NOTES ON THE NESTING BEHAVIOR OF THE BLACKBURNIAN WARBLER

BY LOUISE DE KIRILINE LAWRENCE

A SUMMARY of data on the nesting behavior of the Blackburnian Warbler (*Dendroica fusca*) obtained from my field notes made during the years 1943 to the end of the breeding season in 1951, is herein presented. The data concern in particular 3 pairs domiciled in the same territory at Pimisi Bay, Ontario, 70°01′ W. long. and 46°16′ N. lat., in 1946, 1948 and 1950. This territory was occupied by the species in all 9 years, but since no banding was undertaken I do not know with certainty how many individuals were involved in maintaining the territorial tradition, or how many consecutive seasons any one bird lived there.

Three nests were found, Nest A in 1946, B in 1948, and C in 1950. At the 3 nests a total of nearly 6 hours was spent watching building and 17 hours and 40 minutes observing incubation activities. At Nest B the care of the young was watched during 10 hours and 48 minutes and, at Nest C, for 40 minutes on hatching day. In addition to these 34 hours of nest-watching, many hours more were spent observing the warblers in the course of my daily field work.

In the last 9 years the first appearance of the Blackburnian Warbler in this locality has ranged from May 5 to May 17, with a mean of May 12 and a median of May 13. In the years 1946 to 1950, the females were first seen on given territories 3, 9, 9, 11, and 23 days later than the males. But since 23 days is unusual, the median of 9 days later instead of the average 11 may be taken as a more nearly representative figure of the time of arrival of the females.

HABITAT

Habitat requirements of the species in this area featured chiefly mature evergreens—white pine, *Pinus strobus*, white and black spruce, *Picea glauca* and *mariana*, hemlock, *Tsuga canadensis*, and red pine, *Pinus resinosa*, in that order of importance—with a few deciduous trees, such as aspens, *Populus* spp., and white birch, *Betula papyrifera*, scattered among them. Outside my study area, I found this species in climax stands of conifers with sparse or no undergrowth and with deciduous trees and bushes around only the edges. In none of these habitats were the Blackburnian Warblers established close together. Brooks (1947:293) found this warbler common in the Appalachian Mountains, not only in the coniferous stands, but on the dry chestnut-covered ridges. Kendeigh (1945a:427) found the bird "strictly confined to hemlock trees" on the Helderberg Plateau of New York, "even in woods where the

hemlock occurred singly or in small groups. . . ." Nice (1932:92) recorded a nest found at Pelham, Massachusetts, "among comparatively open, young growth. . . ."

Nest-Building

The building of Nest A began May 25 and continued for 6 days. B was started June 3 and completed in 4 days. Nest C, a second attempt after an earlier failure, was begun June 28 and completed in 3 days. This suggests that more time may be spent building early nests than later ones.

Only the females did the building at all 3 nests. At Nest C, on which I have the most complete notes, the male was very attentive on the first day. He accompanied the female closely, sang and displayed with spread tail and vibrating wings, but I saw no courtship-feeding. Once after the female left, he sat down on the nesting material deposited on the site and remained there when the female returned and stood over him a few seconds. On the second day, he was seen near the nest only once in the forenoon, when he pursued the female and effected coitus, but he failed to appear during the afternoon watch. During an hour in the morning on the third day, he paid no attention to the nest-building, but was heard singing nearby several times. At a nearly completed nest, watched for 82 minutes by Kendeigh (1945b:154) in New York State, the male once alighted close by but was chased by the female.

The energy with which the female worked at Nest C reached a peak before noon on the first day. During this watch of 1½ hours, she made 11 trips with material in the first half hour, 5 in the second, and 7 in the third, or 15.3 trips per hour. In the second half hour she rested for 8 minutes, sitting motionless on the collected nesting materials. There was a marked decline in activity both later in the day and later in the nest-building. During watches on the second day, the female made 12 trips per hour before noon and 4 in the afternoon; on the third day, she made only 3 trips per hour before noon. The data from the other nests are in agreement; at A only 3 trips per hour were made during a watch in the late afternoon on the first day and, at B, the same number per hour were made in the morning of the fourth day. Kendeigh's (1945b) record agrees with these—5.1 trips per hour, presumably before noon, on a day when "construction was nearing completion."

