

Breeding Behavior in the Ruby-throated Hummingbird

(*Archilochus colubris*)

by

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A report on an original field study conducted at the University
of Michigan Biological Station.

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Introduction

A nest of the Ruby-throated Hummingbird (Archilochus colubris (Linnaeus)) was kept under observation for a period of five weeks from July 7 to August 11, 1947 on the University of Michigan Biological Station property, Cheboygan County, Michigan. The work was carried on as a special problem under the direction of Dr. O.S. Pettingill, Jr.

Observations were made from a canvas blind erected about six feet from the nest. Forty-nine hours were spent in observations from the blind and several additional hours were spent in an attempt to determine where the female fed and the route which she took after leaving the nest.

Nesting Site

The nest was located in a paper birch (Betula papyrifera) about 12 feet from the ground on a horizontal branch extending over a road. The nest was saddled in a small crotch of a branch about half an inch in diameter. The branch drooped slightly and was well protected from above by overhanging branches and a canopy of leaves. In all points its location agreed with the criteria set forth by Saunders (1936) for hummingbird nest sites. First, it projected over an open space. It was attached to a limb less than an inch in diameter and this limb slanted slightly downward and was sheltered from above by a canopy of branches and leaves. A comparison of other nesting sites in the Biological Station area may be seen in Table #1.

No attempt was made to study the ecology of the region beyond a listing of a few of the immediate plants and the birds which were heard or seen in the neighborhood of the blind. The trees of the immediate area are:

White Birch - *Betula papyrifera*
Northern Red Oak - *Quercus borealis*
Red Pine - *Pinus resinosa*
Jack Pine - *Pinus banksiana*
Sugar Maple - *Acer saccharum*
Large-tooth Aspen - *Populus grandidentata*

The shrubs and ground plants are:

Sumac - *Rhus glabra*
Diervilla lonicera
Bracken fern - *Pteris aquilina*
Juneberry - *Amenanchier canadensis*

The birds observed were:

1. Mourning dove - *Zenaidura macroura*
2. Flicker - *Colaptes auratus*
3. Eastern Kingbird - *Tyrannus tyrannus*
4. Least Flycatcher - *Empidonax minimus*
5. Wood Pewee - *Myiochanes virens*
6. Black-capped chickadee - *Penthestes atricapillus*
7. Brown Thrasher - *Toxostoma rufum*
8. Eastern Robin - *Turdus migratorius*
9. Eastern Bluebird - *Sialia sialis*
10. Cedar Waxwing - *Bombycilla cedrorum*
11. Red-eyed Vireo - *Vireo olivaceus*
12. Myrtle Warbler - *Dendroica coronata*
13. Black-throated Green Warbler - *Dendroica virens*
14. Pine Warbler - *Dendroica pinus*
15. Ovenbird - *Seiurus novaboracensis*
16. Eastern Cowbird - *Molothrus ater*
17. Goldfinch - *Spinus tristis*
18. Chipping Sparrow - *Spizella passerina*

One other point which might be mentioned in regard to the nesting site is the use of dead branches for perches. In both nests that were watched this summer, it was noted that the female made a great use of the dead branches for perching when preening or watching. Seldom did she use a branch which was leaf-covered.

Territory and Defense

An attempt was made to determine the territory the female had when feeding, but she flew much too far and quickly when she left the nest. The majority of times the bird was observed to leave through a clearing to the southeast of the nest, but how far she went or where she fed I could not determine. Hummingbirds were noted feeding at the flowers around our cabin (#5 Blissville) some two or three blocks from the nest, but observations of them here were so infrequent that it was probably not the main feeding grounds.

During the period of incubation, the female was observed to feed at the base of the sumac off the fronds of the Pteris and the leaves of the low-lying sumac and at the flower of the Diervilla. Occasionally, too, she would pick something off the leaves and branches of the nest tree.

The territory she defended seemed to consist mainly of the nest tree. A kingbird nested in an adjoining tree and she never seemed to have trouble with it. Several birds fed in a nearby Juneberry and occasionally one even lit on the nest tree.

Aggressiveness was observed only three times. The evening we put up the blind, the female became very excited and once dived at one of the fellows helping me, picking him on the nose. A second time she was observed to leave the nest in pursuit of another hummingbird and a third time she severely berated a robin that happened to light in the nest tree. When the robin lit on a nearby branch, she was off in

flash after it like an enraged bumblebee. She darted as close to its head as she dared and swung back and forth like a pendulum in front of him. The robin was obviously startled and every time she went past his head, he would snap his beak as though trying to catch an irritating insect. Finally the robin left and the hummingbird returned to its nest.

