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## A STUDY OF THE NESTING BEHAVIOR OF THE YELLOW WARBLER (*Dendroica aestiva aestiva*).

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### INTRODUCTION.

The data upon which this paper is based was obtained during the summer session of 1912, of the Macbride Lakeside Laboratory, on Lake Okoboji, Iowa, to the director of which I wish to express my obligation. With the exception of about six hours, the nest was constantly under observation during the feeding hours of the day, from 4:15 p. m. on July 2 until the last nestling left the nest on July 12 at 6:28 a. m.

I wish especially to thank Prof. T. C. Stephens for suggesting to me this piece of work, and also for assistance in bringing it to completion. I owe my thanks to Mr. Ira N. Gabrielson, from whom I obtained many valuable ideas for carrying on the observations. It would have been impossible for one individual to carry out the continuous program involved in this work. Relief at meal time and other periods of the day was freely given by students of the laboratory, and for this I am under obligation to the following: Miss Hudson, Miss Nellie D. Fisher, Messrs. H. S. Doty, G. A. Muilenburg, J. Weaver, P. J. Kruse, D. H. Boot, M. O. Insko, A. H. Schatz, C. H. Farr, and Prof. A. O. Thomas.

The nest of this yellow warbler, *Dendroica aestiva aestiva* (Gmelin), was built about two feet from the ground in a buck bush, or wolfberry bush, (*Symphoricarpos occidentalis* Hook), which was located on the south slope of a narrow, winding ravine. In the vicinity of the nest the oak trees were few and scattered as compared to the dense wood farther down the ravine. The soil was black and fairly moist, crumbling very readily. A dense vegetation grew on the slopes and in the bottom of the ravine. The plants named in the following list were found growing within a radius of fifteen feet from the nest: House Mint (*Monarda mollis* L.).<sup>1</sup> Tall Meadow Rue (*Thalictrum polygamum* Muhl.). Cup Plant (*Silphium perfoliatum* L.). True Solomon's Seal (*Polygonatum commutatum* (R. & S.) Dietr.). False Solomon's Seal (*Smilacina racemosa* (L.) Desf.). Virginia Creeper (*Psedera quinquefolia* (L.) Greene). Poison Ivy (*Rhus toxicodendron* L.). Plum Tree (*Prunus* sp.). Sun Flower (*Heliopsis scabra* Dunal). Strawberry (*Fragaria virginiana* Duchesne). Meadow Parsnip (*Thaspium aureum* Nutt). *Anemone cylindrica* Gray. Golden Rod, Stinging Nettle, Ash (seedling), and a grass.

The nest was found on June 21, and was well concealed and shaded by the neighboring plants. It was built into a fork of the bush and anchored with some white cord which was twined around the supports. The foundation of the nest was built of interwoven coarse straws, and was lined inside with soft down mixed with hair.

There were three eggs in the nest when first seen on June 21. The nest was visited shortly before noon on the following day and it was then found that the fourth and last egg had been laid. The nest was visited daily, with one exception, from this time on until the hatching, when the regular observations began.

On June 28 the blind was erected south from the nest at a distance of about two rods. On each succeeding day, except

<sup>1</sup>I am indebted to Mr. H. S. Doty for the identification of the plants in this list.

one, the blind was moved a little nearer to the nest in order to gradually accustom the birds to its presence. Upon visiting the nest on the morning of July 2, at 7:30, it was found that three of the eggs had hatched, and the young, evidently, were but a few hours old. The blind was now brought to within two feet of the nest; during this operation the parents continued to feed the nestlings. At 4:15 p. m. of the same day the blind was entered and observations began, which were continued as described elsewhere. On July 5 the blind was moved six or seven inches nearer the nest so as to get a better view of the feedings and distinguish the young.

#### INCUBATION PERIOD.

The last egg hatched at 5:30 a. m. on July 3; while the fourth egg was first observed in the nest at 11:30 a. m. on June 22. Between these two dates ten days and six hours are counted. It is taken for granted that the egg was laid earlier in the day, perhaps, between four and six o'clock. By adding this calculated six hours, the incubation period would appear to be just about even eleven days.

