

THE WILSON BULLETIN

A QUARTERLY MAGAZINE OF ORNITHOLOGY

Published by the Wilson Ornithological Club

Vol. 52

MARCH, 1940

No. 1

BREEDING BEHAVIOR OF THE BLACK-THROATED GREEN WARBLER¹

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A nest of the Black-throated Green Warbler (*Dendroica virens*) was kept under observation for a five-week period (June 26-July 30) during the summer of 1938 near the University of Michigan Biological Station, Cheboygan County, Michigan. Original nest observations extended from the beginning of nest building to the time the young were five days out of the nest and totalled 55 hours; these are supplemented with data on a second nest and with general observations on occurrence.

Observations were made from a canvas blind built on the platform of a 16-foot tower of cedar poles. The blind was placed three feet to the side of the nest, which was 23 feet from the ground. With the aid of a foot stool, the observer could reach the nest for purposes of examining contents and removing young for weighing.

The majority of the Compothlypidae remain relatively untouched subjects for life-history students. The Black-throated Green Warbler, while not the best known species of warbler or perhaps even of the genus *Dendroica*, has received its share of attention, this largely in general studies of birds or in somewhat casual observation. Individual treatment has been accorded it chiefly by Stanwood (1910, 1914) and particularly by the Nices (1932). Nichols (1919) has most justifiably called attention to the opportunities offered by the genus *Dendroica*.

Acknowledgments are gratefully made to Dr. Olin Sewall Pettingill, Jr., Carleton College, Northfield, Minnesota, for suggestions on nest observation and for critical reading of the manuscript, to Dr. Theodora Nelson, Hunter College of the City of New York, for helpful advice during the course of the study, and to Mrs. Margaret M. Nice for valuable suggestions and corrections of the manuscript.

NICHE RELATIONSHIPS

During the breeding season the Black-throated Green Warbler is one of the more frequent Compothlypids in the conifer regions of northern lower Michigan, though it is by no means to be included

¹ Contribution from the University of Michigan Biological Station.

among the common birds. Locally it occurs in spruces of mature bog communities and in upland developmental forests of mixed pine and deciduous growth. Less frequently it breeds in mature deciduous forest (Blanchard and Nelson, MS). While the niche requirements of the nesting site confine it, with few exceptions, to coniferous trees, the species forages generally in the higher levels of the prevailing vegetation—high shrubs and both deciduous and coniferous trees. It appears to be far more tolerant than such characteristic coniferous forest species as the Pine Warbler (*Dendroica pinus*) and Blue-headed Vireo (*Vireo solitarius*), and will occupy areas that afford only a few evergreens for nesting sites (Bagg and Eliot, 1937:588).

Vegetation of this breeding habitat of *Dendroica virens* in northern Michigan may be characterized by the following chief components: coniferous trees (*Pinus resinosa* and *P. strobus*, the former being the predominant species for the community) and deciduous trees (*Populus grandidentata*, *P. tremuloides*, *Betula papyrifera*, and *Quercus borealis*); scattered high shrubs (chiefly *Amelanchier canadensis*) and ground vegetation of shrubby ericads (*Vaccinium pennsylvanicum*, *Gaylussacia baccata*, and *Arctostaphylos uva-ursi*) and bracken-fern (*Pteris aquilina*).

The avifauna of this pine-aspen community included the Red-eyed Vireo (*Vireo olivaceus*), Hermit Thrush (*Hylocichla guttata*), Crow (*Corvus brachyrhynchos*), Cedar Waxwing (*Bombycilla cedrorum*), Chipping Sparrow (*Spizella passerina*), Nashville Warbler (*Vermivora ruficapilla*), and Pine Warbler (*Dendroica pinus*).

NESTING SITES AND NEST BUILDING

Structure and location of nests are detailed in Table 1. Nests apparently vary according to availability of material and probably according to the skill or past experience of the female (Herrick, 1935:222). Nest A, at which my observations were made, was poorly built (i.e., walls loose and comparatively flexible, foundation thin), and insecurely placed; nest B (obtained in Emmet County, July 4, 1938) was well built and securely placed. The late date at which nest A was started (June 26th) would suggest that it was either a second attempt at nesting or the first attempt of a yearling female.