Nest and Nest-building

No observations were made on the mating behaviour of the hummingbird, nor was the building of the nest seen. Bent (1940) says "that the construction is carried on by the female alone", listing, however, an exception noted by W.A. Walter in 1935 in which the male did his share of work on the first day.

The nest was built of the usual materials. The outside was covered with lichens and the bulk of the nest seemed to be of bud scales though it was not torn apart and examined. The lining was of plant down and the nest was fastened to the branch by spider silk. The dimensions of the nest were 43 mm. long by 33 mm. ~~high~~^{wide}. Inside diameter was 29 mm. x 20 mm. The outside depth was 26 mm. and the inside depth 18 mm.

Nest construction continued during incubation with occasional bits of lichen added to the outside of the nest. The female accomplished this by placing it on the nest with her bill. The day before the young hatched she added material to the inside lining and at several intervals during the day she shaped and reshaped the outline with movements of her body. I believe the feet were used too, as the nest would bulge out as though her feet were being used to tamp the sides.

The nest is sturdy because at the end of thirty-five days of constant use the nest was in almost perfect condition. Just what the activity of the young bird has to do with the condition of the nest is hard to ascertain, but this nest with only one nestling was in excellent condition while the Eyes nest (1947) was rolled out and flattened until it almost looked like a platform rather than a cup.

Egg-Laying

Egg-Laying and Incubation Period

The nest was found by Mrs. R.L. Burget at 7:00 P.M. on July 7th. At that time there were two eggs in the nest. Active observation from a blind was started on the morning of July 9th. The hatching date was July 21st. One egg did not hatch and remained in the nest throughout the entire period of observation. It, along with the nest, was collected on August 15th. It no longer had the pur white coloration of the newly-laid egg, but was stained and discolored, one end being much darker than the other. Its measurements were 13 mm. long by 7 mm. in width. This compares well with Bent's (1940) listing of Bendires average of 12.9 x 8.5 mm. for 52 hummingbird eggs.

It is believed that the nest was found on the day that the last egg was laid as it was exactly 14 days from that date that the first egg hatched. The egg hatched some time between 8:00 P.M. on July 20th and 10:45 A.M. on the 21st. Also, if 14 days is the correct incubation period, the egg which was infertile was the first one laid. The 14-day incubation period was stated by Burns in 1915. (Bent, 1940)

Behavior of the Female During Incubation

Incubation was carried on entirely by the female and at no time was the male observed near the nest. In fact, only one male hummingbird was reported during the summer, and that one was about five miles away from the Station.

An attempt was made to accurately time the female's periods of on and off the nest. It was found that attentiveness to the nest increased as the time of hatching came closer. The variance in time on the nest is shown in Table II. It is noted that on the second day of incubation, the female showed attentiveness roughly 54% of the time and inattentiveness 46%. In contrast, on the day before the egg hatched, the female was on the nest 76 $\frac{2}{3}$ % as compared to 23 $\frac{1}{3}$ % off. These were all morning observations. The afternoon observations were not of long enough duration to have much validity. The afternoon of the 20th of July, she was on the nest 95.2% and off it 4.8%, but as it rained during this time it was not possible to determine if this long period on the nest was due to the impending hatching of the egg or to the rain. The longest period she was on the nest was 59 minutes and the shortest without being disturbed was one minute. The average time for the incubation period was 15 minutes on the nest and four minutes off.

The female took no definite position on the nest. In a morning I checked her facing nearly every direction of the

compass. Nor does she leave the nest in the same direction each time, though usually her direction of flight was to the southeast. She entered usually from above and to the northwest of the nest. Often, however, there was a preliminary "buzzing" of the blind before she entered so I never was entirely sure just from which direction she arrived.

She was not particularly nervous on the nest despite the fact that I was only a few feet away from it. Occasionally, if I made some movement, she would pause before coming to the nest or before leaving the nesting area to hover before the opening of the blind and chirp rather fiercely as though to inform me that she wasn't particularly pleased with my presence there. She did not seem to be frightened very easily. Several times cars would go on the road underneath the nest and she showed no more concern than a watchful eye. If a person came up the path, however, she usually left much in advance of them. Many times she left before I was aware of their presence.

