions where thick growths of spruce and fir have succeeded birches and aspens and where a few of these hardwoods still remain scattered among the conifers. I have seldom observed the bird in the interior of the State, although in Androscoggin County, from 1924 to 1932, a few individuals were regularly noted during their migrations. Here, where spruces are not as plentiful as they are in the northern and eastern sections of Maine, the birds showed a preference for mixed growths consisting of birches, maples, firs and pines.

In the summer of 1936, I found a nest of the Bay-breasted Warbler at South Thomaston in Knox County, Maine. An opportunity for study was afforded and the observations that were made, are here presented. South Thomaston is a coastal town, located a few miles southwest of Rockland, and is situated in the lower Canadian Zone. For the past three summers, I have made numerous observations in the wooded sections of this region and have found the Bay-breasted Warbler only rarely. None was seen



MALE BAY-BREASTED WARBLER ARRIVING AT NEST



FEMALE REMOVING A FECAL SAC

here in 1934. A male was noticed three or four times during June and July in 1935 but no evidences of breeding were noted. No birds were observed in 1936 other than the pair with which this paper deals. During the fall migrations, 1933-1936, I have never seen Bay-breasted Warblers in this section of the State although I have observed them rather frequently in the coastal counties of Washington and Hancock. Knight (1908) knew of no breeding records for Knox County and stated that the species was rare in summer.

The South Thomaston nest was discovered on June 12, 1936. It was situated on a horizontal branch of a fir tree twelve feet above the ground, five feet from the trunk of the tree and one foot from the end of the branch. The foliage around the nest was thick, and a few pieces of grass, seen from below, were the only evidences that betrayed the home. The nest was large but compact, and was constructed externally of small spruce and fir twigs and dried grass, lined with fine grass, black rootlets and moss setae, the last identified by Mr. Arthur H. Norton, of the Portland Museum of Natural History, as probably those of the haircap, *Polytrichum commune*. Two nests found in Hancock County, Maine, and described by Stanwood (1909), were similarly constructed except that they were lined with cinquefoil runners, pine needles and hair.

The following measurements of the 1936 nest were obtained after the young had left: outside depth, 2 inches; inside depth, $1\frac{1}{2}$ inches; outside diameters, 4 and $3\frac{1}{2}$ inches; inside diameter, $2\frac{1}{4}$ inches. These figures are interesting when compared with those of other observers. Data from one of Stanwood's nests, also measured after the young had departed are: outside depth, 2 inches; inside depth, $1\frac{1}{4}$ inches; outside diameters, $4\frac{1}{2}$ and $3\frac{1}{2}$ inches; inside diameter, $2\frac{1}{2}$ inches. Philipp and Bowdish (1917) present measurements of three nests from northern New Brunswick, and the averages of these figures follow: outside depth, $2\frac{1}{3}$ inches; inside depth, $1\frac{1}{3}$ inches; outside diameter, $3\frac{4}{5}$ inches; inside diameter, $2\frac{1}{10}$ inches. Apparently these nests were measured at the time they were found and when they contained fresh or slightly incubated eggs. Maynard describes three nests from Lake Umbagog, New Hampshire, that also appear to have been measured when discovered. The average dimensions are: outside depth, $2\frac{3}{4}$ inches; inside depth, $1\frac{1}{2}$ inches; outside diameter, $5\frac{2}{3}$ inches; inside diameter, $2\frac{2}{3}$ inches.

The nesting tree, selected by the birds at South Thomaston, was beside a road leading from the ocean through a quarter-mile stretch of woodland to the main highway. South of the road, and on the side where the nest was located, is a dense tract of second-growth woods consisting chiefly of spruce and fir. The interior of this area is made up of medium-sized timber and is heavily populated with red squirrels. On the north side of the road,

there exists swampy pasture land and a cut-over tract that is growing rather thickly to spruce, fir, larch, birch and maple. This area is the breeding haunt of many birds typical of the Canadian Zone, the most abundant of which are the Magnolia Warbler, Black-throated Green Warbler, Olive-backed Thrush, White-throated Sparrow and Slate-colored Junco.