#### HATCHING.

At about 5:30 a. m. on July 3 the writer was attracted by a peculiar rolling motion of the egg in the nest, and noticed upon closer observation, that the shell bulged out in a ring around the middle or a little nearer the smaller end; and soon it began to crack at this place. The egg raised on the small end, leaning against the side of the nest, and the young bird freed himself from the shell by a series of pushes and kicks by the head and feet, respectively. The head escaped from the larger part of the shell and the lower part of the body from the smaller end. The crown of the head and the median line of the back of the nestling were downy. This entire process covered a period of less than four minutes.

#### DISPOSAL OF THE SHELL.

The female, bringing a grasshopper, returned to the nest immediately after the hatching of the fourth egg. She fed

one of the nestlings and then picked up one-half of the shell, which she worked around in her bill, thus effecting its comminution. This part of the broken shell was then quickly swallowed. Soon the male returned and perched on the edge of the nest while the female in a similar manner broke up the other half of the shell, after which both birds devoured it. The parent birds then cleaned the nest by picking up and eating the smaller portions of scattered egg shell.

#### MARKING THE YOUNG.

There were three methods tried for marking the young, but only the last one was successful. At about eleven o'clock on July 3 the attempt was made to mark the young with aniline dyes, but it seemed impossible to make them take hold. Though it must be acknowledged that this plan may not have been given a fair trial. Then again a little after one o'clock on July 5, an effort was made to mark the nestlings with colored adhesive papers, but these would not stick very well to the downy skin of the birds, and when one did so the female picked it off upon her return to the nest. On the evening of July 6 the last method was tried, that of tying different colored strings to the legs of the young. In this way the largest bird was marked white, the next blue, and the third in size and activity red.

There are a few explanations which should be made at this time. On July 4 one of the nestlings was lost from the nest and cannot be accounted for, as the disappearance was not observed. This occurred before the marking of the young, and the absence of one would less likely be noticed.

On July 7 the bush, in which the nest was located, was strengthened by being tied to an upright driven into the ground.

In reading the records of the days following July 8 and also the tables, it should be taken into consideration that the proceedings were abnormal, as the male left the care of the young entirely to the female.

FEEDING.

The feeding of the nestlings was carried on by both male and female parent birds. As is shown in Table I, during the first four full days of observation, the male bird made more feeding visits than did the female, but on the following day the female outworked the male in this respect. However, during the remaining days it was impossible to follow this comparison because the male discontinued all feeding visits on July 8, immediately following the snake incident.

TABLE I.

Showing exact periods of observation and totals of feeding visits of the parents by days.

Day	Time	Hours	Min.	m	f	Total
July 2	4:15 p. m.-7:40 p. m.....	3	25	21	24	45
July 3	4:20 a. m.-8:30 p. m.....	16	10	136	91	227
July 4	4:20 a. m.-8:30 p. m.....	16	10	106	94	200
July 5	4:15 a. m.-8:10 p. m.....	15	55	127	114	241
July 6	4:32 a. m.-7:35 p. m.....	15	3	151	131	282
July 7	4:10 a. m.-8:25 p. m.....	16	15	155	189	344
July 8	6:20 a. m.-8:48 p. m.....	14	28	117	161	278
July 9	6:30 a. m.-8:10 p. m.....	13	40	...	264	264
July 10	4:30 a. m.-8:47 p. m.....	16	17	...	221	221
July 11	4:25 a. m.-7:45 p. m.....	15	20	...	238	238
July 12	4:20 a. m.-6:30 a. m.....	2	10	...	33	33
Total	.....	144	53	813	1560	2373

During the first three or four days when the female was brooding, usually the male gave her the food, which she distributed to the nestlings. But there were times when the male ignored the outstretched bill of the female and fed the young himself. She would also, on some visits, move to one side of the nest and allow the male to feed the young. Again there were several times that the male gave part of the food to the female and then both the parent birds distributed their shares to the nestlings. On one occasion (visit No. 1584) the male fed a fly to one of the nestlings, but the female immediately took the fly from the young and ate it herself. When

the food was too large for the nestling to swallow, the parent bird sometimes pulled it out of the young bird's mouth and thrust it in again, repeating this process as many as three times, until the nestling swallowed it. On one visit (No. 336) both parent birds helped to push the food down the nestling's throat. Again if the young did not swallow the food, the parent took it and either broke or shook it into a mass so that it was then easily devoured. The worm brought at visit No. 641 was so large that the outline of it was seen through the skin of the neck of the nestling bird. There were times, also, when the young quarrelled over the food; for example at visit No. 272, two of the young grabbed the food and pulled back and forth until the larger one got it. The parent birds in feeding would also try one nestling and if it did not respond properly he would try another, and sometimes go back to the first one again. On July 10 at 12:36 the female brought some food and tried to feed red, but the nestling did not take it; then the female left and soon returned, but still red would not respond, so the female left the nest, carrying away the food. A very unusual performance occurred on visit No. 398, when the parent birds came to the nest carrying a large yellowish worm between them, which they broke into three pieces and fed to the young.