Her actions on the nest were much as one would expect. She shifted position often as though the one she was in cramped her and occasionally would reshape the nest or add materials to it. She turned the eggs at irregular intervals, sometimes apparently using her feet, and at other times with her bill.

Sometimes on leaving the nest she would go only to a clump of sumac about 15 feet from the blind where she would perch on the dead branches to preen and scratch herself.

Then she would go down to within a couple of feet from the ground and would flit from place to place, obviously in search of food. At times she appeared to be getting it from the leaves of the lowest sumacs, then from the Pteris and at times she would hover at the flower of the Diervilla. Her favorite perch when somebody came by was the electric light wire which passed near the top of the tree or the guy wire of the blind. Here she would watch proceedings and still be out of danger herself.

The greatest activity she showed and still the longest period that she stayed on the nest was on July 20th, the day before the egg hatched. She was not particular about her nest this day as she added lichens to the outside, picked at some of those already placed and added new down to the inside lining. I could not determine just what the material was except that I was certain she did have a plant pappus. Saunders (1936) states that the plants most commonly used in Allegany Park are: Fireweed, Canada Thistle, Orange Hawkweed, and Rattlesnake Root." Possible it was Hawkweed ~~that~~ she used as it was the only one of these that I noticed in down at this time.

I examined the nest at 8:00 P.M. the evening of the 20th and there were still two eggs, but when Russel Burget checked at 10:45 the following morning, one of the eggs had hatched.

The Young and Its Development

I did not make a check of the daily progress of the young bird in weight or feather development, but certain differences were obvious even from the blind. The day of hatching the young

was naked except for a sparse down over the head and back. The bill was shorter than the head and the eyes were closed. The base of the bill was wide. On the eighth day the eyes were open. They looked like luminescent spots surrounded by concentric rings of leather. Its bill was now a little more than half the size of the head and the upper mandible was a dark shiny black. Pin feathers covered the head and along the sides of the neck down its back. On the 13th day it appeared to be a great deal larger and its beak was now as long as its head. The head now had a varying pattern of brown and tan with what looked like fine broken white lines running through it. The greenish bronze tinge was first noticed on August sixth, sixteen days after hatching. On August 10th a black and white wing pattern was observed. On August 10th the bird looked like an adult. In fact I wasn't certain when I first looked that the female wasn't sitting on the nest. The green reached its head and the feathers had come out on the wing so now it was entirely black. The only bare spot I noticed was a small area at the base of the wing. The tail was rounded and had the black and white pattern of the adult.

Preston Smith (1937) found that the feathers of the back became greenish and the tail feathers appeared as little white sheaths on the 14th day of nest life. The wing feathers were released from the sheaths on the last week and no two wings unsheathed alike. Both wing patterns seemed

to be essentially the same on my bird though I could not observe them very closely.

Activity of the young bird changed along with its change in appearance. On its first day the only noticeable movements occurred when the female came to feed. At this time the young bird would lift its head above the rim of the nest to receive the food. On the eighth day it was moving about in the nest and by the ninth the young was definitely going through stretching exercises. Preening and picking at its body was noticeably early in its nest life. Wing exercises were first noted on the 13th day of nest life.

A comparison of these activities with other nesting studies made on the hummingbird here at the Station will be noted in Table IV.

When the young was small it rested stretched out on the floor of the nest, but when it was big enough it rested its head on the rim of the nest or else pointed it straight up in the air. On very warm days its bill would be open. As it neared the end of the nestling stage, it would reach over the edge of the nest and pick at the branch to which the nest was attached. I also noted awareness of insects at this time and several times I saw it snap at an insect passing by the nest. Usually it missed.

Parental Care

As during the incubation period the female took full charge of the feeding and nest care of the young. As can be noted in Tables V and VI the brooding period declined in relatively the same degree as it increased during the incubation period. It will also be noticed that brooding stopped on the ninth day in both nests studied during 1947.

The feeding process was an interesting one to watch. She would perch on the rim of the nest with her bill braced against the branch on which it was saddled or on the very bottom of the nest, much in the same manner as a woodpecker braces itself before it enters the nest hole. There was no begging by the young as is noticed in most other birds. Its one reaction was to open its beak. Stimulation for this was usually the touch of her feet on the rim of the nest though sometimes the young birds mouth would open at the sound of her wings overhead. Her target was the orange lining of the mouth. She would first move her head from side to side and then probe the very bottom of the young one's throat. When the bird was first hatched it looked as though she would go all the way through. As her bill would come out the young bird would grasp her bill and both birds would go through a series of pumpings. I believe it is at this time that the food is passed. It may have been that during the first few days the food is sent directly into the throat of the young bird as the tug of war between the young and the old bird was not noted at that time. The number of times that she regurgitated during each feeding varied between three and seven times. At times

it seemed necessary to probe the side of the young bird's bill before he would respond by opening his mouth. On the last day it was noticed that the young bird refused the offer of food though she tried to probe its bill. In observing Eyer's nest, I noted that the young birds' throats seemed to be more relaxed than the one in my nest. Not enough observations were made, however, to validate this.