At the time the nest was discovered (4 p. m., E. S. T., on June 12), the female was incubating. She was reluctant to leave the nest, even when I had climbed within three feet of her, and it was not until the branches had been pulled to one side that she departed. Injury-feigning was very much in evidence. The bird dropped to a lower limb of the tree and almost literally crawled through the foliage in front of me. The left wing was extended and drooped, the tail was twisted to the left and the feathers spread. The bird uttered no sound, but continued to move through the branches for about fifty seconds after which she flew around me, several times coming very close to my head, and scolded violently. This protest brought the male to the scene and he joined his mate in uttering notes of alarm, although with less vigor. Incidentally, the female expressed injury-feigning on most of the subsequent occasions that she was disturbed while incubating, but did not do so after the eggs had hatched. The male did not always appear in response to his mate's calls and never showed serious concern when in the presence of a human intruder.

The nest contained four eggs when found, but a fifth one was laid the following day some time prior to 9 a. m. At this hour, the female was again incubating and the male was singing from the top of a nearby spruce. As the female left the nest, the male flew toward her, uttered two or three calls of alarm and then flew into a thick clump of spruces where he began to feed. Once he joined his scolding mate for a moment, but promptly resumed his search for food.

There was no opportunity for photography with the nest in its original position, but I decided to forego any experiments in moving it until a later period in the birds' home-life. A few twigs were cut to afford a better view from beneath and this was the extent of any immediate alteration in the natural surroundings. The nest was visited, however, several times daily throughout the period of incubation and observations were made. After having ascertained that five eggs completed the set, I did not disturb the incubating bird until June 21 when I felt that the period of incubation was drawing to a close. From this day on, the adult was forced from the nest at least twice each day until all the young were hatched. At no time during the incubation period was the male seen on the nest. On occasions when the female was absent, her mate remained on guard close to the nest although not on it. At times, while I watched from the ground, the male

brought food to the incubating female; the birds apparently were undisturbed by my presence. The foregoing observations are similar to those of Stanwood who states that incubation is wholly by the female and that she is frequently fed on the nest by the male.

On June 21, the first attempt was made toward moving the nest into position where it could be readily observed and photographed from a blind. In view of the fact that the eggs had not hatched, and that consequently there was more possibility of desertion by the parents, I determined to conduct such maneuvers in a series, with only slight changes at a time, since a considerable move would be necessary before the nest could be located in front of a blind. The initial change consisted merely in cutting off the nesting limb in such a manner that the nest could be moved about three feet nearer the trunk of the tree. The limb was securely fastened to a higher branch in order to prevent possible drop or unnecessary shaking during the sawing. Throughout this procedure, which required at least fifteen minutes, the female remained on the nest although I nearly touched her at times. She followed the movements of my hands by twisting her head but otherwise showed little uneasiness. It was not until the limb was entirely cut and I started to move it back toward the trunk that she left. Injury-feigning was not practised but the bird scolded and flew around my head a great deal. The male, with a beak-full of caterpillars, put in a belated appearance while I was making the nesting limb secure in its new position. The female stopped scolding as soon as I reached the ground and flew across the road into the top of a group of spruces to feed. She returned in about three minutes and immediately went on to the nest, where she arranged the eggs and commenced to incubate. She appeared to accept the new location without trepidation.

When the nest was approached at 7 o'clock on the morning of June 23, the female was incubating. None of the eggs had started to hatch. The male, singing in a nearby spruce, was not visible at first but soon flew out of a thick clump of foliage about two-thirds of the way up the tree and at a point about 25 feet above the ground. It was noted throughout the duration of the study that this tree was selected for singing more often than any other, although there appeared to be no clearly defined 'singing tree.' At 4 p. m., on the same day, it was found that two eggs had hatched. Apparently this process had taken place about noon since the natal down was perfectly dry. The eggshells had been removed. It was interesting to note that one of the young gave the food response twice when I brushed against the twigs supporting the nest.

At this time, the second shift in the nesting limb was made, a move that brought it at a right angle to its former position. Both adults scolded considerably while I was getting the branches in place and the female flew

very near, once alighting on the edge of the nest for an instant. After descending from the tree, I retired to the opposite side of the road and concealed myself. The male continued to call at intervals from the top of the nesting tree. His mate, still scolding, flew back and forth between the nest and the stub where the nesting limb had previously been attached. She appeared to have difficulty in orienting herself and several times hovered over the space formerly occupied by the nest. Gradually, however, she became less agitated and after about fifteen minutes she alighted on the edge of the nest. She remained only a moment and then, followed by the male, flew across the road into the pasture. Five minutes later she returned and immediately settled down on the nest, as though it had not been tampered with. Shortly after 5 o'clock, I again visited the site and was gratified to observe the female incubating and brooding. As I watched, the male flew into the tree with a small green caterpillar or other insect. He hopped from limb to limb until he arrived at the nest and perched on its rim. The female had partially arisen and she took the food from her mate. I believe she gave it to one of the young but could not be sure of this because of my distance from the nest.