The identification of the food was very difficult because of its minuteness. Table II shows the distribution of food per day along with a somewhat indefinite classification. There were periods when the male and female brought the same kind of food during a number of consecutive visits, which may have been due to the fact that at times the parent birds traveled together while feeding, as was seen during a short observation. This was especially true of the green worms.

TABLE II.

Showing the distribution of food by days.

	July 2		3		4		5		6		7		8		9		10		11		12		Total m & f
	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	
Unknown .....	10	12	14	15	9	28	18	32	3	29	21	25	15	9	16	48	9						331
Insects .....	..	..	19	31	23	37	17	26	20	48	63	28	32	55	83	54	6						553
Green Worms .....	4	5	60	83	28	22	29	27	52	53	44	40	24	47	84	63	39	3					659
Fly Forms .....	..	3	5	10	6	13	17	18	26	17	20	21	42	60	33	32	3						326
Worms .....	1	2	13	8	12	9	13	10	16	17	10	11	7	5	10	10	8	..					162
May Fly .....	..	..	..	..	4	4	3	4	3	4	3	10	15	3	14	41	23	16	7				147
Moths .....	1	3	14	7	3	2	4	1	1	2	3	3	1	4	17	16	17	4					103
Miller .....	..	..	..	..	2	..	1	..	..	..	..	2	7	12	8	4	35	4					75
Mosquito .....	..	..	..	2	4	5	4	5	4	1	1	9	..	3	5	..	22	..					65
Larvæ .....	..	..	..	..	5	4	..	4	3	..	..	..	2	..	8	..	..	..					26
Grasshopper .....	4	2	2	4	2	2	..	..	1	..	2	..	2	..	2	..	1	1	..				25
Spider .....	..	..	1	..	..	..	1	..	1	3	1	2	2	3	5	1	3	..					23
Ant .....	..	1	4	..	2	2	..	..	..	..	..	..	..	1	..	6	2	..					18
Grub .....	..	..	4	3	..	1	2	2	..	..	..	..	..	1	..	1	..	..					14
Beetle .....	..	..	..	..	2	1	..	1	..	1	..	..	..	..	1	2	1	..					8
Dansel Fly .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	1	1					4
Tree Hopper .....	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..					2
Bee .....	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..					1
Total .....	20	25	138	87	114	92	137	101	159	134	163	190	120	182	303	261	279	37					2542

The time when feeding began in the morning varied within rather narrow limits. On one day it started at 4:29 a. m., and on another at 4:50 a. m. In the evening the earliest final feeding visit was at 7:56 p. m., except one rainy evening, when the female started brooding at 7:36. The latest final feeding visit was at 8:04 p. m. The average feeding period per day was fifteen hours and thirty minutes. (See Table I.)

Table III is prepared with the view of ascertaining whether the parent birds followed any system of rotation in distributing food to the young. However, there were three facts which prevented the collection of complete data, viz., a) the young birds were so small and delicate that they were not marked until the nestling period was nearly half gone, b) the early death of two of the young, c) and the unusual behavior of the male after the snake incident. No plan could be discovered which they seemed to follow. At one time one nestling received the food as many as seventeen successive visits; at other times the feeding rotated from one to the other.

TABLE III.

Showing the distribution of the food to the different nestling birds by the two parents.

	July 6.		July 7.		July 8.		July 9.	July 10.	July 11.	July 12.	Total
	m.	f.	m.	f.	m.	f.	f.	f.	f.	f.	
Red . . . . .	2	3	51	50	37	51	118	170	238	33	753
White . . . . .	2	3	48	83	43	45					224
Blue . . . . .	3	4	46	58	38	63	146	51			409
Total . . . . .	7	10	150 <sup>1</sup>	192 <sup>2</sup>	118	159	266 <sup>1</sup>	221	238	33	1397
Total for m. & f. per day...	17		345 <sup>2</sup>		277	266 <sup>1</sup>	221	238	33	1400	

<sup>1</sup> Error in total, due to fact that it was impossible to determine which nestling received the feeding.