The female may have had something to do with nest sanitation during the early part of the life of the nestling, but later the young one would evacuate over the sides of the nest much as in the birds of prey. This evacuation was not noted until the ninth day. Whether the female picked out the droppings from the nest beforehand could not be ascertained though she did pick things from the bottom of the nest and eat them. This could have been bits of the egg shell, however, as no remnants were found after the nest was collected. It seems improbable that a bird as small as the new-born young is, could accomplish this type of evacuation. Brent (1940) cites a reference describing the female as laying the droppings in a row on the next branch.

After the ninth day the female became very wary and suspicious compared to the incubation period and the first eight days of nest life. Outside of feeding she was seldom near the young. She did not brood even during a very heavy rain. On the 20th day, however, she again appeared at the nest and for awhile I thought that she would again start brooding. I started observing at 8:00 AM August

10th and though the female was back a couple of times, no unusual movements were noted until 8:25 when after feeding (she seemed to have more trouble than usual) she left the nest, hovered at a leaf above the nest, came back and sat on the edge and picked something from the bottom of the nest and ate it. Then she picked at the feathers of the young bird. She then entered the nest and half-covered and half shared the nest with the young. This only lasted a moment and then she left. The young bird went through a series of preening and wing exercises and this was the first time I heard the hum of the wings or a chirp from the small bird. She repeated this performance at 9:04. At 9:42 she was back and this time completely covered the body of the young bird, but only for a few seconds. She was back at 10:55 and this time did not leave the vicinity, but would perch on the nest, then hover at a leaf and come back and watch the young bird. She left at 11:18, but was back at 11:44 and repeated the hovering and short flights. She made 15 series this time until she left at 11:55. In the afternoon the performance was repeated. Sometimes in her hovering she would touch the young with her body and once she came and sat crosswise over him. Once while she picked at his feathers, he returned the action by picking at hers.

I was unable to observe on the next day, but at 1:42 on August 11th when H. Lewis Batts, Jr. opened the blind to take a picture of the young bird, it rose from the nest and left.

Though I searched the vicinity that afternoon, that night, and the next morning, I did not come across the young bird or the female again. However, in the studies made by Preston Smith (1937) and by Eyer (1947) the young stayed around the nest for several days and were fed by the female. Sandve (1943) was unable to locate the young after leaving the nest.

Discussion

Several interesting problems present themselves during such a study. Some of them are unanswerable and others can be answered at least partly by conjecture. Questions that arise include:

1. Where are the male hummingbirds at this time?
2. How far does the female range in her trips for food? Is her feeding territory fixed or does she vary her feeding grounds? We know, in part, that they visit different parts of the Station, but whether the visits to the cabin flowers were side trips or part of a regular path is not known.
3. Is the first food of the young bird nectar or insects or both? There seemed to be a difference in the manner of feeding.
4. Is nest sanitation taken care of wholly by the voiding over the nest or does the female take care of the fecal material the first few days?
5. What purpose was shown by the actions of the female the day before the bird left the nest? If such actions can be attributed to birds, it definitely appeared as though she was coaching or at least encouraging the bird

to leave the nest. The fact that the bird left the next day when the nest was approached does not necessarily indicate that he had not left previously or that the coaxing she did had not stirred up the instinct in the bird. I have never seen this action described in the hummingbird in print so I have no way of telling whether this is the usual procedure or just an idiosyncrasy in this particular bird.

6. Did the fact that there was only one bird in the nest speed up its development in the nest? Did it get the same amount of food as both of them would have gotten had the other egg hatched? Something might be significant in the fact that the nest that was studied by Lester E. Eyer had two birds and it took 29 days for the first one to hatch while in this nest with only one bird there was only a 21 day nesting period. Using 14 days as an incubation period, the first egg in the Eyer nest was laid on July 3 compared to July 6 or 7 for the first egg in this nest. So the weather and feeding facilities offered to the females were approximately the same.