Nest C was built inside an "alcove" of branchlets and leaves on the horizontal branch of a white spruce, 26 feet 2 inches from the ground and 8 feet out from the trunk. Its bottom was not affixed to the branch but rested loosely upon it, half suspended and attached to 4 short and stiff twigs by means of spider silk. The silk was collected on the first day from the trunks of the trees and the branches of the bushes. The outside of the nest was made of fine, dry spruce twigs and two pieces of birch bark. Hovering or perching,

the female broke the twigs from the trees with her bill. For the most part lining was made of dead white pine needles picked, not from the ground, but from those that hung or stuck to the trees, and a few tendrils and fine, dead grasses. The nest appeared rather transparent when seen from below. The outside diameter was 3 inches, inside 1¾ inches; outside depth 1½ inches, inside 1⅛ inches. The other two nests were built in white pines; A, at an estimated height of 40 feet about 10 feet out from the trunk on a horizontal branch; B was tucked into the crotch of 3 small upright branches at a height of about 55 feet. Spider silk, collected on the first day, was also an important item on the list of materials in Nest A. Nest B was watched only on the fourth day of nest-building. Here the female was seen pulling long strands of horsehairs from a supply at my feeding station. Dragging them behind her up to her lofty home, she often had to stop and disengage them by pulling and twisting as twigs and leaves impeded her progress. Kendeigh (1945a:427) mentioned *Usnea* and other lichens in the nesting materials used by this warbler.

Incubation

Owing to the inaccessibility of the nest, I could not obtain data on the beginning of the egg-laying, clutch size, and the exact time when incubation started. In the case of Nest A, H. M. Halliday climbed to the top of the tree 2 days after building ceased and found one egg in it. Three days later the female was incubating. At B, the female began incubating 5 days after the completion of the nest, but at C the interval between nest-completion and the known start of incubation was 7 days. According to Chapman (1940:462), the Blackburnian Warbler normally lays 4 eggs in the clutch.

At all 3 nests the female alone incubated. In Table 1 the data on the incubation rhythm are presented. The long attentive period of 86 minutes at Nest C was caused by my presence and therefore is not representative. In calculating percentage of attentiveness at this nest, however, I felt that the length of this period would be adequately offset by the longer-than-usual time of inattentiveness.

The Blackburnian Warbler's incubation rhythm appears typical for a wood warbler on an open nest. Available data from a Magnolia Warbler, *Dendroica magnolia* (Doris Huestis Speirs, unpublished data), a Chestnut-sided Warbler, *Dendroica pensylvanica* (Lawrence, 1948), a Nashville Warbler, *Vermivora ruficapilla* (Lawrence, *op. cit.*, 207), and 2 forms of Central American redstarts, *Myioborus miniatus hellmayri* and *M. torquatus* (Skutch, 1945:240, 242), the last 3 nesting on the ground or in niches in banks, slopes, or among vegetation, are the basis for Table 2.

The Blackburnian female B showed a decline in the length of her periods off the nest as hatching day drew near, while her periods on remained almost

TABLE 1
INCUBATION OF THREE FEMALE BLACKBURNIAN WARBLERS

		Periods on Nest			*Periods off nest*			
	Day of incubation	Number periods	Average length[1]	Range[1]	Number periods	Average length[1]	Range[1]	Percentage of attentiveness
Nest A	4th	2		26, 35	2		7, 16	
	5th	5	24.6	10–31	6	8.0	5–11	73
Nest B	2nd	5	24.6	21–34	5	6.6	5– 8	
	8th	4	19.3	16–23	5	5.4	4– 9	
	10th	7	18.1	9–22	8	3.9	2– 9	
	12th	5	20.8	18–23	5	1.8	1– 3	83
Nest C	3rd	2		42, 86	3	12.0	10–14	80
Totals for A and B		28	22.0		31	5.5		77

[1] In minutes

TABLE 2
INCUBATION RHYTHM OF SIX SPECIES OF WOOD WARBLERS

	Periods on nest		*Periods off nest*		
	Average length[1]	Median length[1]	Average length[1]	Median length[1]	Percentage of Attentiveness
Blackburnian Warbler	22.0	22.0	5.5	5.0	77
Magnolia Warbler	16.9	16.0	7.4	7.0	70
Chestnut-sided Warbler	34.2	26.5	7.0	7.0	83
Nashville Warbler	39.5	41.5	14.4	12.5	72
(tropical)					
M. miniatus hellmayri	37.6	—	18.2	—	67.4
M. torquatus	28.9	—	9.8	—	—

[1] In minutes

unchanged. In the Chestnut-sided Warbler which I studied (1948), both on and off periods lengthened with the progress of incubation.

