

A NESTING STUDY OF THE CATBIRD
(DUMETELLA CAROLINENSIS LINNAEUS)
IN SOUTHERN MICHIGAN

Thesis for the Degree of M. S.
MICHIGAN STATE UNIVERSITY

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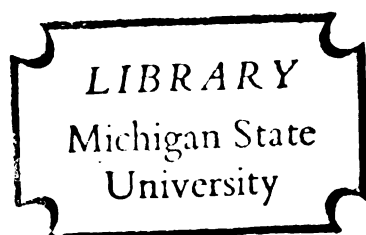
1959

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CATBIRD (DUMETELLA CAROLINENSIS LINNAEUS)
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By

JOHN L. ZIMMERMAN

AN ABSTRACT

Submitted to the College of Science and Arts
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Approved

George J. Wallace

During the spring and summer of 1958 the nesting of the Catbird (Dumetella carolinensis) was studied in Clinton County, Michigan.

Male birds were first observed on May 6, and the females arrived not more than nine or ten days later.

Three songs of the male were discerned and some of their uses determined. No females were heard to sing. Four categories of call notes were variously used by both sexes during the time of the study. The calls of the young while in the nest were also recorded. The male begins to sing shortly before sunrise and has been reported to sing at night. Song cessation occurred during the first week of August and no second song period was observed.

Territories were immediately proclaimed through singing by newly arrived males, and chase-singing clashes occurred between neighbors along the territory boundaries. The male of an established territory exhibited both intraspecific and interspecific defense through distinctly separable behavior, and both sexes attacked non-avian intruders. The territory was defended until completion of the second nesting. The average size of 15 maximal territories was 3.1704 acres (0.315 pairs per acre). There was evidence of the existence of a small reserve of unmated males.

The only courtship display observed was the chase between the male and female.

Both adults carried nest materials during the early days of building, but the female apparently made the site

selection and finished the construction. Locations, dimensions, and heights were determined for 24 nests, and their materials and manner of construction were analysed. Most nests were in brushy uplands, with woodland edge containing the next largest number.

The clutch averaged 3.27 eggs. Egg laying began the day after the nest had been completed, and an egg was laid each morning until the clutch was completed.

Only the female incubated. Incubation time was 14 days for the first egg and 13 days for all the rest in the clutch. The incubation period was 13 days. Incubation did not begin until at least the second egg was laid. Average attentive and inattentive periods were determined and the behavior of the adults around the nest was witnessed and tabulated.

The female apparently contributed to the hatching of the egg by pecking at the shell. Both adults rid the nest of the egg shells by carrying them away or eating them. The adults also ate the smaller bits of shell in the nest and on the natal down of the nestlings.

On the day of hatching, the young weighed 8.45 per cent of the adult weight and by fledging weighed 76.76 per cent. Total length and the lengths of wing and tarsus were taken daily.

The young spent an average of 10.47 days in the nest. Brooding was done entirely by the female. She brooded 53.86 per cent of the observation time the first four days,

26.80 per cent of the time the next four days, only 3.52 per cent the next two, and not at all on the last two days. The drop in brooding was a result of a decrease in the length of each attentive period and the rate of these periods. Brooding fell into three periods during the day. The behavior of the adults was studied closely throughout the brooding period and tabulated.

Both sexes fed the young, but the female did not feed more times than the male until the last two days of nest life. The average interval between feedings was 10.04 minutes. The feeding rate generally increased during the first eight days and then remained the same for the last four.

Fecal sacs were either eaten or carried away. Not until the ninth day, however, were the excreta carried away more often than were eaten. If no fecal sac was voided after feeding, the adult substituted some other behavior 10.71 per cent of all post-feeding periods as compared to leaving immediately 25.30 per cent of the time after feeding.

Only one brood was observed during normal departure; all other broods exploded from the nest when disturbed. Five days after fledging was the latest that the young were found in the immediate vicinity of the nest.

Second nests followed both successful and unsuccessful first nestings, but at a different average elapsed time. There was a change in the size and shape of the territory with the second nest.

Of the 23 nests under observation, 60.87 per cent fledged at least one young. Predation was the major factor in nest failure. No cases of parasitism by the Cowbird (Molothrus ater) were found.

The dispersal of the young during the days following fledging was studied. Flocking of the young and adults was observed on the study area after nesting, but fall departure from the area was not observed.

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INTRODUCTION

Scope and Purpose of the Study

This study is a descriptive investigation of the Catbird (Dumetella carolinensis) in southern Michigan from its arrival in the spring to a period just prior to its departure in the fall with special emphasis on its behavior during the time of nesting.

The Catbird was chosen for study for three reasons: (1) the writer's existing interest in the species, (2) few life-history type studies are to be found in the literature on the Catbird in spite of the fact that it is known to almost any school child, and (3) because of its wide range in North America, it was hoped that there would be an opportunity to make some field studies on the species during a tour of active duty with the United States Air Force that was impending at the time the problem was chosen.

The approach is rather broad, but it is felt that such an approach provided a variety of experiences which might prove valuable upon pursuing further investigations in ornithology.

The field work upon which this thesis is based was carried on during 1958 from March until late September.

Methods of Study

From the last week in March until the arrival of the Catbird in May, reconnaissance trips to select a suitable study area were made at least once a week to the general

area in which it was hoped the study could be conducted. A total of 79 trips was made from May 1 to September 23 to the study area and involved a total of 346 hours and 51 minutes in the field. Of this time 127 hours and 21 minutes were spent in blinds observing the activity around the nests.

Territories, those areas defended by the nesting pair, were mapped out primarily by plotting the various song perches of the male and then marking their location on a map of the area. The presence of non-singing males and females and the movements of the birds were also indicated on the map. Each territory was assigned a letter and each nest was given a number according to the order in which it was found.

Almost all the recorded activity at the nests was observed from blinds placed close enough to allow observation without binoculars.

Since there is no obvious sexual dimorphism in this species, the identity of the sexes had to be determined by behavior. Two assumptions were made to facilitate this determination: that the male would be the individual singing the territory song, that the female would be the individual incubating the eggs. Later in the study, after I had become more familiar with the activities of the birds around the nest, the guarding activity of the male and the use of separate routes to the nest by each of the pair aided in the determination. After deciding the sex by behavior, sometimes a particular aspect of the individual's plumage,

such as a missing or short feather or a color peculiarity, could be used to separate the members of the pair thereafter.

The eggs were marked with dots of red fingernail polish to indicate the order of laying. Weights of the young were taken with a spring-operated platform scale that measured to the nearest gram. Whenever possible weighing was done at about the same time each day, usually between daylight and 0800, and the over-all length and the lengths of wing and tarsus were taken in centimeters at the same time. The nestlings were marked with red fingernail polish on their claws so that individuals could be distinguished in the nest. It was found to be necessary to repaint the young on about the seventh day of nest life.

Nestlings were banded with U. S. Fish and Wildlife Service aluminum bands just prior to their departure from the nest. All the members of a brood were painted with a particular color of butyrate (airplane) dope on the tips of the primaries to facilitate subsequent field identification. Red, yellow, white, green, and brown were the colors used. The young were either painted with a single color on the left or right primaries, or on the primaries of both wings. The young of one brood were painted with one color on the left primaries and a different color on the right primaries. This method of marking the young was quite satisfactory for identification of fledglings and juveniles. No attempt was made to determine whether the painting of the young affected their survival by making them more apparent

to predators or by impeding their ability to fly.

Some adults were trapped and marked. Dripping water as bait in a conventional government sparrow trap, the first method used, was completely unsuccessful. The next method tried was to place the young within the trap on the day of their departure from the nest in hopes that the adults would enter the trap to feed them. This was also unsuccessful, since the adults were satisfied to try to feed the young through the wire mesh of the trap. The third and finally successful method was to place the nestlings at around eight or nine days of age (before they were too active in the nest) in an old nest within the sparrow trap. Since the young did not move to the sides of the trap to be fed, the adults found it necessary to enter to feed them. Once trapped, the adults were also banded with government bands and painted with butyrate dope. In the adults, however, the dope was applied to their tails, either on the tips of the rectrices or on the base of the tail and upper tail coverts. Both adults of a particular nest were marked alike and no distinction between the sexes was made.

Nest height was determined by a plumb line marked-off in feet and inches and was measured from the rim of the nest to a point on the ground directly below. Nest dimensions were taken with a centimeter rule. The means of support of the nest was determined and sketched, and the surrounding vegetation identified and mapped in relation to the nest. The nest was then collected for a later analysis of con-

struction materials.

Acknowledgments

It is with sincere thanks that I acknowledge all those whose interest, help, and advice aided me in this investigation. In particular I wish to thank Dr. George J. Wallace for his willingness to talk over any aspect of this study, for his advise, and for his constructive criticism during the preparation of this manuscript. I am also indebted to the other members of my committee, Dr. Phillip J. Clark and Dr. Roland L. Fischer, for their advise and help in reading and criticizing this thesis.

I am grateful to Dr. C. T. Black, Director of the Rose Lake Wildlife Experiment Station of the Michigan Department of Conservation, for his permission to conduct the field work on the station grounds and for the use of an aerial map of the study area. I likewise express my thanks to Mr. and Mrs. Eber D. Keeney for permission to observe the nests that occurred on their property and also for their interest in this investigation.

I would like to acknowledge the correspondence received from Mr. Walter P. Nickell of the Cranbrook Institute of Science, Bloomfield Hills, Michigan, concerning the nest building activities of the Catbird.

I thank Mr. Roger M. Knutson of the Department of Botany and Plant Pathology for his aid in the identification of plant material collected on the study area.

I am also indebted to Dr. Robert C. Ball of the

Department of Fisheries and Wildlife for the loaning of the planimeter used to measure territory size.

Great credit is due to my wife. Her personal sacrifice, help, and encouragement contributed greatly toward the completion of this study and the preparation of this manuscript.

DESCRIPTION OF THE STUDY AREA

Location

The study area was centered in the northeast quarter of section 24, Bath Township, Clinton County, Michigan, about 12 miles northeast of Lansing on the Rose Lake Wildlife Experiment Station and the adjacent property of Mr. Eber D. Keeney. It covers approximately 306.78 acres (0.479 square miles or 124.15 hectares).

Vegetation

Vermilion Creek flows in a northerly direction through the western half of the study area. The vegetative cover is approximately 1/4 deciduous woodland, 1/4 woodland edge, 1/8 Cornus-Carex lowlands, and 3/8 uplands of fallow pasture, brushy abandoned fields, and several cultivated plots. There are three small stands of red pine (Pinus resinosa) and white pine (P. strobus) on the area. Figure 1 illustrates the distribution of these habitats.