7. Do dead branches answer a requirement in the choice of nesting site?

These and other questions indicate that a much more intensive study of the nesting of the hummingbird is necessary.

Summary

1. A nest of the Ruby-throated Hummingbird (Archilochus colubris (Linnaeus)) was kept under observation from July 7 to August 11, 1946. The work was carried on at the

University of Michigan Biological Station, Cheboygan County, Michigan as a special problem under Dr. O.S. Pettingill, Jr.

2. The nest was located in a paper birch (Betula papyrifera) at the end of a slightly slanted branch extending over a road. The nest was saddled in a crotch about four feet from the end of a branch about 12 feet above the ground. It fitted the requirements for a Ruby-throat nesting site as stated in Saunders (1936).

3. Feeding territory was not determined, but the only territory that the bird seemed to aggressively defend was the nesting tree itself. Aggressiveness was observed three times.

4. The nest was made of a lichen covering, bud scale bulk, and inner lining of plant down. It was fastened to the branch by spider silk. The dimensions were: outside 43 mm. long x 33 mm. wide; inside diameter was 29 mm. x 20 mm. ; outside depth 26 mm., inside depth 18 mm. Nest construction was continued during the incubation period.

5. The nest was found on July 7, 1947 by Mrs. R.L. Burget. At that time there were two eggs in the nest.

6. One egg hatched on July 21, 14 days after the nest was located. Only one egg hatched, the other remaining in the nest the whole period.

7. Incubating attentiveness to the nest gradually increased until the day the egg hatched. The first day of observation showed attentiveness of 54% to 46% inattentiveness while on the last day the female was on the nest 95.2% compared to 4.8%.

8. The female was not particularly nervous on the nest. Nervousness seemed to increase during the brooding period.

9. Progress in the development of the bird seemed great in comparison to the size of the bird at first hatching.

10. Voiding was noticed on the ninth day and at least from this time on, nest sanitation was taken care of this way.

11. As the incubation period increased the time spent by the female in brooding decreased from 62% brooding to 38% inattentiveness on the first day to no brooding at all on the tenth day.

12. Feeding was carried on solely by the female. The method of feeding was by regurgitation and the young bird was fed on the average of every 42 minutes.

13. The female showed marked attention to the nest on the 20th day and it appeared as though she was trying to coax the bird off the nest.

14. The young bird left the nest at 1:42 August 11 when pictures were attempted. It rose directly from the nest, and was not observed again.

15. Comparison is made with several other nests studied on the station area. Tables I, III, IV, V, and VI are all tables of comparison.

16. Many interesting problems arise, showing a definite need for an intensive study of the Ruby-throated Hummingbird.

Table I

A Comparison of Nesting Sites in Hummingbird Nests Studied
at the Biological Station

Date	Person	Tree	Height	Position of nest
1937	Smith	<i>Quercus borealis</i>	12'	attached to side of limb
		<i>Fagus grandifolia</i>	15'	--
		?	18'	--
* 1939	Duer	Elm	11½' 12 12½'	Saddled on branches less than an inch in diameter.
1940	Prockiw	<i>Betula papyrifera</i>	17	Horizontal limbs which bent downward
		<i>Acer saccharum</i>	12	
1943	Sandve	<i>Betula papyrifera</i>	22	Branch ½" in diameter and saddled to a smooth limb
1947	Eyer	<i>Betula papyrifera</i>	26	Straight part of branch
1947	Hofslund	<i>Betula papyrifera</i>	12	Branch ½" in diameter. Saddled in a crotch of a slightly drooping branch.

* One of the branches raised slightly rather than drooped.

Table II
Incubation Attentiveness for Hofslund Nest

Beginning July 9

Date	Time	Length of Observation		Temp. (F)		Average Time Interval		Percent	
		Hours	Min.	Max.	Min.	Minutes Attent.	Minutes Inattent	Attent.	Inat
July 9	AM	3	26	75	61	4.3	3.6	54.1	45.9
13	AM	2	40	90	59	7.1	2.6	62.5	37.5
15	AM	1	50	80	63	9.1	4.4	66.3	33.6
16	AM	2	13	83	66	20.0	6.0	75.1	24.8
16	PM	1	31	100		10.0	6.0	58.2	41.8
20	AM	3	45	69	54	11.5	3.6	76.6	23.2
21	AM	1	10	64	51	10	13.4	95.2	4.8

Explanation of Table II

Using 14 days as the length of the incubation period, these observations are considered to have begun on the second day after the egg was laid. The percent of attentiveness is the relationship of the total amount of time spent on the nest during an observation to the total time of the observation. The percent of inattentiveness is computed similarly. The maximum and minimum temperatures are recorded at 7:00 AM and 7:00 PM Eastern Time.