On the morning of the 24th, at 9 o'clock, the male flew out of the nesting tree as I approached. In about a minute, the female appeared, flying across the road from a mixed clump of gray birches and young firs. She was carrying food which she gave to one of the young upon arriving at the nest. Leaving the nest shortly, she flew into the pasture and a fragment of an eggshell was plainly visible in her beak as she passed me. Upon examination, it was found that a third egg had hatched, and the down on the nestling was still somewhat moist. Each of the other young gave the food response at my approach. At 2.30 p. m., there was no indication that either of the other eggs was about to hatch, but at 5.30 o'clock a fourth nestling was present with down partly dry. Remains of the shell had been removed.

The next change in the nest location was made at 3 o'clock on the afternoon of June 25. At this time the fifth egg had not hatched. The nest was moved at a right angle to its last position (it was now on the south side of the tree exactly opposite its original location) and lowered about four feet. The adults acted in very much the same manner as they had previously done, scolding for several minutes and making repeated trips to the former location. Nevertheless, within ten or fifteen minutes, they had become a part of the new environment. At 7.30 o'clock in the evening, the site was again visited and the female was forced from the nest. The fifth egg had hatched recently, for the down on the nestling was still wet and the eggshell had not been removed. None of the young gave the food response nor did they show any perceptible reaction when the beam of a flashlight was focused on them for a moment.

A blind was set up near the nesting tree on June 26 but, due to adverse weather conditions, no observations were made until the 28th. On this date, I spent slightly more than one hour, from 7.50 a. m. to 9 a. m., in the blind. The adults were somewhat wary at first; they did not scold very much but hovered over the nest and flew about the blind for several minutes. At 7.58 a. m., however, the female alighted on the nest and adjusted one of the moss fragments that constituted the lining. Apparently satisfying herself that the nestlings were safe, she flew to the top of a spruce and commenced to search for food. At 8.01 a. m., the male arrived with a small worm which he gave to one of the young. A few seconds later, the female, also carrying food, alighted on the nesting limb and hopped on to the nest. After the feeding process, both adults remained at the nest for a moment. Then the female seized a fecal sac and flew across the road. The male preened the feathers of his breast and flew about thirty feet to a gray birch where he began to sing. During the hour from 8 to 9 a. m., the male made seven trips to the nest, feeding eleven times, eating one fecal sac and carrying one away. Meanwhile, the female was making 19 trips to the nest, feeding 23 times, eating two fecal sacs and carrying away three. On three occasions, both parents were on the nest at the same time, and once the male passed his food to the female which, in turn, gave it to the young. From 8.41 to 8.48 a. m., the female brooded the nestlings but was unattended by the male during this period.

The fourth and final change in the nest was made on the morning of June 29, and this was the most extensive alteration of all. The nest was moved about ten feet to another tree and lowered until it was but four feet from the ground. The blind also was relocated, being set up about four feet from the nest. The adults made some disturbance during these operations but went about their usual activities as soon as I had withdrawn to the road. I attempted no detailed observations until afternoon, entering the blind at 12.58 p. m. Both parents scolded a little and the female flew back and forth between the nest and the blind. Two of the young had their eyes open and all of them were quite active, frequently giving the food response as the female passed over their heads. At 1.05 p. m., the male flew down from a small spruce, where he had been calling from a perch, and hovered over the nest but did not alight. The female had stopped scolding by this time and at 1.06 p. m. she arrived at the nesting limb and hopped to the nest. She brought a large gray moth which she offered to one young but, when the food was not swallowed, withdrew it and gave it to one of the other nestlings. After this visit, she showed no further fear of the blind and made regular trips to the nest. During the two and a half hours of observation, she brought food to the young 39 times, although on only four occasions did she feed more than one young at a visit. Eight fecal sacs were disposed

of, seven of which were carried away. The male did not take part in caring for the young until 2.21 p. m., and even after that he interspersed his parental duties with frequent periods of song. However, he usually brought more food at a time than did his mate and also was more likely to feed two or three young at a visit. Altogether, he made 24 feedings during 17 trips to the nest, ate three fecal sacs and carried away four. He was often at the nest with his mate and three times gave her the food for the young.