The deciduous woodland is for the most part concentrated in the flood-plain of Vermilion Creek. The major co-dominants in the overstory stratum are American elm (Ulmus americana), red maple (Acer rubrum), and white ash (Fraxinus americana). Shagbark hickory (Carya ovata), swamp white oak (Quercus bicolor), and basswood (Tilia americana) also contribute to the overstory. The understory includes blue beech (Carpinus caroliniana) and wild black cherry (Prunus serotina) in addition to some small

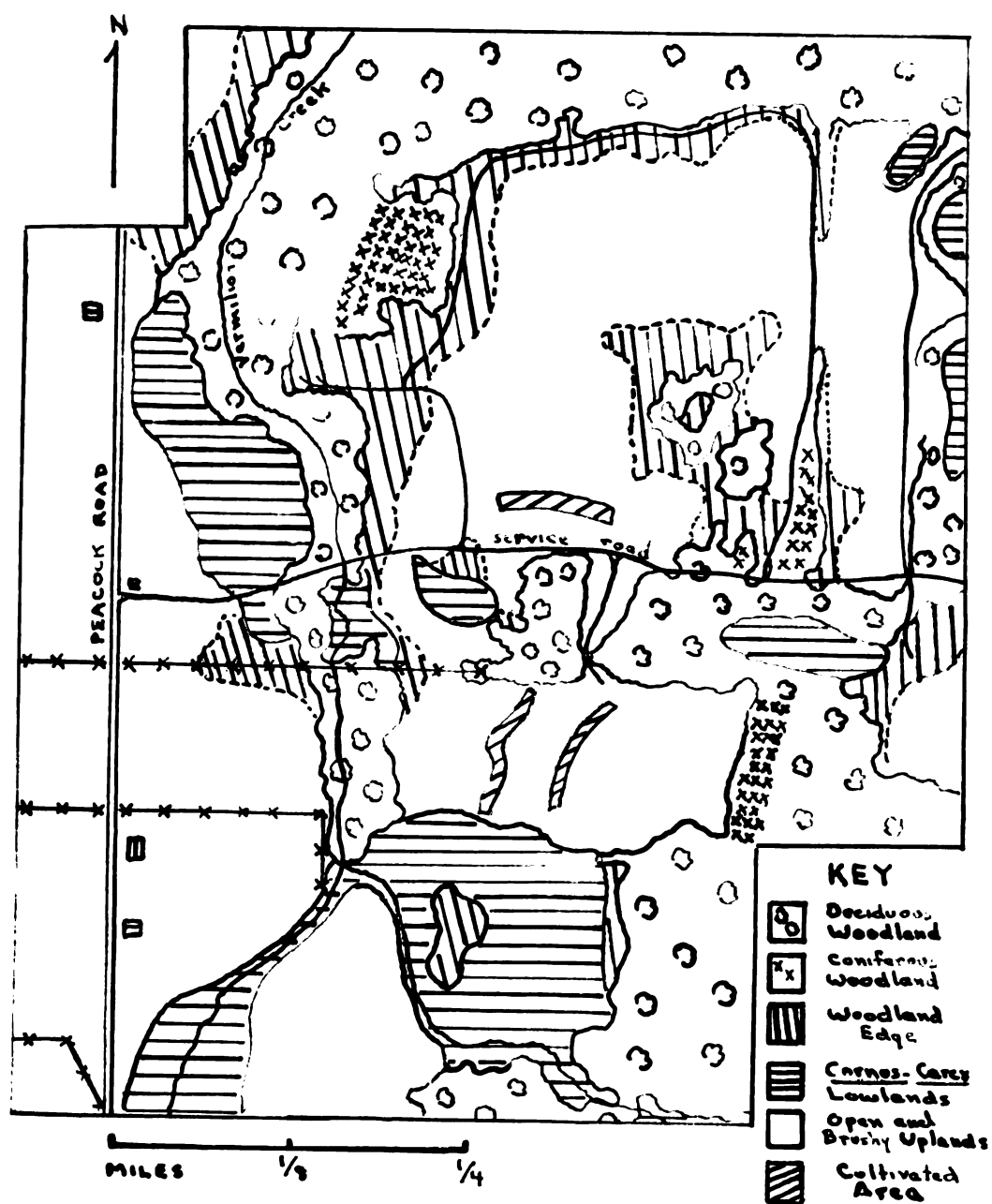


FIGURE 1

MAJOR HABITAT DISTRIBUTION

specimens of those mentioned above. The shrub level was not well developed, silky dogwood (Cornus amomum) being a major constituent. The herbaceous level was not particularly noted except through the discomfort brought on by various nettles and because of the striking color of the cardinal flower (Lobelia cardinalis) in late summer.

Smaller deciduous wooded areas on higher ground contain red oak (Quercus rubra), black oak (Quercus velutina), trembling aspen (Populus tremuloides), and black locust (Robina pseudo-acacia).

Woodland edge is best developed along the eastern border of the woodland along Vermilion Creek in the northwest quarter of the study area. American elm is extremely abundant with wild black cherry, black locust, box elder (Acer negundo), pignut hickory (Carya glabra), and cottonwood (Populus deltoides) also occurring. Shrubby growth is primarily silky dogwood, but multiflora rose (Rosa multiflora), prickly ash (Xanthoxylum americanus), raspberries and blackberry (Rubus spp.), and shrubby St. John's wort (Hypericum spathulatum) also are present. Grape (Vitus sp.) is quite common, often completely covering many small elms. Poison ivy (Rhus radicans) is also present in localized areas. The herbaceous aspect is mainly of various grasses, vetch (Vicia sp.), wild bergamot (Monarda fistulosa), white sweet clover (Melilotus alba), hawkweed (Hieracium sp.), common milkweed (Asclepias syriaca), and soapwort (Saponaria officinalis).

The low area between Peacock Road and Vermilion Creek north of the service road was wet during the early part of the summer but became drier toward late summer. Sedges (Carex spp.) are the dominant herbaceous plant, while silky dogwood is the major woody plant. Willows (Salix spp.) red-osier dogwood (Cornus stolonifera), panicled dogwood (Cornus racemosa), and white elder (Sambucus canadensis) are also present.

The low areas in the southern portion of the study area are primarily stands of sedge with shrubby growths of willow, panicled dogwood, and hawthorne (Crataegus sp.) along their borders. These were quite wet in the spring, but by late summer were very dry except immediately along the channel of the creek.

Some other scattered low areas also contained button-bush (Cephalanthus occidentalis) and poison sumac (Rhus vernix).

The open fallow pastures are primarily herbaceous with various grasses predominating. Pussy-toes (Antennaria sp.) common milkweed, various asters (Aster spp.), white sweet clover, wild bergamot, dewberries (Rubus sp.), soapwort, goldenrods (Solidago spp.), common mullein (Verbascum thapsus), and vetch are also present. The following trees and shrubs characterize the brushier abandoned fields: American elm, wild black cherry, sassafras (Sassafras albidum), wild crab (Fyrus ioensis), stag-horned sumac (Rhus typhina), honeysuckle (Lonicera sp.), silky dogwood,

and multiflora rose.

The cultivated area just north of the service road was planted in corn, while the two narrow strips south of the service road were planted with an unidentified cereal grain.

Soil and Topography

The study area is undulating to hilly with the highest elevation in the fallow pasture just north of the corn field. The land slopes down from this point in all directions, dropping most rapidly toward the south. There is an abrupt cliff-like drop down to the floodplain of Vermilion Creek just within the east boundary of the woodland in the northwest section. This becomes more gradual to the north and disappears to the south just before the service road. The uplands are well-drained Plainfield sand and Oshtemo sandy-loam. The floodplain soils have a high proportion of muck along with alluvial soils.

Uses of the Area

The area is used by the state conservation department for game management studies, particularly as they relate to farm conditions in southern Michigan. A field archery course occupies the area along the east edge of the woodland along Vermilion Creek, both north and south of the service road. One of the author's blinds was set up a few feet to the side of one of the archery targets and was used with some anxiety when it was known that archers were on the course. There are also camping and picnicing facilities in the study

area which were used by both day and overnight camping groups during the summer.

ARRIVAL IN THE STUDY AREA

Barrows (1912) states that the Catbird may arrive in the southern counties of Michigan as early as April 10, but more often it is first observed between April 20 and the end of the month. Wood (1951) gives the period of usual arrival as the last week or ten days of April in the lower peninsula. From the observations of Dr. J. W. Stack and Dr. George J. Wallace, the Catbird can be expected in the East Lansing area during the last week of April or the first week in May.

In the spring of 1958 Catbirds were first observed in the East Lansing area on the evening of May 1 and in the Park lake area, approximately three miles southwest of the study area, on May 3. There were no Catbirds on the study area on May 1, but they had arrived by the next visit to the area on May 6. All of these birds were singing males. Bent (1948) writes that the female arrives a few days after the male, and Charles (1954) states that a period of eight days elapsed from the first arrival until the species became plentiful, which could reflect the arrival of females on her study area. Females were first observed in the Park Lake area on May 13. None were observed on the study area on May 3, but were observed on the next trip on May 15. The female then does not arrive with the male, but follows by not more than nine or ten days.

From banding returns Gill (1934) has shown that the older birds arrive back on the nesting area first - the older the bird, the sooner it returns in the spring.

SONGS AND CALL NOTES

Songs

The song of the male is described by Saunders (1935) to consist "of a great variety of phrases, with short pauses between them. The phrases ordinarily contain from two to six notes each, but groups of notes within the phrases are not repeated." A series of phrases may be up to ten minutes in length with pauses of from 1 to 4 seconds every 5 to 30 seconds. The phrases are usually not repeated but occasionally are. On two instances a particular phrase was repeated numerous times, being very suggestive of the Mockingbird's (Mimus polyglottos) song pattern.

I observed no instances of what I could consider mimicry, although some phrases were suggestive of the songs or call notes of other species. The Catbird has been reported by several authors to mimic many other species of birds and also the call of the tree toad (Hyla sp.); vide: Bailey (1912), Burns (1899), Forbush (1929), Russell (1929), Saunders (1935), Townsend (1924), and Weydemeyer (1930). Todd (1940) states that only occasionally will the Catbird assume the role of mimic, but that it will sing "snatches" of other songs.