My data are too few for definite conclusions to be drawn as to the influence of temperature on the rhythm of incubation. But B's high average attentive periods on the second and twelfth days may have been influenced by low temperatures of 50°–60° F prevailing on these days. The data might also suggest that while the periods on the nest of this bird may have been affected by the temperature, her periods off were not, but these varied instead according to the stage of incubation.

The male exercised some influence over the length of the female's periods on and off the nest. In my presence Male A interrupted 2 periods that were

shorter than average, one of only 10 minutes, by giving loud signal songs close to the nest site whereupon the female left and joined him. Male B caused his mate to leave the nest 8 times after incubating for periods, 6 of which were shorter than average. Two of these 6 were of only 9 and 10 minutes duration. At times this male was seen accompanying the female on her return to the nest, obviously delaying her by his mere presence—once for her longest absence, 11 minutes. On the whole, Male B was more attentive to his mate and nest than the other two males watched; on 3 occasions he was seen coming to the nest and feeding the incubating female, once on the fifth day and twice on the tenth day of incubation.

Care of Young

Unfortunately neither of the two broods that hatched were fledged. At Nest C the young disappeared at the age of 2 days. At Nest B the female was taken by a Pigeon Hawk (*Falco columbarius*) when the young were 4 days old. The next day all young were dead, presumably from lack of brooding.

Both nests were watched during hatching day. The young of Nest C hatched on July 19. This nest was watched for 40 minutes, during which time the female did not brood although the morning was rather cool. She alone fed the young 5 times, averaging once every 8 minutes. The male was already molting heavily at this time and I do not know definitely whether or not his absence was connected with his ignorance of the existence of his offspring. In the Chestnut-sided Warbler (Lawrence, 1948:210), the female also performed the feedings alone immediately after her 3 young hatched, at an average rate of once in 21 minutes. In this case the male did not know of the hatching for the entire duration of my watch so far as I could judge.

At Nest B the male was well aware of the existence of his young when I began to watch at 7:55 a.m. on June 24. During the time of observation he fed the young 5 times, while the female fed them only twice, averaging a combined rate of feeding of once in 26 minutes. The female was occupied mainly by brooding 84 per cent of the time in periods on averaging 34.5 minutes and periods off averaging 6.2 minutes. Twice while the female brooded, the male arrived with food. She hopped on the rim, allowing him to feed the young while she watched. The male carried food visibly in the bill and he fed *more than one* young at each visit. Both parents swallowed fecal sacs.

The next day, during 3 hours of observation when presumably all the young had hatched, the female brooded 79 per cent of the time in periods on averaging 14.2 minutes and periods off averaging 3.7 minutes. On this day, the young were fed an average of once in 10 minutes, both parents having increased their rates of feeding and the female her share of feeding as well, bringing it up from 29 to 36 per cent of the total feedings.

Apart from the number of young in the nest, the feeding rate of some small passerines evidently is influenced also by whether one or several young are fed by the parent at each visit, the rate being faster in the first case. For example, in the Chestnut-sided Warbler (Lawrence, 1948:210) and a Black-throated Blue Warbler, *Dendroica caerulescens* (Nice, 1930:339), only one young was fed at each visit. In the first species, the average feeding rate at the age of 3 days was once in 9 minutes and at 4 days once in 5 minutes for an average of one feeding every 7 minutes; in the second species, the rate was once in 7.5 and 6.4 minutes at the same ages, also averaging once every 7 minutes. In a Magnolia Warbler (Nice, 1926:198), more than one young was fed once in 10 visits; here the average rate at the age of 4 days was once in 8 minutes. By comparison, in my Blackburnian Warblers where more than one young were fed at each visit the average feeding rate at the ages of 1, 4, and 5 days (female B was killed on the fourth day) was once in a little over 13 minutes.