<sup>2</sup> And on one occasion both parents were present at the same moment and all three nestling were fed, but without determining by which parent, thus making the total 345.



After blue left the nest on July 10, the female seemed to take care of it, for many times she was seen to approach with food, but would dart into the weeds near by, and soon fly out with bill empty. She would also remain away from the nest for rather long periods at this time. For example, a period of twenty minutes elapsed between visits No. 2148 and No. 2149, and fourteen minutes between visits No. 2442 and No. 2443.

When the observations commenced the parent birds were feeding the young large food, such as insects and green worms. As described elsewhere the writer was present when the fourth egg hatched and is able to state that the food of this bird was not at all different from that which was being given to the rest of the nestlings, viz., green worms, grasshoppers, and other insects. At no time while the nest was under observation did the parents feed by regurgitation. It might be said that on visits Nos. 138, 440, 745, 769, and 798, one or other of the parents came to the nest with beak empty, so far as could be discerned. This parent then thrust its bill into the mouth and throat of one of the young birds, and then repeated the act on another. Then again on visits Nos. 751, 1059, and 1880, after the parent bird fed one of the nestlings, it put its apparently empty bill in the mouth of one of the other young. This behavior is not understood, but is not regarded as explainable on the assumption of regurgitative feeding, for the reason that it was long after hatching, and so irregular and infrequent.

#### BROODING.

Brooding was carried on entirely by the female, with one possible exception. On July 3 the observer, who was in the blind at the time, recorded that the male brooded for seven minutes. Since this is the only instance where such behavior on the part of the male was noted by any one, and because the writer observed on two occasions the male perched on the edge of the nest inspecting the young, once for a period of four minutes, it seems doubtful if the observer

employed the term brooding in the sense of sheltering the young from sun, wind or rain.

The female while on the nest usually sat facing the blind, but during rains and strong winds from the northwest she would face in that direction, occasionally glancing back at the blind.

The female was more careful in brooding the young during the first few days. She would stop for intervals throughout the day, while feeding, and brood the young. Her way of completely covering the brood was to fluff out the undercoverts against the rim of the nest and bring the wings down, just inside, so as to effectually close the nest. As the young grew older and became larger, brooding also became more difficult. She experienced great difficulty in covering the young, for the nest was very much battered and misshapen, making a larger area to cover. The young were very active and there were times when the female would be contentedly brooding, while covering only the head of one nestling.

The female had different brooding attitudes for the varying circumstances. For protection against the cold of early morning she brooded in the manner described above, completely covering the young. Through the rains she brooded in much the same way as for cold, sheltering the young, so that after an unusually heavy downpour, the nest remained perfectly dry inside. During the heat of midday she usually stood in the nest with wings spread, shielding the young, but without shutting off the circulation of the air. On the contrary, at times she gently flapped her wings, as if fanning the young. During the strong winds she stood in the nest with wings outstretched, and leaned in the direction of the wind, so as to secure a delicate balance and at the same time keep the young in the nest.

Curves were plotted for the brooding period of each day in an effort to determine the variability in intensity of brooding throughout the day. But the results obtained were not satisfactory because of the different elements, such as rain,

wind, heat, cold, and nest location, which help to determine the brooding periods and the length of the same. Then many brooding periods were cut short by the male bringing food. But it was found that the brooding was more intense during the morning, and scattered throughout the rest of the day, according to the wind and the shading of the nest. The length of the brooding periods varied to a great extent, generally ranging from one minute up to between ten and twelve minutes. There were a few periods which exceeded this, the longest being thirty-two minutes, on the afternoon of July 5, and twenty-three and twenty-four minutes, on the afternoon of July 7. These long periods occurred when the nest was unprotected from the rays of the sun.

On July 7 the brooding periods became less in number and more scattered, the parent bird often departing with only a brief inspection. On the day following, and thereafter, brooding was discontinued entirely except during storm; while the brief inspections continued as before. As the young became stronger and walked around the nest, they stretched under the shadow of the leaves or even climbed into the branches.