This song described above, referred to in this paper as "the normal-volumed song" is used in territory proclamation and defense and perhaps as an outlet for excess energy, as suggested by Nice (1943) and others. The male continues to sing this song throughout the nesting period, but it is

used most frequently during territory formation, mating, nest building, and the early days of incubation in the first nesting. Apparently unmated males continue to sing this territory song at a greater frequency throughout the nesting season until general song cessation during the first week of August. Males on territories that followed the first nest with a second nesting increased their use of the full length normal-volumed song soon after the young had left the first nest and on into the early days of incubation of the eggs of the second nest. As in the case with their first nesting, this song was heard throughout the period of their second nesting, but it was heard less frequently and was often of shorter duration than the territory song of spring.

There are two modifications of the normal-volumed song used by the male. They differ from the territory song in that they are shorter and of lower volume, but utilize the same sound and pattern. One I have termed the "quiet-song" which is sung with the bill barely open. It was first heard on May 15 when I recorded the following notes regarding it:

"Singing of a soft song by a Catbird one foot above the ground in the aspens at road fork.....began quiet song again - bill barely open, gular movement..
.....tail down, back and rump fluffed, tail flipping slightly - really sort of a consistently vibrating tail."

This song was used by the male as a signal song later in the season as he approached the nest, although a short normal-volumed song was also used in this situation. The

quiet-song is also used in connection with territory defense when the male was in close proximity to the intruder.

The other subdued variation of the normal-volumed song is the "whisper song", which is sung with the bill completely closed and is lower in volume than the quiet-song. Saunders (1935) states that the whisper song is used after the main season is over and is audible for only a few feet. Bent (1948) reports that the whisper song is most often heard in autumn but has been recorded throughout the year. In this study it was most often heard being used by the male at his guard perch as the female approached the nest. Some males, particularly the male of Territory J, also sang a whisper song immediately after feeding the young, right after assuming the guard perch.

Call Notes

There are four categories of call notes: the "mew", the "quirt", the "quitt", and the "ratchet-call".

The mew note shows the most variety in volume, tone, and quality. This is the note from which the bird gets its common name. The Chippewa Indians called the Catbird "Ma-ma-dive-bi-ne-shi", meaning "the bird that cries with grief", again referring to this particular call note. Herrick (1901) described it as a "tshay", given as the observer set up his blind. Herrick also heard this call note given during "cautious explorations in the vicinity" by the bird. The mew is included as a part of the territory song of the male. The male also gives a thin-sounding, wheezy variation prior

to the chase in intraspecific defense; perhaps this particular use is as a threat-call. The female often approaches the nest giving soft or soft, wheezy mews; both male and female also give the mew at normal volume and quality in the vicinity of the nest. The mew is used almost to the exclusion of any other songs or call notes around the nest during the last two days before the young are fledged. Loud, emphatic mews are used by both sexes in defense of the nest from intruders. There are many other occasions when the mew is used, to which I cannot attach any particular behavior. The mew is the most used vocalization after song cessation in the early fall.

The quirt is given by both sexes and is perhaps a threat note. Bent (1948) describes it as "a low mellow cluck, like the soft quack of a duck.....giving the impression of being uttered way back in the throat". He states that it is a note of minor alarm. It was used whenever I was in the vicinity of the nest or fledged young, and loud quirts were given when I was at the nest itself. Quirts were also heard in the episode referred to later at nest No. 15 while the adults were attacking a blue racer (Coluber constrictor). Like the mew, however, it was often also heard in situations for which I could not determine from my observations the specific behavior correlated with it.

The quitt also is used by both sexes and was heard only around the nest. It apparently is a communication call between the sexes, used by both of them as one of the pair

approaches the nest while the other is there. The male uses it as a signal song, along with the quiet-song, as he approaches the nest, but there is considerable variation in this usage. The male of nest No. 12 seldom used the quitt call, but usually sang the quiet-song; whereas the male of nest No. 19 seldom used the quiet-song but usually did use the quitt call. As the male approached, the female usually began to quitt while she was still on the nest.

Bicknell (1884) described what I call the ratchet-call as "a short, crackling sound, like the snapping of small faggots", and Bent (1948) mentions it as a "harsh, sharply enunciated chatter, rather wren-like". To me, however, it sounded more like the sound made by a ratchet noise-maker twirled in the hand by children at parties and adults on New Year's Eve. This certainly is an alarm note. It is given by the Catbird as it flies to cover, and was given by several birds as I held them in my hand while banding them. I also once recorded an adult to give this call when the young gave an alarm note while being banded.

The only notes I heard given by the young while in the nest were the food-begging calls. They are best described as a series of "seep-seep"s or "pssp"s. They are either given in a series or singularly, and increase in volume with the age of the nestlings. The young of nest No. 3, 12 days since fledging, still gave this food-begging call, perhaps now also serving as a location call note. Young at least a week to a week and a half out of the nest were also heard

to give a loud metallic "tsip" note suggestive of the call note of the Indigo Bunting (Passerina cyanea); they also could give a wheezy-sounding mew.

First Morning Song and Night Singing

The male Catbird begins to sing shortly before sunrise. Allard (1930) found that the first morning song follows the time of civil twilight quite closely, occurring both before and after this time in May and early June and then usually only after civil twilight in late June, July, and August. There have been reports of the Catbird singing at night. Bent (1948) records the observation of Francis H. Allen that the song phrases are farther apart at night. Vaurie (1946) mentions a Catbird singing for over an hour in complete darkness at 2100, and Pierce (1922) observed a bird singing in the moonlight at midnight. The habit of night singing is well known in the Mockingbird.

Singing by Female

At no time did I hear the female sing any song similar to the normal-volumed, quiet-song, or whisper song. Whittle (1923), however, reports a female singing the whisper song while on the nest.

Song Cessation

The males arrive during late April or May in song and continue to sing until the first week in August. Dates in the literature for song cessation are July (Todd, 1940), mid-July (Trautman, 1940), July 26 (Mehner, 1952), August 3

(Vaurie,1946), August 7 (Fry,1916), mid-August (Bicknell, 1934), and also mid-August (Charles,1954). Both Vaurie and Todd correlate this cessation of song with the onset of the postnuptial molt. Eaton (1914) in New York and Charles (1954) in South Carolina record a second song period occurring in the fall. No second song period was observed in this present study.

TERRITORY

Establishment

The territory provides the necessary cover for the nest site and a certain amount of space for the unkindered completion of nest-related activities. It also provides song perches for the proclamation of the territory by the male. Most of the food of the adults and the young is also gathered within the territory, although on a few occasions during the nestling stage adults were seen to collect food outside of the territory. Most territories had no water supply, so it is assumed that most adults must leave the territory to drink and bathe. Figure 2 illustrates the territories maintained on the study area during 1958.

Arriving in full song, the male immediately proclaims an area as his territory. Singing of the normal-volumed song is the primary means of territory announcement. Males sing from exposed perches near the tops of the vegetation or near the tips of branches. The heights of the song perches range from one foot to 40 feet high; the median height range is 15 to 20 feet above the ground. The males were sometimes also observed to sing in flight while going from one song perch to another, or to sing while moving from branch to branch around a song perch. The territory song continues from the time of arrival throughout the nesting cycle, but decreases in frequency during early incubation of the first nesting, increases again slightly after the first brood leaves the nest, decreases again

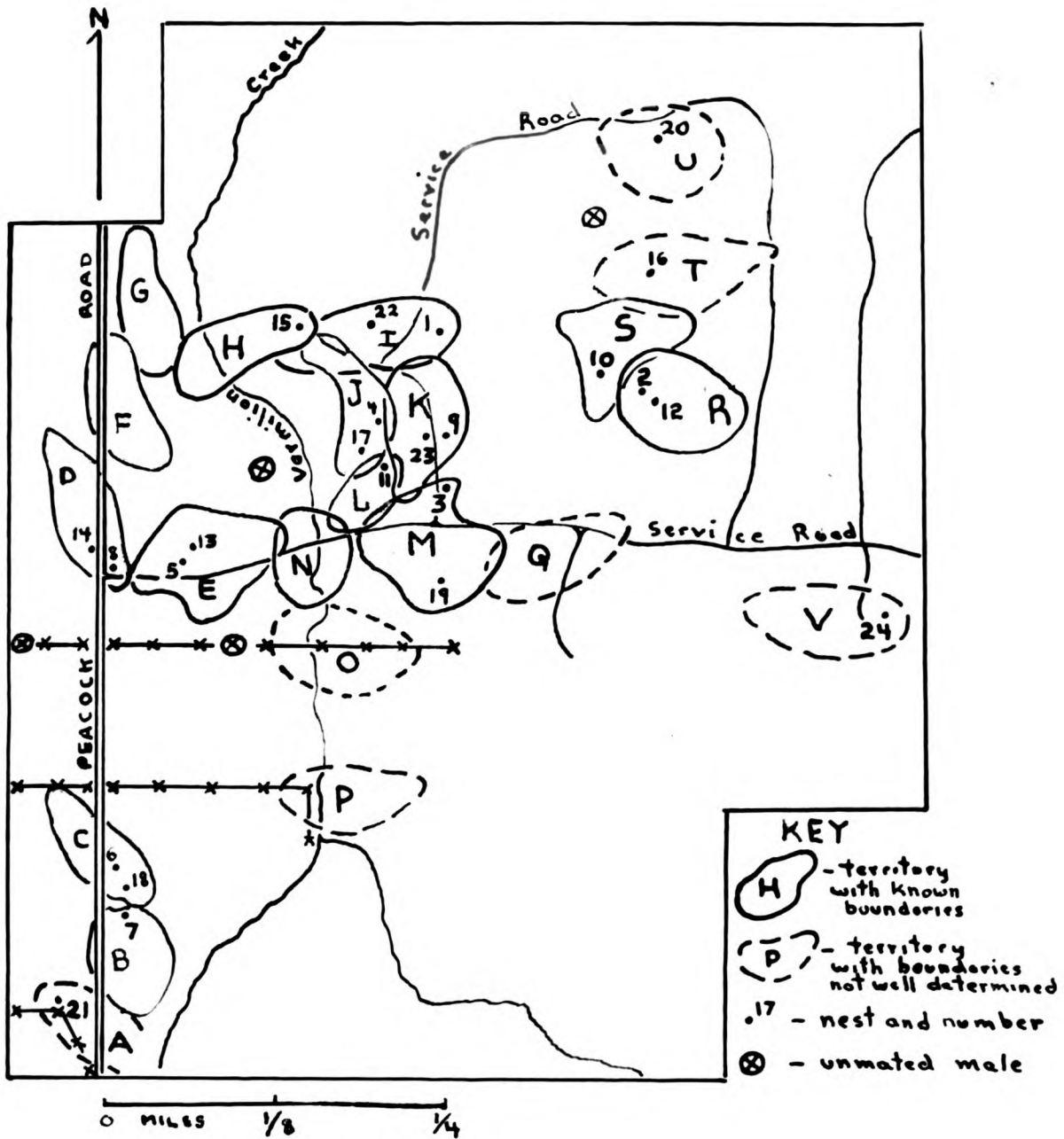


FIGURE 2
LOCATION OF CATBIRD TERRITORIES

during early incubation of the second nest, and ceases completely after the second brood is fledged.