Moreover, it is known that birds which bring larger amounts of food at each visit feed their young less often than those which bring smaller helpings (see Nice, 1943:235), a circumstance which may possibly depend on the kind of insects each species generally prefers. Caterpillars, dragonflies, mayflies, for instance, are bulky insects as compared to mosquitoes, gnats, or certain spiders. Because the food carried by the Blackburnian Warblers as they moved about in the tops of 60 to 70 foot pines was plainly visible to me on the ground through 8 $\times$ 30 binoculars, the amount of each feeding must be considered as large. Sometimes when the warblers happened to come within closer range I was able to identify the food—once as a green larva and several times as mayflies. Hence, apart from the modifying influence of the events that occurred at this nesting (Nest B), two factors, *i.e.*, the number of young fed at each visit and the size of the meals, provided good reasons for the comparatively slow rate of feeding I found in this warbler.

Female B was killed in the morning in the absence of the male. The first time he came to the nest after it happened he was obviously affected by not finding her near the nest as usual. He hopped around "nervously" with his bill full of food, he glanced in this and that direction, but finally went to the young and fed them. Based on 51 minutes watching before the female was killed, the feeding rate of both parents was once in 17 minutes. After her death, during 129 minutes of observation, the male alone fed the young on an average once in 16 minutes. The next day I watched him feed them 5 times in 68 minutes, or once every 14 minutes. While there appears to be an acceleration in the male's feeding after the female vanished, his mean rate during the fourth and fifth days' watches equals that of the 3-hour watch on the first day, *i.e.*, once every 15 minutes. Keeping in mind the increasing need for food of the young, we should perhaps have found an increased rate of

feeding from the first to the fifth day of nest-life in this male. The lack of this might be accounted for by a change in the number of young in the nest; I had no means of knowing how many hatched or if any disappeared during these days.

In all the time I watched him, Male B showed a clearly defined rhythm in his feeding. In one hour he would feed once or twice, followed by a half hour in which he fed 3, 4, or even 5 times, in rapid succession, after which he repeated the series again. In this way he allowed himself time for preening, resting, and feeding himself between periods of close attendance upon the young. He maintained this rhythm rigidly also after the female was killed.

It seems safe to conclude that my Blackburnian Warbler male was not fitted to raise his brood alone after the loss of the female. Even had the young been able to survive the lack of brooding (which I think was the main reason for their dying), it is questionable whether the male could have kept abreast of their increasing need for food as they grew, although normally he might have increased his rate of feeding and/or the size of his offerings towards the end of the nest-life.

Song

Saunders (1951:194) described the song of this warbler as consisting of two parts—a series of notes in even time and a trill sometimes higher and sometimes lower in pitch than the first notes. He gave examples of 3 different songs.

At Pimisi Bay I recorded 5 different types of song and additionally one courtship-song.

(1) The most common was the long single-note song with rising end-trill (Saunders' No. 3). The length of this song was from 1 to 1½ seconds. Certain males used it almost exclusively, although some sang both this song and that (2) described below. Male B favored this version all through his nesting. After the young died, he began singing again, with particular vigor and intensity in the early morning and into the forenoon, and early in this period often unusually late at night (one record at 8 p.m.). But no new female presented herself and his singing gradually decreased until after July 12, 13 days after the young died, he was heard no longer.

(2) The long double-note song with higher end-trill (Saunders' No. 1) lasted longer than (1), from 1½ to 2 seconds. This also was a song that certain males used almost exclusively. Sometimes, however, I have heard it given by any male as a challenge song when another Blackburnian Warbler invaded his territory and fighting ensued.

(3) Only once I heard songs with double first notes and lower trill (Saunders' No. 2). This song was given by a migrating male passing through the study area.

(4) Half songs were a fourth variety. These songs consisted of the preliminary notes only, without the ending trill, *zree-zree-zree-zree* or *tsevee-tsevee-tsevee-tsevee*, either one used separately on various occasions. These "half-songs" were not heard before the later part of the nestings and perhaps are correlated with the decline of singing.

(5) Male C often sang "half-songs" during his second nesting and he was also heard giving a fifth version—*tse-tse-tse-tse-tsii* with rising inflection at the end. Nice (1939:92) records a similar song but with the last note lower than the rest.