Nichols (1919:226) maintains that nests of different species of *Dendroica* are remarkably distinct; according to his observations, the nests of Black-throated Green Warblers (in a limited area of New Brunswick) are characterized on the outside by spruce twigs and birch-bark whorls, on the inside by hair, and an occasional feather. Undoubtedly a good many nests of the Black-throated Green Warbler do not possess those characteristics or, if present, such materials may be few (see examples in Table 1). Judging by the literature (e.g., Standwood, 1910:290-292, also 1914:187; Sutton, 1928:215) as well as my

TABLE 1
STRUCTURE OF NESTS

| | Nest A | Nest B |
|-------------------------|---|---|
| Location | Horizontal branch of Norway Pine (<i>Pinus resinosa</i>) | Same |
| Height from ground... | 23 feet (7 meters) | 12 feet (3.66 meters) |
| Distance from trunk ... | 5.5 feet (1.68 meters) | 5 feet (1.52 meters) |
| Material | | |
| Lining | Mostly hairs; some grasses, a small black feather and wool-like plant fibers | Rootlets, blades of grass short pine twigs |
| Bulk | Grasses, rootlets, thin and short pine twigs | Rootlets, blades of grass short pine twigs |
| Trimming | Mostly birch bark; more of the wool-like plant fibers, some cottony material (from seeds?), and a piece of partially decayed leaf blade | A considerable quantity of hypnaceous mosses and bits of birch bark |
| Measurements* | | |
| Inside Diameter | 4.5 cm. | 5.0 cm. |
| Outside Diameter | 7.8 | 7.5 |
| Inside Depth | 3.0 | 3.0 |
| Outside Depth | | |
| Maximum | 5.5 | 6.5 |
| Minimum | 3.0 | 3.0 |
| Approximate Dry Weight. | 4.9 grams | 7.8 grams |

* Nest measurements as given by Knight (1908:527) are slightly greater in diameter and inside depth, indicating a bulkier structure. His figure of 1½ in. (3.8 cm.) for inside diameter (p. 527) is doubtlessly an error.

own observations on the present species and other passerines, the materials of nest construction are relatively variable. To a large degree this variation may be explained by the simple principle of availability (McAtee, 1932:135), modified, of course, by niche and territorial limitations. Thus differences between nests A and B in materials used can easily be explained from an examination of the surrounding territory, the first being built in a dry, upland pine-aspen-birch forest, the second in a grassy pine grove bordering a *Thuja* bog where ground mosses abounded.

Nest-building lasted four days; both sexes participated at least during the first day when they were observed working the initial material together and individually. The female apparently completed the bulk of the structure. Stanwood (1910:292) likewise recorded a 4-day nest building period, the male taking part only on the first day; in a second case nest building occupied 8 days, performed entirely by the female. The interval between completion of nest and laying of the first egg was but one day in my own observations, nine days and one

day, respectively, in the two nests observed by Stanwood (1910:293). The figure of nine days seems doubtful since this makes a 13-day interval between beginning of nest-building and appearance of the first egg. Nice (1937:94) finds that in the Song Sparrow (*Melospiza melodia*) this interval is 3 to 7 days, usually 4 to 5, with exceptional records of 9 and 13 days connected with subnormally reactive females. For the White-crowned Sparrow (*Zonotrichia leucophrys*), Blanchard (MS, 1938) reports that the interval between beginning of nest building and appearance of first egg is 8 to 12 days (8 known cases), the *nest-building itself occupying 7 to 9 days* in this species.

EGG LAYING AND INCUBATION

Three eggs were laid (July 1, 3, 4). A Cowbird's (*Molothrus ater*) egg was found with the first warbler's egg. Although the nest was examined on July 2, no additional egg was found, but it is possible that one was removed by the Cowbird (see Nice, 1937:157). However, when the third egg of the warbler was found, the Cowbird's egg was gone from the nest and was later found broken on the ground near the trunk of the home tree. No explanation can be given for its removal.

Not only do different species react differently to Cowbird parasitism (Friedmann, 1929:193), but individuals of the same species may vary likewise. One of the three known pairs of Black-throated Green Warblers near the Biological Station was observed feeding a Cowbird several days out of the nest. Knight (1908:530), on the other hand, cites a case of desertion when a Cowbird's egg was added to the first egg of a Black-throated Green Warbler. Friedmann (1929:245) regards this species as one "very seldom bothered by the Cowbird."