Several workers have shown from banding studies that some males are constant to approximately the same territory from year to year and also that young of the previous year do return to the area of hatching. Gill (1940) records a Catbird banded as a fledgling one year returning to establish a territory a few hundred feet from its place of hatching and then returning to the same territory the next year. Batezel (1939) also writes of an immature bird banded one year returning to the area of hatching the next year, while the adults likewise returned to the same area. Gill (1935) records an immature male banded during one season returning to the vicinity of the nest where it was hatched for the next two breeding seasons. He also reports of another male (Gill, 1936b) that was constant to the same territory for six nestings over a period of four years. The same male and female were trapped by Perkins (1928) on the same territory for two years, the nest of one year being within five feet of the two nests of the previous year. Groskin (1945) recaptured a female for five consecutive years in the same nesting area, and Wharton (1945) reports of a female retaken in the same area three times over a period spanning seven years.

Boundaries of the territories are rather indefinite except where territories are immediately adjacent to each other. In these areas of contingency, neighboring males

did become involved in chases with one another in addition to proclaiming territory by song. On May 15 in the area where territories N, M, and L come together, the following excerpts are taken from my notes covering a period from 0830 to about 0915:

"Two birds now in a circular chase - sometimes singing short song enroute by at least one bird - very seldom came into actual contact (just two or three times during time of observation). Occasionally stop at a distance of 10 to 30 feet apart and sing. The one bird chases the other, often to be chased in turn by the other.....many soft quirt calls and quiet singing..... The singing bird is flown at by the other in most observed cases - the singing bird leaves its perch and the other bird arrives in chase after it from its perch almost immediately..... Area of chase seems to be cut in about half now.... Now they are both singing on opposite sides of the clearing..... After a stop in the chase, the birds have been observed to wipe their bill (a few times), preen (once), or sing (most often)..."

A third Catbird became momentarily involved in the chase described above, but then moved off to the west and sang. A fourth male also came on the scene near the end of the observation period and sang just to the south of the chase area. In the Song Sparrow (Melospiza melodia) Nice (1937) states that a series of chases ends in a fight on the ground. Although occasionally the Catbirds described above did come into contact while in the chase, no fighting was observed either in this case or on any other similar occasion during the study. The participants in a fight of Song Sparrow retire to "sing loud and long, answering each other". In the previously described territory encounter the Catbirds, while not fighting, did stop their chasing from time to time to sing from 10 to 30 feet apart before

renewing the chase.

On May 28, while nest No. 4 was being built, the male and female of Territory J were observed on their territory with nest material in their bills when a third Catbird appeared nearby. The following was then observed:

"The male flew to the third bird in the multiflora rose thicket, then one circular chase in the thicket (chase with a radius of about five feet), then one on the ground singing quietly with body feathers fluffed, wings drooped, and tail dragging at its tip; - moved deliberately back and forth in front of the other bird - other bird did not sing, but moved slowly on ground or in low branches. The female remained about ten feet away in a low position in another shrub. Then the two birds in a short flight up. Then all three were lost from view."

Apparently this is an example of a threat or challenge display on the part of the defending male whose territory was being trespassed. Nice (1943) describes an erected-feather threat posture given by the owner (or owner to be) of a territory as a challenge preceeding the chase portion of a territory establishment encounter.

Defense

The male of an established territory continued to be quite active in both intraspecific and interspecific defense at least in the vicinity of the nest for I observed no instances of territory defense at the periphery of the territory after establishment.

In reaction to another Catbird, the male of the territory upon noticing the intruder moves toward the intruder and usually gives a series of thin wheezy variations of the mew note. He then chases the intruder. The defending male

will continue to fly at and chase the intruding Catbird until the intruder leaves the defender's territory. I never observed an instance of this defense behavior where I knew the intruder to be a female, but in many instances the sex of the intruder was unknown. The female of the territory was never observed to fly at or chase another intruding Catbird.

Interspecific defense was also only observed in the male. Nineteen instances were recorded involving eight species. These were as follows: House Wren (Troglodytes aedon), 1; Cedar Waxwing (Bombycilla cedrorum), 4; Golden-winged Warbler (Vermivora chrysoptera), 2; Cowbird (Molothrus ater), 1; Rufous-sided Towhee (Pipilo erythrophthalmus), 5; Indigo Bunting, 2; Field Sparrow (Spizella pusilla), 1; Song Sparrow, 2; and unidentified species, 3. Nice (1943) records no encounters between Song Sparrows and Catbirds that were nesting commonly on Interpont. All these cases of interspecific defense occurred in the immediate vicinity of the nest. It differed from intraspecific defense in that no prior calls were given by the defending Catbird, and the bird flown at was never pursued, although he might have been flown at repeatedly. Not all non-Catbird intruders were always attacked. The male of Territory M was never observed to chase other species, although several opportunities for such behavior were available. Likewise the male of Territory R, while chasing some intruders such as a Towhee, tolerated the presence of Cardinals (Richmondiana

cardinalis) which had nested within 15 feet of nest No. 12. Orford (1929) reports a case of unsuccessful defense by a pair of Catbirds against Cardinals. The Cardinals drove the Catbirds away from an almost completed nest and began to build onto it. It was not known, however, if the Cardinals actually took the nest over completely, since it was subsequently found deserted and containing one Cowbird egg.

Non-avian intruders, if attacked, were attacked by both sexes, although the male played a more vigorous part. On the day the third egg was laid in nest No. 15, an incident involving a two and one half foot blue racer and the adults of this nest was observed.

"The pair of birds behind the blind now, quirting. Male singing short quiet phrases. Male still singing, female in nest bush low down - 1054. Male jumped at blue racer with wings upraised above the shoulders - fluttering - quirted and mewed. Didn't see it peck at snake, I believe it jumped at it with its feet - singing quietly. Snake was headed into the blind but I moved a little, it paused, head and forepart of the body off the ground, then moved to the west side of the nest bush and coiled. Both birds there - quirting. Male also singing quietly with wings occasionally raised and tail spread..... Male now flew off, female still in branches above the snake. Female has been quirting all this time, but did not behave as the male did with wings and tail spread. Male now singing quietly behind blind - 1106. Male now singing normal volumed song from prickly ash thicket to east. Female still in nest bush near snake. Snake began moving away at 1110 - female followed in branches of trees and bushes about one to two feet above the ground - quirting..."

After the snake had moved 10 to 15 feet away from the nest and apparently continuing on its way, the female returned to perch in the nest bush.

A similar display was observed in the male of nest

No. 3, but the snake involved, if there was a snake, was not seen. In this particular instance the female did not take part. The male was on the ground, his feathers erect-ed, wings held up over his back, and his tail feathers spread. He continued to cross back and forth over the same spot, singing quietly most of the time. Then after ten minutes the male flew away in a series of pouncing flights, perching on the taller weed stems. When about 25 feet away he returned to a tree just east of the nest bush.

Preston (1949) reports an incident of a Catbird at-tacking a snake identified as either an immature black racer (Coluber constrictor) or an immature pilot black snake (Elaphe obsoleta). The Catbird pulled the snake out of a tree by its tail. Taube (1939) states that a Catbird peck-ed a three foot water snake near its tail and that the bird exhibited "wings partly outspread and drooping to the ground" when the snake stopped crawling. A black snake at a Catbird's nest was driven away by four Catbirds, two Eastern Kingbirds (Tyrannus tyrannus), a male oriole, and a wren as described by Morris (1925).

Eastern chipmunk (Tamias striatus), thirteen-lined ground squirrel (Citellus tridecemlineatus), red squirrel (Tamiasciurus hudsonicus), and long-tailed weasel (Mustella frenata) were observed in the immediate vicinity of the nests. Of these, the chipmunk and ground squirrel were the most often seen; although the red squirrel was often heard, it remained in the woods or adjacent edge. Only two

instances of defense against mammals were observed, and in both cases defense was by the female Catbird from on the nest. The female on nest No. 15 left and flew at a chipmunk ten feet away. The other occasion involved a red squirrel at nest No. 17. The squirrel was observed moving through the trees northeast and uphill from the nest. It then came to the rim, flushing off the brooding female. The female immediately flew at the squirrel, mewling loudly and with much wing fluttering. The squirrel left without taking the single young in the nest and moved off to the south. The female continued to fly at it with wing flutterings and loud news, but she did not continue the chase after the squirrel was from 10 to 15 feet away from the nest. On two occasions dogs passed directly under females on the nest, but the females gave no reaction to their presence that I could observe. Gabrielson (1913) mentions that his Catbirds chased a chipmunk away and that the female became uneasy in the nest at the approach of a cat or dog.

My presence at the nest, either to check the eggs or weigh the young, elicited a response by the adult similar to that for other non-avian intruders. If both members of the pair were there, the male was the more aggressive. Both birds would mew loudly and quirt and would go into the raised wing, tail spread, erected feather attitude; but the male did this for more than the female. Usually the male would approach with his tail spread and his body feathers erected, but his wings held slightly drooped at

his sides; then upon getting within two or three feet, he would go into the raised wing attitude. The male would also occasionally sing quietly while in this display. Berger (1954) describes a similar intimidation display after the incubating Catbird was flushed from the nest. The bird moves off "a short distance away from the nest before advancing with outstretched wings toward the observer giving the typical loud alarm note repeatedly" and would approach to within two or three feet. The males of some nests were more aggressive than others; some birds would regularly fly at and strike my hand in the nest. Once the male of nest No. 7 flew at me from behind, striking me on the shoulder, similar to experiences I have had with nesting Mockingbirds. On several occasions adults remained away from the nest while I was there, but could be heard nearby quirting.