Table III
Nesting Success as Shown in the Hummingbirds Studied
At the Biological Station

Date	Person	Eggs	Number Hatched	Number Left the Nest
1937	Smith	2	2	2
1939	Duer	2	?	1
		2	?	?
		2	?	?
1940	Prockiwi	2	2	1
		2	2	2 #1
1943	Sandve	2	2	2
1947	Eyer	2	2	2 #2
1947	Hofslund	2	1	1

#1 One bird was caught and an attempt was made to rear it, but it died at the end of three days.

#2 The second bird had not left the day after the first at 11:26 AM and it had the appearance of being sick. The mother fed it on the nest.

Table IV
A Comparison of Activity of the Young Birds in
Hummingbird Nests Studied at the Biological Station.

Date	Person	Number of Birds	Movement	Stretching and Preening	Wing Exercise	Left Nest (Day)
1937	Smith	2	--	--	14	21
*1939	Duer	1	--	--	--	16
1940	Prockiwi	1	16	--	--	19
1943	Sandve	2	11	15	17	21
1947	Eyer	2	8	9	10	29
1947	Hofslund	1	8	9	13	21

*Picture of young bird was shown outside nest with caption of 16 days, but it was not stated that the young flew from the nest or merely crawled out.

Table V

Brooding Attentiveness for Eyer Nest Beginning
The First Day After the First Young was Hatched.
July 18

Date	Time	Length of Observation		Weather Sky	Temp (F)		Average Time Interval		Percent Att. Inatt.	
		Hours	Min.		Max.	Min.	Att.	Inatt.	Att.	Inatt.
July 18	AM	2	25	cloudy	75	56	23.0	3.7	86.0	14.0
	PM	1	37	clear			22.0	3.2	87.0	13.0
20	AM	2	31	cloudy	69	54	15.0	6.1	71.0	29.0
	PM	1	15	cloudy			10.0	7.7	56.0	44.0
22	AM	1	05	clear	70	49	9.5	3.3	74.0	26.0
23	AM	2	58	clear	77	50	10.5	7.4	58.0	42.0
	PM	2	38	clear			12.0	8.8	42.0	58.0
25	AM	3	20	clear	85	63	12.0	20.0	37.0	63.0
	PM	1	21	clear			3.0	38.0	07.0	93.0
27	PM	2	00	Hot	76	64	0.0	0.0	00%	100.0%

For explanation of percent of attentiveness and inattentiveness see explanation of Table II.

Table VI

Brooding Attentiveness for Hofslund Nest Beginning

Date	Time	Hours	Minutes	July 21		Av. Time Int.		Percent	
				Temp. Max.	Temp. Min.	Att.	Inatt.	Att.	Inatt.
21	AM	1	28	64	51	55	32	62	38
22	AM	3	03	70	49	107	76	58	42
	PM	1	59			79	40	66	34
27	AM	1	52	76	64	24	28	46	54
* 30	AM	1	52	91	75	2	110	1	99

* After this first two minute brooding she was not seen to brood again.

Table VII

Date	Day	Feeding Activity		No. of Feedings	Av. Time Between Feedings
		Time Observed			
July 21	1	1 hr. 20 Min.		4	22 Min.
22	2	4	8	6	41
27	6	1	10	2	35
29	8	2	35	4	44
30	9	1	52	3	37
Aug. 3	13	3	30	3	70
5	15	2	30	4	37
6	16	2	05	3	41
10	20	5	36	6	56

Average time between feedings was slightly over 42 minutes.

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A Breeding Behavior Study of the Ruby-throated Hummingbird

By Pershing B. Hofslund

A nest of the Ruby-throated Hummingbird, *Archilochus colubris*, was kept under observation for a period of five weeks (July 7 to August 11) during the summer of 1947. The study was made at the University of Michigan Biological Station, Cheboygan County, Michigan, as a special problem under the direction of Dr. O. S. Pettingill, Jr.

Observations were made from a tower blind erected about six feet from the nest. Forty-nine hours were spent in direct observation from the blind, and many additional hours were spent in observing the female away from the nest.