Incubation was done entirely by the female and apparently began with the laying of the last egg. Hatching took place the early morning of July 16, making the incubation period 12 days. Forbush (1929:265) states that the male takes part in incubation, but in the present study, the male was seen at the nest during this period only once when the female, disturbed at the observer's approach, called excitedly and attracted the male, who made an examination and adjustment of the nest contents and then left. Inattentiveness of the male during this period was also noted in two nests by the Nices (1932:166).

No extended observations were made of attentiveness of the female with regard to incubation except for one afternoon, on the second day of incubation, during which time (130 min.) the female was attentive for periods of 32 and 65 minutes (81 per cent), inattentive for 12 and 13 minutes (19 per cent). These figures are similar to those of the Nices (1932:95). During incubation the female was noted to leave the nest when the singing of the male was particularly near, giving a soft *chip* as she left. This has also been noted by the Nices (1932:97) and

suggests that, while the male may not take part in incubation, he may be attentive in the sense that he remains rather close to the nest during the female's absences. (See also Nice, 1937:126). During incubation more or less frequent shifts of position were made. One late afternoon the female was discovered asleep on the nest. When disturbed during early incubation the female left the nest in silence, a fact observed also by Knight (1908:529). However, as hatching time approached, the female became increasingly fearless, and if disturbance continued for more or less prolonged periods, she called excitedly, but the state of alarm was broken intermittently by feeding periods, evidencing a "waning of reactions" in the behavior pattern of the bird as described by Howard (1929:58).

NESTLING STAGE

At hatching, down feathers were distributed chiefly over the dorsal tracts of the otherwise naked young (coronal and occipital regions of the capital tract, pelvic region of the spinal tract, also the femoral, crural, alar, and caudal tracts); they were longest on the crown (5 mm.). Feather sheaths of the alar tract (remiges) emerged on the fourth day after hatching; those of the major body tracts appeared on the fifth day, at which time the eye slits also began to open. Sheaths began breaking on the seventh day. Weights of nestlings, taken at approximately 5 P.M. each day, are diagramed in the accompanying graph (Figure 1). (The death of one nestling indicated on the weight diagram was caused by exposure following accidental fall from nest.)

PARENTAL CARE

Feeding. Both sexes fed the young, the female more often. Brooding of young, like the incubating, was done by the female. Details of feeding activity are presented in Table 2. As indicated, data were extracted from the full day's observation on July 21 for equivalent periods spent at the nest on July 19. From a comparison of these data, it is evident that feeding was more frequent at 5 days of age than at 3 days. As shown by the Nices (1932:102, 166), increased feeding frequency is the general trend during the nestling stage. Distribution of feeding visits by numbers per hour (Figure 2) with two 5-day old young in the nest indicates increased activity in both male and female during early morning, noon, and early evening. In a complete day's observation made by Nice and Nice (1932:97) at a nest with young of the same age, the female fed alone and with less apparent regularity (Figure 2). The total number of feedings for both observations chances to be the same (46). The Nices, however, regard feeding frequency in the case of both females observed as slow (that is, normal, given the

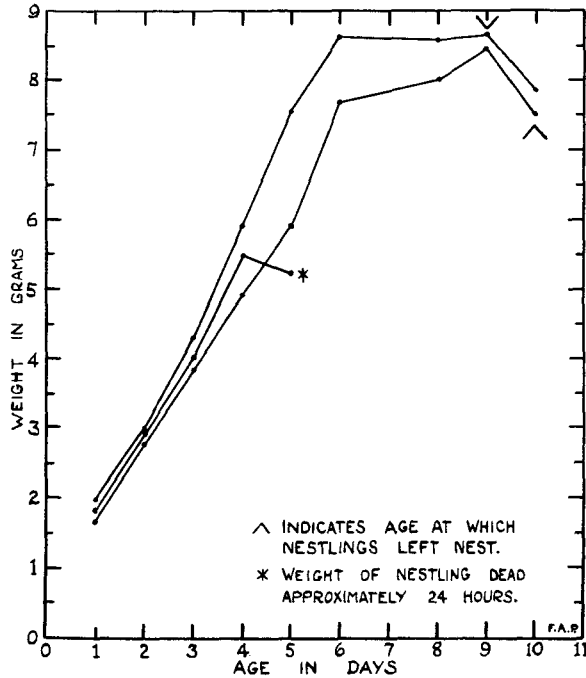


Figure 1. Daily weight increases of Black-throated Green Warbler nestlings.

assistance of the male), following an inherent rhythm adjusted to this assistance (1932:166).