This raised-wing attitude in defense against non-avian intruders is the only observed occurrence during the entire study that might be considered wing-flashing as described by Sutton (1946) for the Mockingbird. He describes wing-flashing as the remiges being spread and lifted "arch-angel fashion" over the body. He feels this is "an instinctive gesture indicating wariness, suspicion, distrust" and continues that it is "occasionally, but more or less accidentally, associated with the capture of food", an idea that has been sometimes presented. Vaurie (1957) in his discussion of the Western Red-legged Thrush (Mimocichla

plumbea) mentions that it wing flashes like the Mockingbird and states that he has also observed this behavior in the Catbird. He writes that as with this thrush, the wing flashing in the Catbird takes place only during the courtship performance.

Injury-feigning

No examples of injury-feigning by Catbirds were observed during the study. Berger (1954) states that F. V. Hebard mentioned such an incident to him occurring on May 30, 1949. A bird was flushed from a nest and flew to a gravel road a few feet away and gave a modified broken wing display, fluttering its wings moderately fast as it moved slowly along the ground away from the nest.

Upon being attacked by a Blue Jay (Cyanocitta cristata), Freeman (1949) describes a Catbird imitating a young bird as a defense behaviorism for escape. He states that the bird squalled and flew from the tree with half opened, feebly fluttering wings, sinking rapidly and almost touching the ground, then rising up to another tree. The bird then shook itself, looked around, and flew off "normally" toward its nest.

Mobbing

No cases of mobbing by the Catbird were observed by me, but Friedmann (1929) states that two Catbirds joined a Robin (Turdus migratorius), three Yellow Warblers (Dendroica ~~be~~ techia), and one Blackpoll Warbler (Dendroica striata) in

chasing a female Cowbird from a Robin's nest. Hamerstrom (1957) observed Catbirds to initiate mobbing of a Red-tailed Hawk (Buteo jamaicensis), and Bolles (1890) found Catbirds and thrashers to be "coarsely abusive" to a pet Barred Owl (Strix varia).

Length of Maintenance of the Territory

The male at least was observed to continue the defense of the territory after the young had left the first nest and were being fed by the adults. Charles (1954) states that the Catbird holds its territory throughout the nesting season regardless of how many nests are built. After the completion of the second nesting, however, there is no more territory defense, although the adults will continue to give quirts and loud mews at my presence while the newly fledged young are nearby. In the instances where there was no second nesting after the completion of the first, the territory was discontinued soon after the first brood had left the nest. Singing of any type ends during the first week of August, which corresponds with the general completion of the second nesting period. Nest No. 23 was just in the incubation period then, but the male was never heard to sing after this time.

Size of Territory

Odum and Kuenzler (1955) define two types of territories, the maximal and the utilized territory. The former is that area that is contained within the outermost points

of observed territory activity, while the latter refers to that area within the maximal territory that is most used - including the nest location, most frequently utilized song perches, and regular feeding areas. Only the maximal territory was determined in this study, although it was apparent that a somewhat smaller utilized territory did exist. On territories where a second nesting took place, the utilized portion did shift its location within the maximal territory in relation to the new nest site. The plotting of maximal area was made during the period of territory formation and through the incubation period of the first nest. During the nestling stage, the maximal territory was not as easily discernible and with the beginning of the second nest was not as vigorously maintained as during the early days of the first nesting. The areas of these maximal territories were measured with a planimeter and are listed in Table 1. They ranged from 1.47 acres to 5.169 acres with an average of 3.1704 (standard deviation - 0.9023 acres). This mean gives 0.315 pairs per acre. In southern Illinois, Brewer (1955) had two pairs of Catbirds with home ranges equalling 0.16 and 0.36 acres which are decidedly different from those determined in the present study and were areas that were not necessarily completely defended. Young (1949) found a pair density of 2.2 per acre in Wisconsin which gives an average territory size of 0.455 acres. Young's study likewise reflects a much higher concentration of birds than my Rose Lake population.

TABLE 1
SIZE OF TERRITORIES ON THE STUDY AREA

Territory	Area
A	not determined
B	2.5845 acres
C	2.2626
D	3.8479
E	4.2611
F	3.0241
G	3.3892
H	3.2186
I	3.5789
J	2.7839
K	2.7550
L	1.4700
M	5.1690
N	2.2122
O	not determined
P	not determined
Q	not determined
R	3.4156
S	3.5837
T	not determined
U	not determined
V	not determined
mean	3.1704 acres
stand. dev.	0.9028 acres
number	15

Unmated Males

There were four males that maintained song perches on the study area for various lengths of time but never attracted mates. The location of their singing areas is indicated in Figure 2. Nice (1937) also mentions a small reserve of unmated birds in her Song Sparrow population.

COURTSHIP AND MATING

No observation of courtship and mating was recognized as such prior to the first nesting. Apparently mated pairs would move about the territory together while feeding, never getting far apart. In fact, since this type of paired behavior was observed on May 15, the first day females were noted in the study area, selection of mates must take place quite soon after the arrival of the females.

The only observation of this type of behavior during the entire study was with the pair of territory M two days after the first brood had left nest No. 5 and were still in the immediate vicinity being fed by the adults. This male and female were seen in a short chase from branch to branch within the nest thicket, both mewling.

Bent (1940) describes the courtship as a chase in and out of the underbrush, the male often stopping to sing with the plumage and tail raised, bowing. Later he describes the display as one of strutting with the wings lowered and the tail high and erect, displaying the chestnut undertail coverts. Charles (1954) describes another display. She states that in the courtship display the male puffs up to twice its normal size with the neck and tail stretched in line with the body and clambers around the female in this posture. If the female flies away from the male's display, he either flies after her or sits and gives the mew note.

NESTS AND NEST BUILDING

Nest Building

Both adults were seen carrying nesting material as early as 10 days prior to the day when the first egg of the first nesting was laid. Latham (1936) records the building of dummy or trial nests before the final nest to be used is completed. According to Latham, these are open, bulky affairs built in an exposed location. Walter F. Nickell, naturalist at Cranbrook Institute of Science, writes me that he had observed clumps of twigs near many finished Catbird nests, but it was several years before he had the opportunity to witness the male's role in regard to these dummy nests. Mr. Nickell summarizes this behavior as follows: "The male carries a twig or even in one case a piece of cellophane which someone had folded up into a narrow strip about five or six inches in length. He flies ahead of the female, singing excitedly and goes to an upright fork in the shrubbery where he, at the approach of the female, deposits his burden. If the female, which she usually does, flies away, he immediately grasps the twig or other object and flies away after her, in a short time returning to the same place, followed by the female. This may go on for sometime. Obviously, in the total process, the male gathers up to ten or twelve twigs depositing them in the crotch he has chosen and not always carrying them away again so that what eventually results is the clump of twigs, which is either used as a foundation by the female

or if she chooses another site, she will build the nest entirely." I did not observe any dummy nests under construction, but I did find incomplete nests varying from collections of twigs placed in a crotch or fork to nests almost complete except for the lining.

Whittle (1923) gives evidence of the dominant role played by the female in construction. He reports that if the male brought material while the female was at the nest, he would give it to her to place in the nest. Also if the female brought material while the male was there, he would get out of her way.

Bent (1948) gives five to six days as the time necessary to complete the nest, while Herrick (1935) gives eight days. Three days prior to the laying of the first egg is the earliest that I found a nest under construction. By that time the foundation and cup formation had been almost completed, and the middle bark or leaf layer was just beginning to be laid down.

In the building of the nest for the second brood, there apparently is no prolonged period of site selection. Nickell (by correspondence) likewise concurs with this observation. The male is usually involved with the feeding of the young of the first nesting, and in the few instances observed the nest building at this time was done entirely by the female.

Description and Placement

The nest is of the cup-shaped statant type. Table 2

gives the dimensions for all nests on which measurements were taken. It is interesting to note that the inside diameter has the smallest standard deviation. The reduced variation of this dimension might possibly reflect the dependence of the inside diameter of the cup on the size of the bird rather than on the particular configuration of the nest site.

Of the 24 nests described, eight were supported from beneath on upright crotches, seven on horizontal forks, five on single horizontal branches or two or more parallel branches, and three on twigs brought to the nest by the Catbirds to provide such support in a too deep nest site; one nest had no basal support. Todd (1940) reports a nest that was located on the top rail of a fence, and Colton (1909) writes of a nest built in a natural cavity of a dead apple tree which the birds had filled to a depth of nine inches so that the twigs stuck out of the opening. All the nests had some lateral support provided by the branches or twigs of the nest tree or shrub or of an adjacent tree or shrub.

The nests were placed from 2 feet, 5 inches to 6 feet, 11 inches above the ground; the average for 24 nests was 63.83 inches (5 feet, 3.83 inches). Most nest heights reported in the literature fell between two and ten feet above the ground (Baerg, 1931; Bent, 1948; Berger, 1951b; Brackbill, 1950; Burleigh, 1927; Charles, 1954; Davis, 1942; Gabrielson, 1913; Howell, 1932; Latham, 1936; Mallory, 1915;

TABLE 2
NEST DIMENSIONS

	Inside Diameter	Outside Diameter	Inside Depth	Outside Depth
number	20	20	20	19
mean	8.075 cm.	11.65 cm.	3.715 cm.	3.447 cm.
range	7.5-9 cm.	10-14 cm.	2.6-5 cm.	6-10.5 cm.
st. dev.	0.4064 cm.	1.001 cm.	5.165 cm.	1.649 cm.

Morse, 1925; Todd, 1940). There are several other recorded heights outside this range. Pearson, Brimley, and Brimley (1942) give the commonest range as between 3 and 15 feet, but they also mention records of 50 and 60 feet. Baerg, Mallory, and Morris (1923) all report nests 20 feet above the ground. Todd found a nest built 25 feet up, as did also Latham. Latham also reported the observation of a nest built one foot above the ground, and Trautman (1940) found two nests built on the ground.

Table 3 gives the type of vegetation in which the nests were built. The 24 nests were located in 14 different species of trees and shrubs with no one species being used with outstandingly greater frequency than any other. Of these nesting locations, five had grape vine (Vitus sp.) as a part of the nest substrate. All but two were located at a site where grape vine was immediately adjacent or quite close by. With these two, grape vines did occur within the territory but were at least 100 feet away from the nest in one instance.

Nesting Habitats

Most nests were located in the brushy uplands. Woodland edge was the second most frequent nest site habitat, and the least number of nests were located in the Cornus-Carex lowlands. No nests were placed within the woodlands or associated with the open uplands. Table 4 lists the nests on known territories for the five habitat types within the study area.