These observations show a certain adaptability of behavior under natural environment. It was also shown that their behavior could be modified by artificial conditions. Between the hours of 1:00 p. m. and 5:00 p. m. the sun shown directly upon the nest, owing to the fact that the tall weeds which normally shaded the nest, were trampled down, in erecting the blind. During this time broad leaved burdocks were hung upon the guy ropes to throw a shadow over the nestlings. The female did not brood when the nest was thus shaded, unless there was a strong wind. Thus it would seem that the accident of location would have some bearing upon the intensity of brooding.

During the first days, the female began the brooding in the evening and was also on the nest in the morning before the feeding began. But on the last two days it was not seen which parent commenced the brooding in the evening or

which left the nest in the morning. It is not known whether the female brooded the entire night or whether the male relieved her, although there is no reason to suspect that such a change took place. The attitude of the female in sleep was to turn her head to the left, backwards and tuck the bill under the wing.

#### SANITATION.

The parent birds were very careful as to the cleanliness of the nest. The mother bird seemed to be more particular in this matter, for she did more than an equal share of work in keeping the nest clean.

From the beginning of the observation up to the snake incident the parent birds failed to catch the excreta sac only fifteen times. While, from this time on to the departure of the young she failed thirty-four times. But it must be borne in mind, that during this latter period the responsibility of caring for the young rested entirely upon the female. With this extra share of labor it was not surprising that she occasionally missed the excreta sac. This circumstance was, of course, an abnormal one. The records show that in many of these instances the excreta sac was voided "immediately following the departure of the female, after feeding one of the young." Several times when the sac fell to the ground the female picked it up and carried it away. Again the female made more feeding visits, *per young*, for, as the nestlings grew, they demanded more food. And, too, as the birds became older and larger their bodies often projected over the rim of the nest. Table IV shows the number of times each day that the excreta sac was not caught by the parent.

TABLE IV.

Showing the total number of times each day the excreta sac was not caught when voided.

	July	2	3	4	5	6	7	8	9	10	11	12	Total
Not caught .....			4		1	6	2	3	5	10	15	3	49
Total number of excreta sacs .....	13	38	41	34	34	49	45	35	39	32	3		363

There was an unusual occurrence on July 8, when an excreta sac was left in the nest during two successive visits by each of the parent birds, although on the third visit the female carried it away. This instance is the more extraordinary, for there were times when one of the parent birds would be making a feeding visit and upon seeing an excreta sac in the nest, would promptly swallow the food so as to carry away the excreta at once.

While the nestlings were small, they were watched as far as was possible to ascertain whether the excreta was always taken from the same bird as fed. It was noted that this generally held true. Then after the young had been marked, more complete records were taken. Out of a total of one hundred and sixty-eight times, there were but five times recorded that the young voiding the excreta was not the one fed at that visit.

The excreta was usually eaten by the parents until July 5; on this day it was carried away a little over half of the time. And from then on, it was eaten only on eight occasions. Table V shows the disposal of the excreta and the total number of defecations.

TABLE V.

Showing by days the total number of excreta sacs, together with their disposal.

	Sex	July	2	3	4	5	6	7	8	9	10	11	12	Totals
Eaten	m		4	7	6	1								18
"	f		8	25	23	12	3	2	1		2 <sup>1</sup>			76
Carried	m			6	8	9	10	20	17					70
"	f		1		4	12	21	25	27	34	36	27	2	189
Total			13	38	41	34	34	49 <sup>2</sup>	45	34	38	27	2	363 <sup>3</sup>

<sup>1</sup> One of the sacs of excreta was but partly eaten.

<sup>2</sup> On one trip the sex of the parent bird was not determined, and also once not noted whether excreta was carried away or eaten.

<sup>3</sup> Eight times the excreta sac fell to the ground and was neither carried away nor devoured by the parent birds, but are included in the final total.

Observations were taken as to what was done with the excreta when carried away and it was seen that the parent

bird flew to the limb of one of the nearby oak trees and either dropped the sac to the ground or deposited it on the bark of the tree. The bird then wiped the sides of its beak against the limb.

#### MISCELLANEOUS BEHAVIOR.

Throughout the period of observation, the female made close inspections of the nest. She was very careful of the young, through the heat, wind and rains, covering them well and keeping the interior of the nest dry. During the early days, if the young leaned out over the rim of the nest, she pulled them back or pecked them until they moved of their own accord.