The female's feeding of the young appeared to be independent of that of the male (see also Nice and Nice, 1932:96). However, the appearance of the latter with food at the nest, more often in the absence of the female than in her presence, is probably to be accounted for by the use of the song during the male's approach (see "Songs and Call-Notes") in response to which the female would leave before he appeared. If the male arrived rather soon after the female had fed the young, the female would leave the nest, remaining nearby to return after the male had completed feeding. On one occasion, the female returned to the nest while the male was still feeding and assisted him in re-inserting food in the mouths of the young.

At almost every one of his visits the male, although feeding less frequently, brought more food than the female, a point noted also by Smith (1934:33) during observations on the Black and White Warbler (*Mniotilta varia*). The males of Black-throated Blue and Myrtle Warblers (*Dendroica caerulescens* and *D. coronata*) have been reported

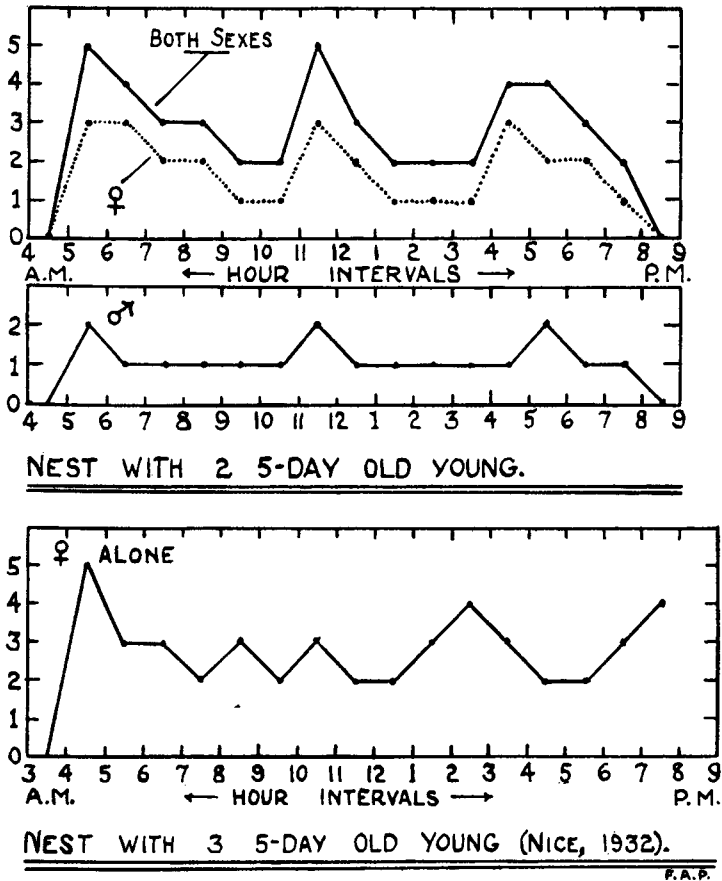
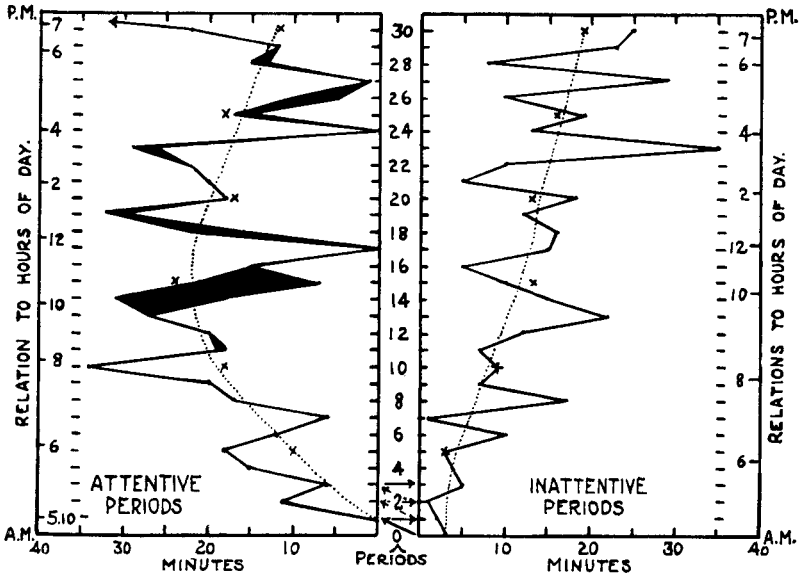