TABLE 3
NESTING VEGETATION

Plant Species	Number of Nests
American elm (<u>Ulmus americana</u>)	3
Honeysuckle (<u>Lonicera</u> sp.)	3
Lilac (<u>Syringa vulgaris</u>)	3
Multiflora rose (<u>Rosa multiflora</u>)	3
Silky dogwood (<u>Cornus amomum</u>)	3
Alder (<u>Alnus rugosa</u>)	1
Beautybush (<u>Kolkwitzia amabilis</u>)	1
Black locust (<u>Robina pseudo-acacia</u>)	1
Choke cherry (<u>Prunus virginiana</u>)	1
Elderberry (<u>Sambucus canadensis</u>)	1
Forsythia (<u>Forsythia</u> sp.)	1
Mock orange (<u>Philadelphus</u> sp.)	1
Wild crab (<u>Eyrus ioensis</u>)	1
Wild crab and multiflora rose	1

TABLE 4

NEST HABITATS

Habitat	Nests Found	Territory Known, One Nest Presumed	Total
Brushy uplands	14	0	14
Edge	8	1	9
<u>Cornus-Carex</u> lowlands	2	5	7
Deciduous woods	0	0	0
Open uplands	0	0	0
Totals	24	6	30

Nest Structure and Materials

The nest is essentially a three-layered structure. The first is the foundation layer; the second, the cup-forming layer; and the third, the lining. The foundation layer was moderately to well developed in 15 of the 21 nests analysed for their materials. In all but one of these nests it was primarily composed of woody twigs. In this one particular nest the foundation was formed from dried herbaceous weed stems. The twigs used were of kinds that indicated that they were mostly gathered close by. Herbaceous weed stems, straw, bark, paper, and leaves were also found in this first layer. The cup-forming layer, which usually formed the bulk of the nest, can be further divided into three sub-layers - a transition sub-layer next to the foundation, the main cup-forming sub-layer, and a transition sub-layer next to the lining. The main cup-forming sub-layer was usually the best developed of the three. It was almost entirely of bark in 14 nests, primarily of leaves in three nests, mostly of herbaceous weed stems in two nests, and of about equal portions of bark, leaves, and weed stems in two others. Grape was the most frequently used bark, but that of the ninebark (Physocarpus opulifolius) and of the beautybush (Kolkwitzia amabilis) was used as the major type in several nests. The transition sub-layer next to the foundation was better developed than the main cup-forming sub-layer in four nests and in these cases was increased by the addition of large amounts of herbaceous

weed stems. The transition sub-layer next to the lining was never very thick, being primarily an area of merger between the main cup-forming sub-layer and the lining. The third layer, the lining, was in every case composed of rootlets. In 13 nests there were also small bits of bark, small twigs, leaves, and herbaceous material in addition to the rootlets. Dark brown to black and light brown to yellow-brown rootlets were found with about equal frequency in the nest linings. Red-brown rootlets occurred much less frequently and always in combination with other colors of rootlets.

After dismantling the nest, an analysis of the materials was accomplished by making a sight judgement of the proportions according to the bulk of the various materials. Considering the nests together, herbaceous materials were the commonest, forming 27.2 per cent of the average nest; woody twigs formed 25.1 per cent, bark formed 23.5 per cent, rootlets formed 14.2 per cent, leaves formed 7.7 per cent, paper formed 0.7 per cent, and twine formed 0.4 per cent. Table 5 gives the proportion of different materials comprising the nests that were analysed. Bent (1940) mentions that some nests in the Mid-west are lined with horsehair. McAtee (1940) reports the presence of lumps of dirt in the foundation of one nest, and Turle (1930) includes rags as occurring in Catbird nests.

TABLE 5
PROPORTION OF MATERIALS IN NESTS

Nest No.	Twigs	Herb. Mat.	Bark	Leaves	Paper	Twine	Rootlets
1	.056	.333	.500	0	0	0	.111
3	.250	.500	.125	X	0	0	.125
4	.500	.167	.167	0	0	0	.167
5	.167	.333	X	.333	X	0	.167
6	.200	.200	.300	0	.050	.050	.200
7	.300	.100	.400	.010	.050	.040	.100
8	.417	.083	.083	.333	X	0	.083
9	.220	.220	.220	.220	0	0	.110
10	.250	.525	.125	X	0	0	.100
11	.222	.333	.333	X	0	0	.111
12	.333	.333	.167	X	X	0	.167
14	.421	.316	.053	.053	.053	0	.105
15	.273	.182	.364	.090	0	0	.091
17	.167	.333	.250	.167	0	0	.083
18	.250	.250	.250	X	X	X	.250
19	.333	.167	.333	0	0	0	.167
20	.333	.111	.333	.167	0	0	.056
21	.0625	.375	.0625	.250	0	0	.250
22	.167	.167	.500	0	X	0	.167
23	.125	.500	.125	X	0	0	.250
24	.438	.167	.250	X	X	0	.125
mean	.261	.272	.235	.077	.007	.004	.142

Nests 2, 13, and 16 were destroyed before they could be collected for analysis. The mark, X, indicates presence, but in a quantity too small to evaluate.

EGGS AND EGG LAYING

No field study of the eggs was attempted. Bent (1948) describes the eggs as being deep glossy greenish-blue or bluish-green, much deeper toned than the eggs of the Robin or Wood Thrush (Hylocichla mustelina). They are usually without spots, but Sage et al. (1913) reports Catbird eggs spotted with red. Bent gives the size from a sample of 50 eggs in the National Museum as 23.3 mm. X 17.5 mm.

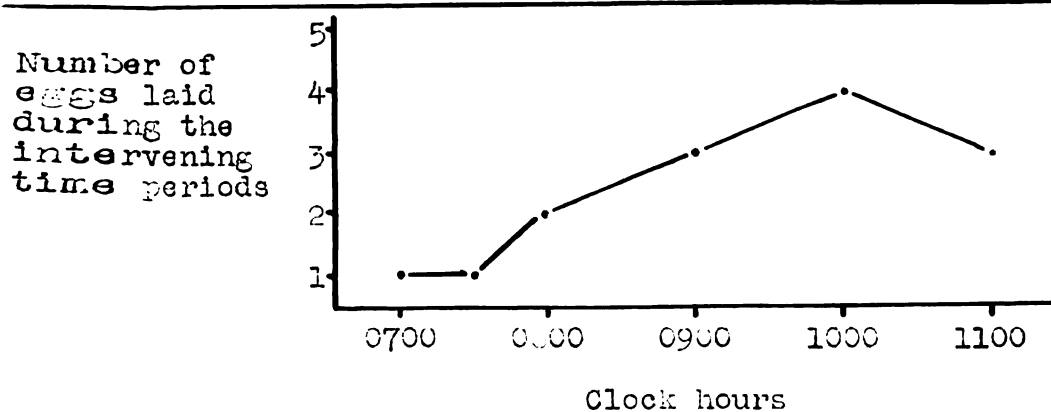
The number of eggs per clutch ranged from two to four. There were ten nests with four eggs, eight with three eggs, and four with two eggs. This gives a mode of four, a median of three, and a mean value of 3.27 eggs per nest. Bent (1948) gives the range as from two to five as does also Berger (1951b). Harlow (1918) reports the range as from three to five, and Young (1949) gives an average of 3.1 eggs per nest. Trautman (1940) reports a nest containing six eggs. Table 6 gives the number of eggs per clutch according to the time of nesting. In both this tabulation and in the determination of the clutch figures above, nest No. 1 has been omitted, since it failed during egg laying before the clutch was complete. Of the ten nests that were first nestings, seven had four eggs, two had three eggs, and one had two eggs. This gives a median and mode both equal to four and a mean of 3.6 eggs per nest. There were four nests that were considered as either late first nestings or second attempts after the failure of the first nesting. In this category the median and mode each equalled

TABLE 6
NUMBER OF EGGS PER CLUTCH

Time of Nesting	Number of Nests with			Mode	Median	Mean
	4 Eggs	3 Eggs	2 Eggs			
First nestings	7	2	1	4	4	3.6
Second attempts or late first nestings	0	3	1	3	3	2.75
Second nestings	3	3	2	3,4	3	3.125
Total nests	10	8	4			

FIGURE 3

FREQUENCY OF EGG LAYING DURING MORNING



three with a mean of 2.75 eggs per clutch. Second nestings had a bimodal number of eggs at three and four with the median at three and the mean equalling 3.125 eggs.

Nests No. 19 and No. 23 were the only ones that were under daily observation while being built. In both nests the first egg was laid the day after each nest was completed. Bent (1948) and Shufeldt (1893) also give this as the elapsed time until the first egg, but Herrick (1935) reports a nest in which the first egg was not laid until three days after the completion of the nest, and Berger (1951b) gives three, four, and five days as the elapsed time between the completion of the nest and the laying of the first egg. Latham (1936) states that the first egg of three laid was deposited in the nest the day the nest was finished and that the last was not laid until seven days later.

The eggs are always laid in the morning. Figure 3 shows the frequency of laying of 14 eggs. One egg was laid by 0700, another by 0730, two more by 0800, three more by 0900, four more by 1000, and three more by 1100. There is some evidence that certain females laid consistently in the early part of the morning, while other females laid consistently in the late morning; but the number of definitely observed instances of this are too few to make any generalization. Herrick (1935) and Shufeldt (1893) place the time of egg laying between 0900 and 1200 with the most frequent occurrence between the hours of 0900 and 1100. Davis (1942) found all four eggs of one nest to be laid,

one egg daily for four days, at 0600.

In all nests under observation a single egg was laid each day until the clutch was complete.

INCUBATION

Only the female was observed to incubate the eggs. The only instance recorded in the literature of a male incubating is by Forbush (1929), who states that the male does incubate sometimes, occasionally singing while on the nest. He gives no further details.