Nesting Site and Nest Structure

The nest was located in a paper birch, *Betula papyrifera*, on a horizontal branch extending over the road. Saddled on a crotch of the branch about 12 feet from the ground, its location agreed in all respects with the characteristics of the Ruby-throated Hummingbird's nest site as given by Saunders (1936). It projected over an open space; it was attached to a limb less than an inch in diameter, the limb slanting slightly downward; and it was sheltered from above by a canopy of branches and leaves. One other notable point about the nesting site was the importance of the dead branches to the female. Constant use of the dead branches was made when preening or watching; seldom, if ever, did she use a leaf-covered branch.

Because the nest was discovered after completion, no observations were made on the behavior of the hummingbird during mating or nest building. Bent (1940) says, "In the experience of almost all observers the female parent builds the nest . . . unaided by her mate." Bent cites Walter's interesting observation of a male aiding in nest construction during the first day.

The bulk of the nest was of bud scales, covered on the outside with lichens, and lined with plant down. It was fastened to the branch with spider silk. Outside diameter was 43 x 33 mm and the inside diameter 29 x 20 mm. The outside depth was 26 mm, the inside depth 18 mm.

The nest was sturdy; at the end of 35 days of constant use it was in almost perfect condition. Just what the activity of the single nestling had to do with this is open to question. A nearby nest containing two nestlings during the same period (Eyer, 1949) was rolled out and flattened like a platform instead of being cup-shaped.

Nest construction continued during the incubation period with occasional bits of lichen being added to the outside of the nest. The day before the egg hatched the female added to the lining, and with movements of her body and tamping with her feet, she reshaped the outline of the nest.

Aggressiveness and Defense

The female apparently defended only the nest tree. A Kingbird nested in the adjoining tree, and a nearby Juneberry, *Amelanchier canadensis*, was a feeding station for many birds. The presence of these birds apparently did not disturb her.

Aggressive behavior was observed only three times. The evening the blind was erected the Hummingbird became very excited, diving at one of my helpers and pecking him on the nose. Once she was observed to leave the nest in pursuit of a passing Hummingbird, and once she attacked a Robin that lit in the nest tree, taking after the intruder like an enraged bumblebee. She dashed as close to the Robin as she dared, swinging back and forth in front of him like a pendulum. The Robin was obviously startled. Everytime the Hummingbird swung past his head he would snap his beak as though trying to catch an irritating insect. Finally the Robin left and the female returned to the nest.

The Incubation Period

The nest was found by Mrs. R. L. Burget at 7:00 P. M. on July 7. At that time it contained a full clutch of two eggs. The hatching date was July 21, just 14 days after the discovery of the nest. Bergtold (1917) cites three references giving the incubation period as 14 days. One egg did not hatch. It remained in the nest throughout the period of observation, and was collected along with the nest on August 15, 1947. It measured 13 x 7 mm.

Incubation was entirely by the female. During the five weeks of observation only one male was seen, some five miles away from the nesting site.

Attentiveness at the nest increased as the time of hatching approached. On the second day of observation (presumably the second day of incubation) the female was attentive 54 percent of the time and inattentive 46 percent of the time. In contrast, on the day before the egg hatched the female was on the nest 77 percent and off 23 percent of the time. These were all morning observations. Most of the afternoon observations were for short periods only, but it is interesting to note that on the afternoon of the day before the egg hatched, the female was on the nest 95 percent of the time of observation. The longest period on the nest was 59 minutes and the shortest period was one minute. The longest time off the nest was 21½

minutes. The average for all observations during the period of incubation was 15 minutes on the nest and 4 minutes off.

The female took no definite position on the nest. In a morning I could check her facing in nearly every direction of the compass. Her most frequent direction of flight from the nest was to the south. She usually returned from above and from the northwest. Often she would make a preliminary "buzzing" of the blind before alighting on the nest. Sometimes on leaving the nest she would go directly to a clump of sumac, *Rhus glabra*, about 15 feet from the blind where she would perch on the dead branches to preen and scratch herself. Her favorite perch when frightened from the nest was a wire that passed near the tree, or the guy wires that anchored the blind.

On the day before the egg hatched, the female was very active about the nest as she added lichens to the outside, picked at some of those already placed, and added new down to the inside lining.

The Nestling Period

Even from the blind certain differences were obvious in the development of the young bird. The newly hatched bird was blind, naked except for a sparse down over the head and back, and with a bill shorter than the length of the head. By the 8th day the eyes were open and pin feathers covered the head and dorsal tract. The bird was noticeably larger by the 13th day, with a beak as long as its head, and a head pattern of varying brown and tan with fine, broken, white lines running through it. The greenish-bronze plumage did not appear until August 6, 16 days after hatching. By August 10th, the young bird was almost indistinguishable from the female.