Figure 2. Feeding frequency of adult Black-throated Green Warblers at two nests with 5-day old nestlings (complete day's observation in both cases).

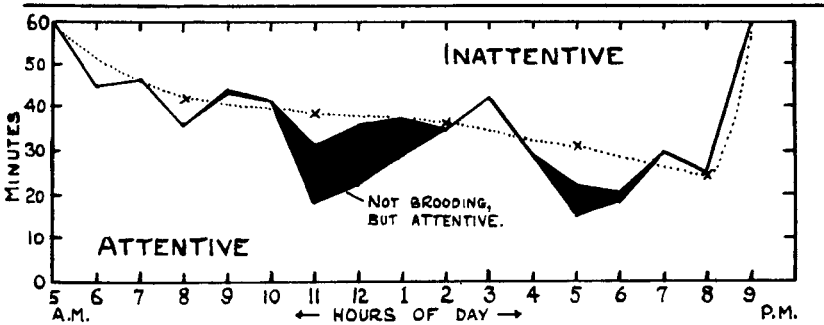
to bring more food per visit than females (Nice, 1930a:60, 1930b:343). In the present study, each of the male's mouthfuls usually consisted of two or three green lepidopterous larvae of one species, measuring about one inch in length. The female brought small Diptera, various small larvae, etc., the bulk of which always amounted to but a fraction of the male's food.

Sanitation. Both sexes removed and swallowed fecal sacs with approximately equal frequency, and on occasions when these were extraordinarily large, they were carried away and probably dropped. Reading and Hays (1933:403) recorded a feeding pair of which only the female removed fecal sacs.

Attentiveness. Observations on the attentiveness of the female



A. Complete day's record of attentive-inattentive periods of female. Sequence-relationship shown by arrows in 0, 1, 2, 3. Dotted lines indicate trends based on averages of every five periods (indicated by small crosses). Darkened outer segments of attentive periods show time during which female was attentive but not brooding.



B. Analysis of attentiveness by fractioning of successive hours. Dotted line indicates trend based on average of every four periods.

Figure 3. Activity of female Black-throated Green Warbler at nest with two 5-day old young.

during the nestling stage are summarized in Table 3 in a manner similar to the feeding data of Table 2. In addition to data from a full day's observation, the table provides a comparison of equivalent periods at 3- and 5-day ages of nestlings. It is evident that attentive periods are shorter, the total attentiveness is less on the fifth than on

the third day. While inattentive periods approximate the same on both days, the total inattentiveness is increased. A plotting of the full day's record of attentive-inattentive periods of the female (Figure 3A) show that attentive periods were longest during the middle portion of the day, while inattentive periods increased in length as the day progressed. Time spent in attentiveness but not brooding (i.e., female perching at nest) is indicated by the darkened portions of attentive periods in Figure 3A. An hour-by-hour analysis of attentiveness (Figure 3B) indicates that attentiveness decreased during the day and shows more clearly the time of day when brooding subsided (darkened portions) though the female was attentive.

In accordance with the above comparison, the Nices (1932:102, 162) show brooding periods to decrease in length during nestling life.