Length of Incubation

The incubation time in this study is defined as the elapsed time from the laying of an egg to its hatching. The term incubation period refers to the supposed time the eggs are actually being effectively incubated and is counted from the day the last egg is laid until the day the last egg hatches. The incubation times of five eggs are known rather accurately. Egg No. 2 and egg No. 3 of nest No. 18 both hatched after 13 days. Egg No. 4 of nest No. 17 hatched after not more than 13 days, 2 hours. Egg No. 3 of nest No. 17 had an incubation time of not more than 13 days, 5 hours. Egg No. 1 of nest No. 18 hatched after 14 days. Along with the times of 12 other eggs, it appears that the first egg laid hatches on the 14th day after laying, while all the other eggs in a clutch hatch after 13 days. The incubation period is 13 days and is equal to the incubation time of the last egg laid. Mrs. F. W. Commons as reported by Roberts (1932) gives the following incubations times for five eggs in one nest: the first egg hatched after 15 days, the second after 14 days, the third after 13 days, the fourth after 14 days, and the

fifth after 13 days. Bent (1948) and Gabrielson (1913) give from 12 to 13 days as the incubation period. Herrick (1935) and Kendeigh (1952) give 13 days as the average. Burns (1915) reports the range of the incubation period from 12 to 14 days. Berger (1951b) states that the periods ranged from 13 to 15 days. Davis (1942) writes that each of four eggs was laid in a Catbird nest daily from June 15th to June 18th, and that they all hatched on July 1st. This gives an incubation period of 13 days.

The eggs in nest No. 23 were incubated through the 23rd day since the first one was laid; on the 24th day the nest was deserted although the eggs were still there and apparently not disturbed. Latham (1936) had a second nesting that went to 22 days of incubation before the nest was abandoned.

Attentiveness and Inattentiveness

Only the female of the nest No. 18 was observed incubating the day the first egg was laid; and it seems quite probable, considering the incubation times of the eggs, that incubation does not begin regularly until at least the second egg is laid. Females were observed to incubate on the day the second egg was laid, but not for long periods. Bent (1948) mentions that the female does not begin incubating regularly until a few days after the set has been completed. Schufeldt (1893) states that the female sat at irregular intervals during the first few days, and Herrick (1935) writes that the Catbird did not begin to incubate

"with earnest" until after the third egg was laid.

The average attentive period was 20.53 minutes for 47 periods of known length, and the average inattentive period for 47 periods of known length was 12.03 minutes. From these values it is determined that 63.97% of the female's observed activity was in incubating. Kendeigh (1952) gives figures for the Catbird of 22.7 minutes for the average attentive period and 7.0 minutes for the average inattentive period. He gives an average of 33 attentive periods a day, with the female spending 75.9% of her daytime activity in incubation. Davis (1954), from data supplied by Kendeigh, states that the female spent 65.9% of the observed time in incubation. Counting also periods of unknown length, the attentiveness in my study ranged from 0.5 minutes to 120 plus minutes, while the inattentiveness ranged from 0.5 to 78 plus minutes. There were 1.7 attentive periods per hour and 1.6 inattentive periods per hour. Table 7 tabulates these data.

No day to day trend in the lengths of the inattentive and attentive periods as incubation proceeded was apparent in the data. Kendeigh (1952) found that the only daily variation in the attentiveness was due to the temperature. At 69 degrees F. the attentive periods were the longest and came at the least frequent intervals. Above and below this temperature the periods of attentiveness were shorter and alternated more frequently with inattentive periods.

TABLE 7

A. ATTENTIVE PERIODS IN MINUTES ACCORDING TO
THE DAYS SINCE THE FIRST EGG WAS LAID

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
-	1 2	14 11	-	49	1 .5 1 .5 1	-	-	-	9 6 11.5 10 7 12	29 17 15	-	51 17.5 22 7 45.5 23 25	70 39 11 5.5 16 9 7.5 11	36 43 23	54	13 19 75 .5 0	9 14 1 8

B. INATTENTIVE PERIODS IN MINUTES ACCORDING
TO THE DAYS SINCE THE FIRST EGG WAS LAID

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
-	-	11	-	19 5	7 12 7.5 29	-	13	-	6 7.5 4 6 5 8	6 6 18	24	4 4.5 9 8 .5 35 14 22	5.5 5.5 19.5 2 12 3.5 7 7.5	33 17 26 27	14.5 12	7 2 18 19.5	16 15 5

TABLE 7-Continued

C. NUMBER OF ATTENTIVE AND INATTENTIVE PERIODS PER OBSERVATION PERIOD

	Time Period	Attentive Periods	Inattentive Periods
	2+34	4	3
	1+53	2	3
	2+38	8	9
	1+22	5	6
	1+00	1	1
	1+48	7	7
	1+45	4	4
	1+47	4	4
	1+29	3	3
	2+37	4	4
	1+32	6	6
	1+56	3	2
	2+05	2	1
	2+45	1	0
	2+00	1	0
	1+30	1	0
	3+11	4	4
	1+11	2	1
	2+11	2	2
	2+14	3	2
	2+57	5	6
Total	42+25	72	68

Behavior during Incubation

The female came to the nest usually by the same route to perch on the same rim; however, she might come with a good bit of hesitancy, often making several approaches up to the rim only to retreat. Other times she came directly over her usual route to the nest rim to immediately settle on the nest. Most females were quite constant in the position they faced on the nest, but I have not seen any correlation with cover, sunlight, compass direction, or slope that would be the same for all nests. I would imagine that the position on the nest is merely a function of the approach route which did seem to be determined by the availability of cover and suitable perches. The female may settle on the nest with a side to side motion, or more often without any such motions. The female would sometimes approach the nest giving soft, quiet or soft, wheezy mews, and she would occasionally continue to mew after settling on the nest. The female of nest No. 17 was twice observed to come to the nest with food in her bill although there was only a single unhatched egg in the nest at the time. Both these instances occurred, however, the day following the hatching of one of the eggs, but the newly hatched bird had disappeared by the next morning. In both cases the female ate the food immediately after settling down on the nest.

While the female was at the nest, the male would often sing from a regular song perch, usually at normal volume,

either the long territory song or more often a shortened variation of this song of only a few phrases. When not singing the male has been observed to perch quietly, preen, or move off to feed in the area. Davis (1942) states that while the female was on the nest, the male perched nearby or fed. Concerning the singing of the male during incubation he further writes, "the male sings in the usual loud manner occasionally but frequently sings a weak warbling song. These notes are very similar to the usual song but the volume is greatly diminished. One must be near to hear the song". He did not mention during what activities these songs were used, but the weak song referred to perhaps is the whisper song used by some males in this study at the guard perch.

The female was observed to leave the nest under three different circumstances: when disturbed, in response to the male's signal, and for unknown reasons. Of all the observed departures 12.5% were when disturbed, either being flushed off the nest or purposely leaving to fly at an intruder. When flushed, she would leave the nest quickly and quietly, dropping low, and moving rapidly through the underbrush away from the nest. The female left the nest 48.2 per cent of the time in response to the male's signal, which was usually the quiet song, although a short normal-volumed song was also used, and the male of nest No. 19 would generally only give the quitt call. In almost half (44.4 per cent) of all signaled departures the female also

gave one to several quitts when leaving the nest. On several occasions she would begin to quitt on the nest prior to the vocal signal of the male, having apparently realized his presence by some other means. The female of nest No. 12 delayed leaving for several minutes 20 per cent of the times the male signaled. The female of nest No. 17 failed to leave 71.4 per cent of the times the male signalled; she would, however, quitt a number of times and become quite restless. No other females delayed or refused to depart when signalled by the male. After leaving the nest, the female would most often fly away from the immediate area. Occasionally she would fly in the direction of the male; both birds would then perch near each other, quitting. During the 13th day of incubation of nest No. 12 the male fed the female after she left the nest.

"Female to perch southeast of nest at 1324 - moved down and then back up to perch. Moved to east rim and then onto nest facing west at 1325. Bird mewed to northeast of nest. Male singing short phrases to north at 1330. Male quitting east at 1334 - female left nest then to east. Male flew to perch in honey-suckle north of nest. Female flew to him. Male fed female. Then female flew northeast; male perched just north of nest, wing fluttering."

No other instance of the male feeding the female during incubation was observed. Davis (1942) observed the male and female to perch near each other while she was off the nest and touch or rub bills. Table 3 illustrates the departures of females from the four nests under observation during the incubation stage.

During the periods while the female was off the nest,

TABLE 2

FEMALES' DEPARTURES FROM THE NEST WHILE INCUBATING

Nest No.	♀ Left the Nest	Left Without ♂'s Signal	Left With ♂'s Sig.	♂ Signals, ♀ Quitt	♀ Delays
15	10	disturb. 3 (30%) unknown 4 (40%)	3 (30%)	3 (100%)	0 .
12	28	disturb. 1 (3.6%) unknown. 12 (42.9%)	15 (53.6%)	2 (13.3%)	3
17	15	disturb. 3 (20%) unknown 6 (40%)	6 (40%)	6 (100%)	0
19	3	0	3 (100%)	1 (33.3%)	0
Total	56	disturb. 7 (12.5%) unknown. 22 (39.2%)	27 (48.2%)	12 (44.4%)	3

the male was observed to assume the guard position on 77.6 per cent of these inattentive periods. The two samples of the duration of unguarded inattentive periods were 4.4 and 3.8333 minutes. The three samples of duration of guarded inattentive periods were 7.6842, 14.4286, and 19.0 minutes. The mean of the unguarded period samples equalled 4.1167 minutes, while the mean of the guarded period samples equalled 13.7043 minutes. Although these two means are not significantly different from each other at the 5 per cent level of significance, there is the possibility that there still is an actual difference in the lengths of unguarded and guarded inattentive periods ($t=2.2614$, with $df=3$, $0.10 < P < 0.20$). The female apparently stays away longer when she has seen the male come to a guard perch as she left, and she returns sooner on occasions when the male did not come to guard. The male used several regular perches varying from one to eight feet from the nest, most often moving three or four times between perches during a single guarding period. Occasionally he would come to the nest, perching quite close by or on the rim, and then move off to one of his other guard perches or back to the one from which he came. The male was usually silent during the guarding period, but at nest No. 17 he used the whisper song at least once during about three out of four periods, and the male of nest No. 12 sang the quiet-song at least once about one out of four periods. The male would wing flutter for a period following his arrival at a perch,

then stop and remain quiet. Often he would preen momentarily while perched. Immediately before moving again the male would begin to wing flutter and would usually wing flutter while moving about. Wing fluttering referred to here and mentioned elsewhere was observed in both the male and female, but was observed much more frequently in the male. The wings are held out away from the body approximately 30 degrees to the longitudinal axis and fluttered or quivered rapidly and stiffly. It is not continuous, but is interrupted by pauses. As the activity wanes, the pauses between successive flutters become longer. Davis (1942) also observed this wing fluttering in male and female Catbirds and mentions that it "occurred when the birds appeared to be excited, as, for example, after I had disturbed the nest or when the female returned after feeding". This wing fluttering should not be confused with wing flashing as described by Sutton (1946) and Vaurie (1957) and mentioned before under territory defense. The male averaged 9.14 minutes on guard out of an average period of 11.25 minutes during which the female was off and gone from the immediate vicinity. The male was actually guarding, therefore, 81.2 per cent of the time the nest was unattended by the female. Davis reported that the male always guarded during the inattentive periods at a perch a few feet away.