On this afternoon, I had a good opportunity to observe the behavior of the birds during inclement weather, since a brief but severe thundershower occurred. At 2.10 p. m., the first peal of thunder was heard. By 2.25, it was quite dark in the woods and the wind had freshened noticeably. Up to this time the birds had continued their normal routine, but it was noted that the female, in the process of removing a fecal sac, raised her head suddenly at a very sharp flash of lightning. By 2.27, it was apparent that the squall was about to break. The wind had completely died down and the air was exceedingly oppressive. The female warbler arrived, fed two young, ate one fecal sac and then remained on the nest facing the approaching storm. At 2.30 p. m., the male appeared, passed a moth to the female—which she gave to one of the young—and then flew away, leaving his mate on the nest. Shortly, the oncoming wind could be heard in the distant treetops. As the first blast struck, the nesting tree swayed violently and the adult departed, flying across the road. The rain followed immediately to the accompaniment of severe thunder and lightning. The female returned in a moment and stood on the nest shielding the young. The rain increased steadily and, after a few minutes, the bird crouched in the nest with wings drooped over the sides. She was still in this position when I left the blind at 2.38 and she showed no fear when I went past the nest. I re-entered the blind at 2.57 p. m., just as the rain was ceasing and the bird was then standing on the edge of the nest with one wing partially drooped over the young. The male did not appear to be nearby and he did not come around until 3.09 p. m.

On June 30, the nest was under observation from 9 to 11 a. m. The young were very active, especially the two largest ones which were now seven days old. These latter engaged in frequent though short periods of wing-flapping and made feeble efforts to stand erect. Even the smallest nestling, which was but five days of age, managed to keep from being submerged under the pack, although it usually was forced to wait for food until the immediate needs of its nestmates were attended to. The parents fed the young 70 times during the observation period, making 57 trips to the nest with food. Twelve fecal sacs were disposed of: six were eaten and six carried away. As was the case previously, the female averaged nearly three trips to the nest to each visit of the male.

The morning of July 1 was very hot, and from 10.30 until 11 a. m., the sun beat relentlessly down upon the nest. During this period, the male took part in the feeding process somewhat more than usual and the female devoted considerable time to shading the young. This was definitely not an act of brooding for the bird simply stood on the edge of the nest in such a manner that a shadow fell across the young birds. The afternoon was much cooler and, although the nest was exposed to the sun part of the time, neither shading nor brooding was noticed. The young birds were very active during the middle of the afternoon, climbing over one another and snapping at wings and necks. The two oldest ones were able to stand erect for a few seconds at a time. During a three-hour period on this day, the male fed 38 times, making 26 trips to the nest to do so. He ate three fecal sacs and carried away four. His mate made 79 feedings during 68 visits. She carried away seven fecal sacs and swallowed eight others.

On the morning of July 2, it was again hot and the female shaded the young much of the time between 10 and 11.30, although she left the nest for two or three minutes at a time in search of food. Once more the male did extra nesting duty during this time. The young exercised and played with one another considerably during the cooler part of the forenoon but were very quiet from 10.40 a. m., until about noon. Shortly after 7 o'clock in the evening, I visited the blind without disturbing the brooding female. The male, bringing food, arrived at the nest at 7.25. His mate stood up to greet him, and to eat a large moth that he had brought. None of the young appeared to be awake, and the female soon settled back on the nest.

It was evident, on July 3, that the two oldest young were nearly ready to leave the nest. They were both well feathered out and one of them showed some fear of me as I stood beside the nest. This was the first time this instinct had been noted. Between 7.30 and 10.45 a. m., the hours of observation, both of these nestlings climbed up on the edge of the nest several times, and they engaged in frequent periods of wing-flapping. The weather was clear and cool with a slight northwesterly breeze and there was no need for brooding or shading. The male fed 33 times during 24 trips to the nest in a three-hour period, and the female made 63 visits, feeding 69 times. Twenty-four fecal sacs were removed by the parents, 19 of which were carried away.

On a brief visit to the nest shortly before 8 o'clock on the morning of July 4, one of the oldest young was perched in the original nesting tree about twelve feet from the ground. The other eleven-day-old bird was on a small branch about a foot from the nest. At my approach, it flew into a birch, fifteen feet away, alighting somewhat heavily. The two nestlings which were ten days of age showed fear of me, although neither made any attempt at flight.