Activity of the young bird changed along with its appearance. On its first day the only noticeable movements occurred when the female came to feed. At this time the youngster would raise its head to receive food. On the 8th day it was moving about the nest, and by the 9th the young bird was going through stretching exercises. Preening was noticeable early in its nest life. Wing exercises were seen first on the 13th day. As it neared the end of the nestling stage the young bird would reach over the edge of the nest and pick at the branch to which the nest was attached. It was aware of insects at this time, and would often snap at them. Usually it missed.

Brooding lasted from the day of hatching until the 10th day of the nestling's life when the female concerned herself only with the feeding of the nestling.

The feeding process was an interesting one to watch. The female would perch herself on the rim of the nest with her

tail feathers braced against the nest branch or against the nest, much as a woodpecker braces itself before its nest hole. There was no incessant begging by the young bird. Stimulation for the opening of the beak was the touch of the female's feet on the rim of the nest. She would first move her head from side to side and seemingly probe the very bottom of the nestling's throat. As the parent withdrew her bill the young bird would grasp it and both birds would go through a series of pumpings. It is at this time that the food is apparently exchanged. It may be that during the first few days the food is placed directly into the nestling's throat, because the "tug of war" was not noted until later. If the young bird did not respond to the first stimulation, the female had to probe the side of the nestling's mouth before it would respond. On the day before the bird left the nest, it was not stimulated to feed even by the touch of her bill. The number of times that the female regurgitated during each feeding varied between three to seven times. The average time between feedings was slightly over 42 minutes.

The female may have something to do with the nest sanitation during the first few days of the nestling's life, but after the 8th day the young one would evacuate over the sides of the nest much in the manner of birds of prey. The female appeared to pick up and eat droppings from the bottom of the nest during the first few days, but this could not be ascertained for sure. Bent (1940) cites a reference describing the female as laying the excreta in a row along the nest branch.

After the 9th day the female became more wary and suspicious than was noted in the earlier stages. Except when feeding she was seldom near the nestling. She did not brood even during a heavy rain.

I started observing at 7:00 A. M. on August 10, and though the female was back twice, no unusual movements were noted until 7:25. After feeding the young bird with some difficulty, the female left, hovered at a leaf above the nest, and then returned to the nest, half covering and half sharing it with the young bird. A moment later she again left. The young bird went through a series of preenings and wing exercises, and for the first time I heard the hum of the wings and a chirp from the nestling. The female was back at 8:04 and repeated the above performance. At 8:42 she was back again, but this time she covered the young bird's body completely. This lasted but a few seconds. At 9:55 she returned, perched on the nest, hovered at the leaf, and then came back to watch the young bird. She left at 10:18, returned at 10:44, and between then and 10:55 made 15 sorties of the types previously described. In the afternoon the performance was repeated.

I was unable to observe the next day, but at 12:42 on August 11 as H. Lewis Batts, Jr., opened the blind to take a picture of the young bird it rose from the nest and left. Although I searched the area that afternoon, night, and the next morning, I did not come across the young bird or the female. Sandve (1943) was unable to locate a young bird he had been observing after it left the nest.

Summary

A nest of the Ruby-throated Hummingbird, *Archilochus colubris*, was kept under observation from July 7 to August 11, 1947. The work was carried on at the University of Michigan's Biological Station, Cheboygan County, Michigan, as a special problem under the direction of Dr. O. S. Pettingill, Jr.

The nest was located in a paper birch, *Betula papyrifera*, at the end of a slanting branch about 12 feet above a road. It was composed of bud scales, lichens and plant down, and was discovered July 7 by Mrs. R. L. Burget. The nest contained two eggs, one of which hatched July 21. The other egg remained in the nest until it was collected after the young bird left.

Aggressive behavior was noted only three times, and the only territory that the female was observed defending was the nest tree.

Feeding, brooding, and incubation were carried on solely by the female. No male was seen at the nest during the period of observation.

Attentiveness increased gradually until the day the egg hatched. Brooding decreased gradually until the 10th day when it ceased all together. Feeding was by regurgitation, and the young bird was fed on an average of every 42 minutes.

The female showed marked attention to the nest on the day before the young bird left, and it appeared as though she was trying to coax it off the nest. It left at 12:42 P. M., August 11, and was not seen again.

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