The parent birds were very watchful of the young, and always present at the approach of any intruder. Several birds, such as the cowbirds, blue jay, wren, chickadee, brown thrasher, king bird, and blackbird, came into the neighborhood of the nest at different times. They were driven away either by the combined efforts of the male and female, or by one of the parents alone. The only bird which did not seem to arouse the warblers, and which was not driven out, was a catbird.

On July 8, shortly before noon, the observer in the blind caught sight of a small garter snake crawling along on the tops of the weeds, not more than a foot away from the nest. While the snake seemed to be directing its course aimlessly, yet it came nearer to the nest, and even rubbed against the bush containing the nest, a few inches beneath the latter. At this point the observer interfered, but failed to capture the intruder. In the meantime the parents were very greatly disturbed and afraid to return, notwithstanding the calls of the young birds. Five minutes after the snake had been driven away, the female returned to the nest with a miller. The male came almost at the same time with food.

Later in the same day another snake incident occurred, which terminated in a tragedy. The following account was

written up immediately after the incident by Miss Nellie D. Fisher, who was in the blind at the time:

"At 2:40 p. m. the male bird fed the young and immediately afterward the female flew close to and directly above the nest without stopping; this act being unusual I looked around closely and at the base of the bush in which the nest was located a garter snake<sup>1</sup> was seen lying partly coiled up. I watched it for about two minutes, not thinking it would harm the birds; then it began to move, and I took a large piece of stove wood, all that was at hand in shape of a weapon, and struck at the snake through the peep-hole in the tent. At once it began to show fight, and in so doing it came almost into the tent; but when nearly under it, turned and went up the stick, which had been put in place to strengthen the bush, passed over the nest to the farther side, took the larger bird, and at once started off with it. The nestling, in the meantime, made considerable noise. I ran out of the tent after it, and followed the noise a few feet to the northwest, near the plum tree, when the noise stopped. I looked around a short time and then returned to the blind and found the snake just below the nest with the bird in its mouth. With the same stick of stove wood the snake was killed. By this time the bird was dead. Meantime, the male and female were flying about, uttering loud angry calls, and flying close to the ground where the snake lay."

The following notes are taken from the field records:

"Before 6:00 p. m. observer laid dead bird on branch near the nest; female, after feeding, seized dead bird by the leg with her beak, then darted against the tent as if frightened; but soon returned and took its head, hopped backward and unbalanced it so it fell to the ground. She seemed afraid of it; but made little darts at it, pulling it away from the nest.

"The female flew down near dead bird with food and twit-

<sup>1</sup>I am indebted to Dr. Alexander G. Ruthven, of the University of Michigan Museum, for identifying the snake as *Thamnophis sirtalis parietalis* (Say). This particular specimen was not over twelve inches in length.

tered several times; after feeding young, she again flew down about in the bushes and even under the nest.

"About 5:42 p. m. the female flew near the dead bird with a mosquito.

"Male came into the bushes, no food left.

"For a time parents approach nest, chirp and twitter.

"Again female flew near dead bird."

Following the snake incident the female was much more careful in approaching the nest, being nervous and very easily frightened away by the slightest noise. The male stopped feeding and left the entire care of the two remaining nestlings to the female. This action on the part of the male may have been due to fear. He remained throughout the day in an oak tree to the right of the nest. The two parent birds occasionally called or sang to each other, while the male came down from the tree at the warning call of the female, usually to drive away some intruding bird.

There was a certain stereotyped method of approach by both the parent birds, which remained unchanged throughout the nestling period. The female alighted in the weeds at some little distance to the north of the nest and gradually approached the nest by hopping from weed to weed. Thus she concealed her actions from any passers by. She usually stopped for a moment and inspected the young. The male invariably came straight down from the oak tree to the right and perched on the edge of the nest with his back or right side to the blind. He fed in a hurry and left at once. This made it difficult at times to identify the food or see which nestling received it.

During the first few days, the nestlings threw up their heads, with bills open, both when the parents visited the nest and when there was no observable stimulus. At this time it seemed that all they lived for was food. After the eyes had opened, they became more attentive to the things happening around about them.