TABLE 2
FEEDING ACTIVITY

| Age of Nestlings | 3 days (July 19, 1938) | 5 days (July 21, 1938) | |
|---------------------------------|---|---------------------------|---|
| Period of Observation | 5 hrs., 10 min. (8:35-11:30 A.M.; 1:15-3:30 P.M.) | Same as 3 days | 15 hrs., 40 min. (4:20 A.M.-8:00 P.M.) |
| Number of Nestlings | 3 | 2 | 2 |
| TOTAL FEEDING VISITS: | | | |
| Average No. per hour | 1.7 | 2.4 | 3.1 |
| Extremes | 1 to 3 | 2 to 3 | 2 to 6 |
| Intervals | 7 | 10 | 45 |
| Average length | 34.7 min. | 23.2 min. | 19.1 min. |
| Extremes | 5 to 55 min. | 1 to 50 min. | 0 to 50 min. |
| No. of Nestlings Fed per Visit: | | | |
| Known Instances | 6 | | |
| Average | 2.5 | | |
| Extremes | 1 to 3 | | |
| MALE: | | | |
| Total feeding visits | 4 | 5 | 18 |
| Average No. per hour | 0.8 | 1 | 1.2 |
| Extremes | 0 to 1 | | 1 to 2 |
| Intervals | 2 | 3 | 17 |
| Average | 75 min. | 50.3 min. | 49 min. |
| Extremes | 61 to 89 min. | 37 to 62 min. | 31 to 90 min. |
| FEMALE: | | | |
| Total feeding visits | 5 | 7 | 28 |
| Average No. per hour | 1 | 1.4 | 1.9 |
| Extremes | 0 to 2 | 1 to 2 | 1 to 3 |
| Intervals | 3 | 5 | 27 |
| Average | 47 min. | 44 min. | 31.9 min. |
| Extremes | 41 to 52 min. | 32 to 57 min. | 2 to 64 min. |

Brooding ceased on the seventh day after hatching (sixth and seventh days, respectively, recorded in two nests studied by the Nices).

Bigglestone (1914:58) has justifiably called attention to the number of factors, chiefly climatic, affecting the attentive-inattentive periods of at least dendroicine warblers. But the Nices (1932:164)—in spite of a number of variations—find two female Black-throated Green Warblers more alike than different in the matter of attentiveness as well as other respects when compared with nine other species of the Compothlypidae. As Bigglestone suggests, there is a certain adaptability of behavior under varying conditions. Nevertheless, by studying a *number* of pairs and comparing with closely related species, these variations in behavior may be more accurately evaluated and the inherent, characteristic rhythm more closely determined (Nice and Nice, 1932:166).

TABLE 3
ATTENTIVENESS OF FEMALE DURING NESTLING STAGE

| Age of nestlings | 3 days | 5 days | |
|-----------------------|--|------------------------------|---|
| | (July 19, 1938) ¹ | (July 21, 1938) ¹ | |
| Period of observation | 4 hrs., 4 min. (9:05-11:30 A.M.; 1:15-3:30 P.M.) | Same as 3 days | 14 hrs., 23 min. (5:07 A.M.-7:30 P.M.) |
| Attentiveness | 71% ² | 64% | 57% ³ |
| Periods | 4 | 6 | 30 |
| Average length | 36.3 min. | 23.2 min. | 16.4 min. |
| Extremes | 33 to 39 min. | 18 to 31 | 0 to 34 min. |
| Inattentiveness | 29% | 36% | 31% |
| Periods | 6 | 7 | 31 |
| Average length | 13.3 min. | 13.4 | 12.0 min. |
| Extremes | 7 to 30 min. | 5 to 22 min. | 1 to 29 min. |

¹ Days of observation were clear, mild, and "average" in both cases.

² In a complete day's observation, percentages of attentiveness are calculated on basis of time from beginning of first inattentive period to ending of last inattentive period.

³ This percentage expresses total attentiveness, but only 52% constituted actual brooding since portions of eight attentive periods (see Figure 3) averaging 5.6 min. (extreme 1 to 14 min.) were spent simply near the nest.

Reaction of Adults to Intrusions. Display on the part of the excited adults was not noted until the second day after hatching when the female left the nest upon the observer's approach but remained a few feet from it, fluttering her wings and bending forward slightly. Such a reaction was also observed after the first nestling left the nest, at which time display was more intense. On the same date, the male appeared on the scene and behaved similarly, dragging the outspread tail along, fluttering wings and lowering the head.