Male C also furnished me with the sole example of a courtship song. At the time I heard it I described it as a short twittering song given at the moment of copulation.

It is noteworthy that in Allegany State Park, New York, Saunders heard the Blackburnian Warbler give songs with double preliminary notes and descending end-trills, and Kendeigh (1947:71), having listened to the birds at Black Sturgeon Lake, north of Lake Superior, remarked that their most common songs were with single preliminary notes and rising end-trill. Nice (1932), in her study of one bird at Pelham, Massachusetts, recorded no song with double first notes but did hear songs with the trills both higher and lower in pitch than the first notes.

From these published observations and mine at Pimisi Bay it may be concluded that the use of the various types of long songs is mainly individual rather than related either to occasion or time in the nesting cycle. In such a case, the preference or ability to sing certain types of song may be a matter of inheritance. This would explain why in one place Blackburnian Warbler songs of one type are more common than the others, while the types of song unusual for that district are heard only from birds passing through in migration.

One call-note was heard. It was used both when scolding and when alarmed, but I could hear no difference of enunciation on the two occasions. Sometimes there appeared to be a slight variation in the note as given by individual birds. The note *chit, chit* (Saunders' *tseek*) is not so sharp as the call-note of the Nashville Warbler, but is otherwise similar.

Dispersal

In the 8 years, 1944-1951, the dates when the Blackburnian Warbler was last seen ranged from August 12 to September 17, the mean being September 2 and the median, September 6. Migration of warblers in general usually begins during the last days of July when the first flocks passing southward may be seen. I have no evidence of any resident Blackburnian Warbler remaining on the nesting territory even as late as this, nor of a third nesting being attempted after two previous failures. The onset of the postnuptial molt

in this region seems to mark the end of the breeding season. Blackburnian Warblers seen during the last three weeks of July are overwhelmingly "molty" in appearance. With the onset of the molt singing ends abruptly and the birds move out of their territories, often pursued by a string of fledglings still begging to be fed.

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SUMMARY

This study was based primarily on observation of 3 pairs of Blackburnian Warblers occupying the same territory in 1946, 1948, and 1950 and, secondarily, on field notes obtained during the years 1943 to 1951.

The spring arrival date for 9 years at Pimisi Bay was May 12, the median May 13. The females of given pairs were seen about 9 days later than the males.

Habitat requirements of the species were mature evergreens, either in climax stands or sparsely intermingled with deciduous growth.

A total of 34 hours was spent watching activities at 3 nests. The building of the nest was completed in an average time of a little over 4 days, but more time was spent on the early nests than on one started later. The female alone built the nest. The male accompanied her, displayed to her, and sometimes effected coitus during the nest-building. There was a notable decrease in building activity toward the end of the day and toward the completion of the nest.

Nests were located in evergreens, most often in white pines, at heights varying from 26 to about 55 feet. A preferred site was on horizontal branches well out from the trunk. The nesting materials consisted mainly of dry twigs, fine grasses, rootlets, and evergreen leaves. Spider silk, collected during the first day of building, was an important item in two nests and was used to attach the nest to the branch.

The female alone incubated. Her average duration of time on the nest was 22.0 minutes, with 5 minutes off for feeding and resting. The mean percentage of attentiveness was 77. The male exercised an influence on the length of the periods off and on the nest by causing the female to leave when she heard him sing loudly or call near by, and by delaying her return by distracting her with his company. One male fed his mate on the nest on 3 occasions during incubation.

On the twelfth day at Nest C and the thirteenth day at Nest B after the female began incubating steadily, young were being fed. At Nest B the male undertook the larger share of the feeding of the young, while the female spent most of her time brooding. The female at this nest was killed by a Pigeon Hawk on the fourth day of nest-life, but the male did not respond effectively to the emergency and the young died the next day, mainly from lack of brooding.

Five types of song as well as one courtship song and one call-note were recorded.

The Blackburnian Warblers left their territories immediately after the nesting cycle was concluded and the postnuptial molt began. This occurred comparatively early, about mid-July. No third nesting was undertaken after two previous unsuccessful attempts. The birds began their southward migration through this region in the end of July. In the past 8 years, the mean date when the Blackburnian Warbler was last seen was September 2, but the median date was September 6.

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