FEMALE BAY-BREASTED WARBLER FEEDING YOUNG



FEMALE BAY-BREASTED WARBLER SHADING YOUNG

Returning at 9.15 a. m., I knew that something was amiss even before I had reached the immediate vicinity of the blind, for both adults could be heard scolding. The chattering of a red squirrel signified the reason for the disturbance, and shortly the mammal ran across the road, carrying one of the young warblers. Another nestling lay dead under the tree. It had a severe neck wound and a scratch along the lower abdomen. One young still remained in the nest and appeared to be uninjured. This bird was one of those which had hatched on June 24 and was now ten days old.

The nest and its lone occupant were under observation from 9.17 to 11.05 a. m. During the first few minutes, the adults showed no interest in the nest as they flew among the trees, scolding. The female made numerous trips to a thick patch of small spruces and gray birches about 25 yards away where, as later investigation showed, the two oldest young were located. At 9.25 a. m., she came to the nest and fed the bird there. Following this act, she flew across the road and did not visit the nest for half an hour. However, she spent a great deal of time near the young which had left the nest safely, and she carried food to them. One of these birds could be seen perched on top of a spruce about five feet high, but the other apparently was at a lower elevation and was invisible from the blind. At 10.05 a. m., the female again came to the nest but remained only long enough to eat a fecal sac. She did not feed the bird and did not return to the nest until 10.31. This time, as well, no feeding took place, and it was not until 11.03 that she finally brought food to the nestling. She scolded somewhat from time to time although there seemed to be no enemy near and, when not feeding the two oldest young, flew rapidly from tree to tree. The male, despite his mate's somewhat abnormal behavior, showed no distraction whatsoever. He attended to his domestic duties faithfully and did considerably more than his usual share of this work. He fed the nestling ten times and made seven trips with food to the trees where the two other young were located. He varied the feeding activities with occasional brief periods of song. At 8.30 p. m., on this same date, the last remaining young had disappeared. In all probability the squirrel returned to the scene of its earlier depredation, since I do not believe the nestling would have left voluntarily for at least another day.

On the morning of July 6, the male was singing in the original nesting tree and one of the young was perched on a low branch of the same tree. Again on July 12, both adults and one of the young were found, still in the vicinity of the nest. The male was feeding and singing near the top of a tall tree. This was the last date on which any of the birds was observed.

The incubation period was measured accurately only in the case of the fifth egg laid and it proved to be slightly over twelve days. The fact that more than fifty hours elapsed between the hatching of the first and the

last egg, and the fact that all of the eggs hatched at quite regular intervals would indicate that incubation commenced during the early part of the laying period.

The two oldest young left the nest when they were eleven days of age. Stanwood found that in a nest of five young, two departed when ten days of age and three left on the eleventh day. Forbush (1929) says that the young leave the nest in about ten days.

One very interesting point observed during the study was the relationship between the male and the female when they were together on the nest. This occurred fairly often, and almost invariably at such times, the female would tremble and droop her wings, fluttering them slightly but rapidly. No emotional response on the part of the male was noticed although he frequently passed his mate food following the act.

SUMMARY

During the breeding season, the Bay-breasted Warbler appears to show a decided preference for fairly dense coniferous growths. The male usually sings near the tops of such growths and much of the food is gathered in the thick upper branches.

The period of incubation was observed to be slightly over twelve days, and the eggs hatched at intervals, with more than two days between the hatching of the first and the fifth egg. Two young left the nest at eleven days of age.

Incubation and brooding apparently are carried out solely by the female, which is, at least part of the time, fed on the nest by the male.

Injury-feigning was commonly observed when the female was flushed while incubating.

During the observation periods from June 28 to July 3 (when there were five young in the nest), the female averaged 26.4 feedings per hour, while the male fed on the average 13 times an hour. However, under certain conditions and for short periods of time, the male performed a much greater proportion of the nesting duties.

Both adults and one of the young were still together in the vicinity of the nest eight days after the home had been forsaken.

The adult birds showed a remarkable degree of adaptability in the face of the four changes in location to which the nest was subjected. In fact, for a species of the woodlands, the Bay-breasted Warbler appears to be exceedingly tame and unsuspecting in the presence of man.

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