On the eighth day after the hatching, a red squirrel (*Sciurus hudsonicus*) was observed to approach the blind, coming to within seven feet of the nest. At this time, the female simply left the vicinity of the nest at once and gave no alarm notes. Later the same day, when a young Black and White Warbler approached the nest to a distance of five feet, the female pounced upon it and struck with considerable force. When the intruder returned a second time the female flew at it and drove it away. The indifference to red squirrels and at the same time the offensive reaction toward small passerine intruders (*Vireo olivaceus* and *Penthestes atricapillus*) has also been noted by the Nices (1932:160).

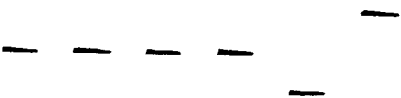
Fledgling Stage. Young left the nest 9 and 10 days after hatching. Forbush (1929:266) records length of nest life as 8–10 days, the Nices (1932:171) as 8 and 9 days. After the young left the nest, the male was not observed to take any part in feeding and, save for the single instance of display mentioned above, was not seen near the young. However, both adults of a second pair were observed feeding a Cowbird several days out of the nest, and the Nices (1932:167) report males feeding young out of the nest in nine cases. Following the departure of the second or last nestling, the female continued to bring food to the empty nest. Similar behavior was noted by the Nices (1932:99) in the case of a male, likewise by Mousley (1924:283) in both members of a pair of Magnolia Warblers (*D. magnolia*) and by Common (1933:413) in a female Ruby-throated Hummingbird (*Archilochus colubris*). Five days after leaving the nest, a single juvenile fed by the female was still in the vicinity of the nest. Nice (1936) reports a molting female Black-throated Green Warbler feeding two fully grown young in winter plumage on September 7 in Massachusetts. Probably the length of fledging dependency is somewhat shorter than this would imply and is similar to that of other dendroicine warblers or closely related passerines. In the Magnolia Warbler (Nice, 1928:253), this period is at least 22 days; in the Ovenbird (*Seiurus aurocapillus*) (Hann, 1937:212) it is recorded as 30 days, in the Prothonotary Warbler (*Protonotaria citrea*) as at least 19 days (Walkinshaw, 1939), and in the Song Sparrow as 28 to 30 days (Nice, 1937:133). Four weeks is the approximate figure for small passerine birds.

SONGS AND CALL-NOTES

The Black-throated Green Warbler has two songs, both of which may be given with certain modifications. Comparable interpretations are recorded by Hoffman (1904:113), Thayer (cf. Chapman,

1907:160), and the Nices (1932:168). The first and most common song may be shown as follows:

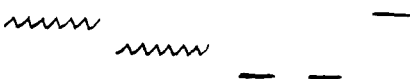
SONG B*



ZEE - ZEE - ZEE - ZEE - ZU - ZWEE

The *zee's* preceding the *zu-zwee* may be reduced to two or increased to six in number. The second and less frequent song may be shown as follows:

SONG A*



ZRRR - ZRRR - ZU - ZU - ZWEE

The second or last or both notes may be omitted, resulting in the following modifications: *zrr-zrr-zu-zu* or *zrr-zu-zu-zwee* or *zrr-zu-zu*.

There was an interesting use of the song by the male as an apparent warning to the female brooding the young of his approach to the nest with food. Odum (1931:316) observed the male of a Hooded Warbler (*Wilsonia citrina*) singing during approach to the nest over all of the first seven days of nestling life, suggesting a similar behavior. The present observations were made during the fifth day after hatching (July 21). As a rule, for about three to five minutes before arriving at the nest with food and for the same period after leaving the male sang. During the approach to the nest, song B was given; after leaving either song A or B was given.

The singular thing about the approach song was that the closer to the nest the male came, the softer became the song. When the singer was but a few feet from the blind, the song became a whisper and unless one was aware of the male's presence, it sounded as if coming from the distance. Mousley (1934:215) has suggested ventriloquial properties in the voice of the Crested Flycatcher (*Myiarchus crinitus*). Aretas Saunders (1929:81) believes that apparent ventriloquism may be due to a psychological condition of the hearer, but in this case the

* In accordance with the Nices' designations.

approach song can be described as ventriloquistic in the sense that it seemed to come from a distance when the singer was close (as Saunders suggests). Usually the female left the nest before the male reached the nest tree. Once the female left the nest in response to a single performance of the song, remaining perched near the nest while the male came with food a minute or so later. On a few occasions the female remained on the nest until the male was within a few feet of her and had given a few soft *chip*'s in addition to the whisper song. During the late afternoon when singing subsided, the male approached silently and when only a few feet from the nest, gave the whisper song; whereupon the female left the nest. During the singing periods, song B was given on an average of 5 to 6 times a minute, song A only 3 times a minute. The last (emphatic) note of song B was usually dropped in the whisper song.