It had been noticed that the young birds threw up their heads, with bills open, when the parent birds reached the



nest, and also when a gust of wind moved the nest. On July 7 a simple experiment was carried on. And it was found that the nestlings threw up their heads for food at the snapping of fingers, scraping the pencil on the blind, a low whistle, or contact with the nest. This instinct was shown whenever the birds were artificially stimulated, but on July 8 it became modified. For, at this time, such a stimulus caused the response from one, or, possibly, two birds, or from none. As they grew they became more watchful and attentive, for they perceived the parent bird approaching with food at some little distance. On July 9 the young marked red opened its bill at the shutting of a farm-house door, and both red and blue opened their bills when the nest was moved by the wind. Then on July 10 red opened its bill at an artificial chirp. It seemed that this instinct lessened each day, from July 8 on, but still it was present to a certain degree when the nestlings left the nest.

During the first half of the nestling period, the parent birds evinced a peculiar habit of pecking the young, especially about the eyes. It would, perhaps, be hazardous to attempt an interpretation of this beyond suggesting that it might simply indicate an impatience on the part of the old birds for the eyes to open. The eyes of all three nestlings were open by the evening of July 5, or, approximately, within a period of three days and a half after hatching. After this pecking about the eyes ceased, though continued on the other parts of the body.

On several occasions one of the nestlings swallowed the end of a hair, which was used in constructing the nest. This caused the bird much distress, and also made it impossible for its food to be swallowed. When the female visited the nest, on such occasions, she picked up the hair and attempted to pull it out, sometimes flying in a semi-circle around the nest. This certainly could become a grave danger to the nestling bird, because in many cases the hair was quite securely fastened in the gullet, and might easily result in the dislodgement of the young from the nest.

On the afternoon of July 11 the one remaining nestling (red) left the nest several times for the twigs nearby, sometimes for shade, and at other times as if to leave, but it returned to the nest each time, as if not yet sure of its ability to travel. On several occasions during this behavior, the female stayed in the weeds near at hand, watching the young bird, as if to be of assistance when needed.

The following notes are taken from the field record:

"On the morning of July 12, at 4:22 a. m., the nestling awakened, stretched, flapped wings, and chirped for some time. Then settled down again and seemed very listless.

"At 5:15, red was on the west edge of the nest; at 5:30, red left the nest for nearby twigs; foot was caught but soon pulled it loose.

"Red went from twig to twig until it reached another bush at 5:24; here it stretched and preened. At 5:35, red turned around on the twig and then back again. At 5:41, crawled farther out, stood up twice, as if to go, and then settled down again.

"Female approached and called.

"At 6:05, red jumped farther down on the same twig, four to six inches lower. Tried to climb up a weed, but slid down to first landing.

"At 6:07, red flew to weed about one and one-half inches away, but went back again.

"Female departed.

"At 6:25, red moved to another part of the same twig.

"At 6:27, red jumped to a low clump of weeds, and so on to another, and then on to the ground, at 6:28.

"Then I removed the red string from the leg; while both male and female were near, calling and scolding.

"All during this period, while the nestling was leaving the nest, the female brought food."

#### SUMMARY.

1. The young in the nest were under observation for 144 hours and 53 minutes.

2. During this time the parents fed the nestlings 2373 times.
3. The incubation period for *Dendroica aestiva* is eleven days.
4. The egg shells are disposed of by being devoured by the parents.
5. This species does not feed its young by regurgitation at any period.
6. Brooding is carried on only by the female.
7. Intensity of brooding is due to a complexity of factors, including nest location.
8. The brooding instinct can be modified by artificial environment.
9. During the first half of the nestling period, the excreta sac is usually devoured, and carried away during the latter half.
10. The excreta sac is either dropped to the ground or deposited on the limb of a tree.
11. The parent birds have a stereotyped approach to the nest.

*Sioux City, Iowa.*

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## SOME RECORDS OF THE FEEDING OF NESTLINGS.

BY LYNDS JONES.

During the summer of 1912 two students made a number of studies of the feeding of nestlings, summaries of which I herewith present. These studies were made without the aid of a blind, because it was found possible to approach within a few feet of the nests without disturbing the parent birds in their feeding activities. It was also found that the sex of the birds could be determined positively, after noting each bird for the first few hours. This was done by noting the individualities of the two birds, and by the frequent singing of the male, either just before or just after he delivered the food.