The apparent ventriloquistic quality of the song seems adaptive in that there is less possibility of attracting enemies when the male is close to the nest, but nevertheless the song may serve to coordinate behavior of the sexes in that it warns the female of the male's approach with food. In almost all of the cases where the female remained on the nest in spite of the male's approach, the former had fed the young shortly before. The song, while superficially alike in late spring migration and nestling stage, can hardly have the same relation to behavior of the adults throughout these various phases of the breeding cycle (Herrick, 1935:17). Undoubtedly this relation changes as the breeding cycle advances, and during the nestling stage song may well serve a coordinative function in the feeding activities of the adults.

The usual alarm note of the female was a soft *tzip* distinctly less metallic than the *chip* of the male. During the excitement of the first two days after the young left the nest, the female gave a decidedly sharper, louder *chip* upon the observer's approach. Once the female gave a series of soft *chips* directed at a nestling which did not open its bill when she attempted to feed it. The female's call to the young while approaching them was a soft and rapidly repeated *sh-sh-sh-sh-sh* of variable length. On the seventh day after hatching, the nestlings began to utter a rapidly repeated *chi-chi-chi-chi* upon a parent's arrival at the nest or during the observer's handling of them. At time of leaving the nest, young were noted to give two calls, a simple *chip* and a *chi-churr*. Stanwood (1914:188) and Thayer (in Chapman, 1907:160) describe additional call-notes.

FURTHER STUDIES

In the present paper, certain details of breeding behavior may be contributory to our knowledge of the life history of the Black-throated Green Warbler, but in large part, these observations serve to confirm facts presented by the Nices in a longer, earlier study (1932). Mousley's

(1924) studies of five species of Compothlypidae (including the genera *Compothlypis*, *Dendroica*, and *Setophaga*, but not *D. virens*) present general conclusions on the breeding behavior of North American warblers. The majority of these (numbers 2 to 11) are applicable to the Black-throated Green Warbler, judging from my own experience as well as that presented in the literature. However, as is apparent from data presented here and also from the Nices' detailed table (1932:165), his conclusions regarding feeding rate and length of attentive periods need revision and amplification. Available data indicate that the species of Compothlypidae vary in a number of phases of breeding behavior—feeding frequency, attentiveness, relationships of sexes, etc. In view of known similarities and close phylogenetic relationships, the detailed study of these variations should prove all the more interesting.

SUMMARY

1. In northern Michigan, the Black-throated Green Warbler is found chiefly in developmental communities in which conifers are available in pure growths or mixed with deciduous growth.
2. Phases of the breeding cycle have the following time lengths: nest building, 4 days; incubation, 12 days; nestling life, 8 to 10 days; dependent period of fledglings, approximately four weeks.
3. Nests are placed at various heights in conifers. A rather extreme variation is noted in strength of nest structure. Materials used in nest structure apparently vary largely according to availability.
4. Both sexes (but chiefly the female) participate in nest building and care of young. In the present study the male was not observed to take part either in incubation or in feeding of fledglings.
5. Observations at 3- and 5-day stages of nestling life indicate an increasing feeding rate over the nestling period and a decreasing amount of brooding, which apparently ceased on the seventh day. Details of feeding frequency and attentiveness are given in tabular form.
6. The female fed more often, though the male brought more food at each visit. While the sexes appeared to be independent of each other in time of feeding, a coordinative behavior was detected in the use of song as an approach warning so that the male usually brought food during an inattentive period of the female.
7. Two songs are characteristic: *zee-zee-zee-zee-zu-zwee* and *zrrr-zrrr-zu-zu-zwee*; these are varied with a number of modifications. Call notes of both adults and young are also described.
8. The song, as given with relation to the male's approach with food for the young, is softened increasingly with approach towards nest to a whisper song having a ventriloquistic quality.

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