In the Song Sparrow, Nice (1937) found that the male guarded for only a few minutes and then left to join the

female, often escorting her back to the nest. Table 9 presents the guarding activity of the male at the four nests observed during incubation.

When the female returns to the vicinity of the nest while the male is at his guard perch, the male would either sing or remain silent. For the four nests observed during incubation, Table 10 gives the activity of the male on the return of the female. The female was observed to return to the vicinity of the nest 44 times while the male was guarding. He sang some sort of a song or call note on 59.1 per cent of these instances. The male of nest No. 12 most often sang the quiet song; the male of nest No. 17 used the whisper song or the quitt call with about equal frequency and the male of nest No. 19 only used the quitt. Mews and short normal-volumed songs were used much less frequently. The male would always depart soon after the arrival of the female. On 18 occasions (41 per cent) he would perch momentarily near the female or the female would fly to perch near the male, after which the male would leave and the female would approach the nest. After she was on the nest, the male was heard to sing a quiet song or short normal-volumed song 43.1 per cent of the time from a perch nearby.

On two separate days when the temperature was in the high eighties, the female gaped while incubating. She would open the bill about 20 to 30 degrees and then close it slowly or with a series of quick snaps. The female

TABLE 9

ACTIVITY OF THE MALE WHILE THE FEMALE IS
OFF THE NEST, THE GUARD PERCH

Nest No.	♂ Off, not guarding	♂ Off, on guard	No. of Perches Used During a Single Period					Guarding Off and Gone (in min.)	Length of non- guarded periods
			1	2	3	4	5		
15	6	1		1				-	01, 09, 02, 06, 04 min.
12	6	21	1	1	8	7	4	$\frac{118}{146}$	03, 08, 03, 04, 02, 03, min.
17	1	19	2	2	3	3	3	$\frac{165}{202}$	-
19	0	4	4					$\frac{56}{57}$	-
Total	13	45	6	4	11	10	7	$\frac{339}{405}$	45 min.

TABLE 10

ACTIVITY OF MALE UPON THE RETURN OF THE
FEMALE WHILE THE MALE IS GUARDING

Nest No.	♂ Did Not Sing	♂ Did Sing	If ♂ Sang					♂ leaves		♂ sang after ♂ on nest
			New	Whisper Sing	Quiet Song	Normal Vol. Song	Quint.	direct	to near ♂	
15	1							1		
12	13	12	2	-	6	1	3	15	10	16
17	4	11	-	5	1	1	4	7	8	2
19	0	3	-	-	-	-	3	3	0	1
Total	18	26						26	18	19

always reopened it slowly. The bill was usually held open between 30 seconds and one minute, then closed for a few seconds, and then reopened. The female did not gape all the time she was on the nest, but separated a series of gapes by periods of several minutes. There was no gular movement associated with this gaping.

HATCHING

The eggs are pipped the day before hatching, or sometimes just a few hours before hatching. Two eggs in nest No. 10, however, were pipped five days ahead of hatching. The female has been observed to poke at the eggs while incubating during the days prior to hatching; she apparently contributes to the pipping of the eggs by this activity. Some eggs, such as those in nest No. 10, were noticeably pipped from the outside rather than from the inside as seen in other eggs. The pipping appears a little beyond the center of the egg toward the larger end. One of the eggs in nest No. 12 broke with a crack audible eight to ten feet away.

I was present at the hatching of three eggs, and the following notes were written at these times:

"Nest No. 12, July 9, 1958. Male now left to south at 1011 as female came from southeast and wing fluttering, then female to east rim and then onto nest facing southwest - did not feed, gave a single quirt, 1012..... Female quirting on nest and poking under body. Heard a crack and female immediately carried egg shell away to the south at 1015. Checked nest immediately - other egg has hatched, half of egg shell still in nest. Female back to nest from southeast at 1018, facing west on nest.....when female returned, she paused slightly on east rim but did not poke in nest.....Male singing north at 1029. Female began to quirt on nest, left to southeast with a few quirts.....Female came in from southeast, male left to south. Female to east rim with food, quirted, fed one young, picked up the other half of egg shell and flew with it to north."

"Nest No. 17, July 22, 1958.....then male flew up to north rim of nest and bent over with head in nest for about 15 seconds at which time the female flew up to just north of nest in nest tree, and male flew south to perch, wing fluttering there momentarily. Female moved onto nest to incubate after a slight

hesitation on north rim - 1156.....I left blind at 1200, flushed female to check eggs. Egg No. 3 is hatching right now, egg almost completely open. No. 4 is still pipped about the same, and No. 2 not pipped at all. Female came to north rim at 1204, hesitated awhile, looking and poking in nest, then onto nest facing southeast..... Female poking and looking in nest.....Female stood up several times to look and poke in nest - 1218..... At 1221 female stood up, poked in nest, and picked up one half of egg shell and ate it, then poked in nest and picked up other half of egg shell, leaving with it to north at 1222. At 1223 perched on south rim apparently eating bits of shell, then settled on nest facing north..... At 1224 repeated eating of shell bits..... At 1225 stood up and poked in nest just momentarily..... Again at 1226, up on south rim poking into nest and again apparently eating something - can hear bill snapping. Not back down on nest until 1228, facing north again."

"Nest No. 17, July 23, 1958. At 1139 male up on north rim, moved around to east rim, picked up egg shell half and left immediately with it to the northeast. Male then back with food, perched just north, wing-fluttering. Then to nest on north rim - did not feed, but flew to just southeast, quitting..... At 1144 male flew up to east rim, poking in nest, quirted a number of times and apparently eating egg shell bits. Left then to southeast..... I checked nest - young bird still in larger piece of shell (the small end), removed young from shell breaking the allantois. Young weighed 2.25 g. (average of three weighings). Replaced young in shell and put back in nest. No bits of shell were on exposed portion of young - 1200.....Male came from north to perch just south with food.....flew to nest at 1215, east rim; hesitated, apparently did not feed, left immediately with the other half of egg shell to southeast. Back again just to south, whisper sang, up on vine bridge, wing fluttering, without food - 1216"

Both sexes were observed to rid the nest of the egg shell halves. In the first instance above the female left with half of the shell immediately after it hatched, then returned within three minutes and settled down on the nest. Then she left the nest after being on for 11 minutes and returned with food in six minutes, fed one of the newly

hatched young and then left with the other half of the shell. She returned within half a minute and settled on the nest to brood. In the second case the young apparently began hatching while neither bird was at the nest. The male came to the nest but did not take the egg shell and left as the female arrived and settled down to brood. She stood up several times and poked in the nest but always settled back down. At approximately 26 minutes after the egg had hatched, the female stood up on the rim of the nest and ate one half of the shell, then picked up the other half and left with it. She was back at the nest within a minute. The third instance observed was an egg that broke open while neither adult was at the nest. In this case, however, the male took the smaller half and left with it. He immediately returned to the nest with food but did not feed, then left. After four minutes, he came back to poke in the nest, then left again. Neither adult came to the nest for the next 30 minutes; then the male returned with food. He did not feed, but he picked up the other half of the egg shell and left with it. Gabrielson (1913) observed the female Catbirds to peck at pipped eggs prior to hatching and also to remove the smaller bits of shell from the nest.

The natal down of the newly hatched young is damp and matted and covered with small bits of shell. The adults pick off and eat these shell bits in addition to some bits of shell within the nest. The adults must not carry the

egg shell halves very far from the nest site, since they are usually back to the nest within a minute.

One young at nest No. 10 had the allantois still attached to its abdomen. It remained dried, shrivelled, and attached for several days. This particular nestling showed a noticeable retarded development and never was successfully fledged.

DEVELOPMENT OF NESTLINGS

Table 11 gives the average measurements of weight, wing length, tarsal length, and overall length of all nestlings upon which these measurements were taken. Figure 4 illustrates these data graphically. Table 12 gives the percentages of the average adult weight attained by the nestlings for each day of nest life. Since no adult weights were taken in this study, the average weight was determined from weights given for a total of 162 individuals measured in other studies (Baldwin and Kendeigh, 1938; Blake, 1958; Hartman, 1955; Nice, 1938; Norris and Johnson, 1958; Stegeman, 1955; Wetherbee, 1934). These are tabulated in Table 13. Nice (1943), discussing the weights of passerine nestlings, states that a newly-hatched bird weighs six to eight per cent of the adult; and after the first ten days, the weight increases to 60 to 80 per cent. Young Catbirds in this study weighed 34.5 per cent of the average adult weight on the day of hatching, and at ten days they weighed 72.4 per cent. On leaving the nest at 11 days, the young had attained 76.76 per cent of their adult weight. Data given by Baldwin and Kendeigh (1938) and Wetherbee (1934) on a total of 83 immatures indicated that these birds weigh an average of just 0.38 grams more than the average adult.

Nice (1943) reports data collected by W. E. Schantz on the development of activities in Catbirds which had been raised from eggs. The various activities and the days

TABLE 11

DAILY AVERAGE OF WING LENGTH, TARSAL LENGTH,
TOTAL LENGTH, AND WEIGHT OF NESTLINGS

Day	Wing Length		Tarsal Length		Total Length		Weight	
	n	$\bar{x}$ in cm.	n	$\bar{x}$ in cm.	n	$\bar{x}$ in cm.	n	$\bar{x}$ in g.
0	5	0.76	5	0.51	5	4.14	13	3.06
1	17	0.92	17	0.63	17	4.60	19	4.63
2	19	1.10	19	0.72	19	5.22	19	6.95
3	17	1.30	17	0.93	17	5.35	18	10.44
4	15	1.80	15	1.13	15	6.39	19	13.34
5	16	2.52	16	1.45	16	7.17	18	17.06
6	15	2.92	15	1.60	15	7.62	15	20.47
7	14	3.64	14	1.82	14	8.02	13	23.46
8	21	3.95	21	1.95	21	8.30	19	25.68
9	17	4.59	17	2.00	17	8.67	17	26.76
10	13	4.90	13	2.12	13	8.77	13	26.23
11	8	5.39	8	2.14	8	9.25	8	27.81

AVERAGE MEASUREMENTS OF NESTLINGS

FIGURE 4

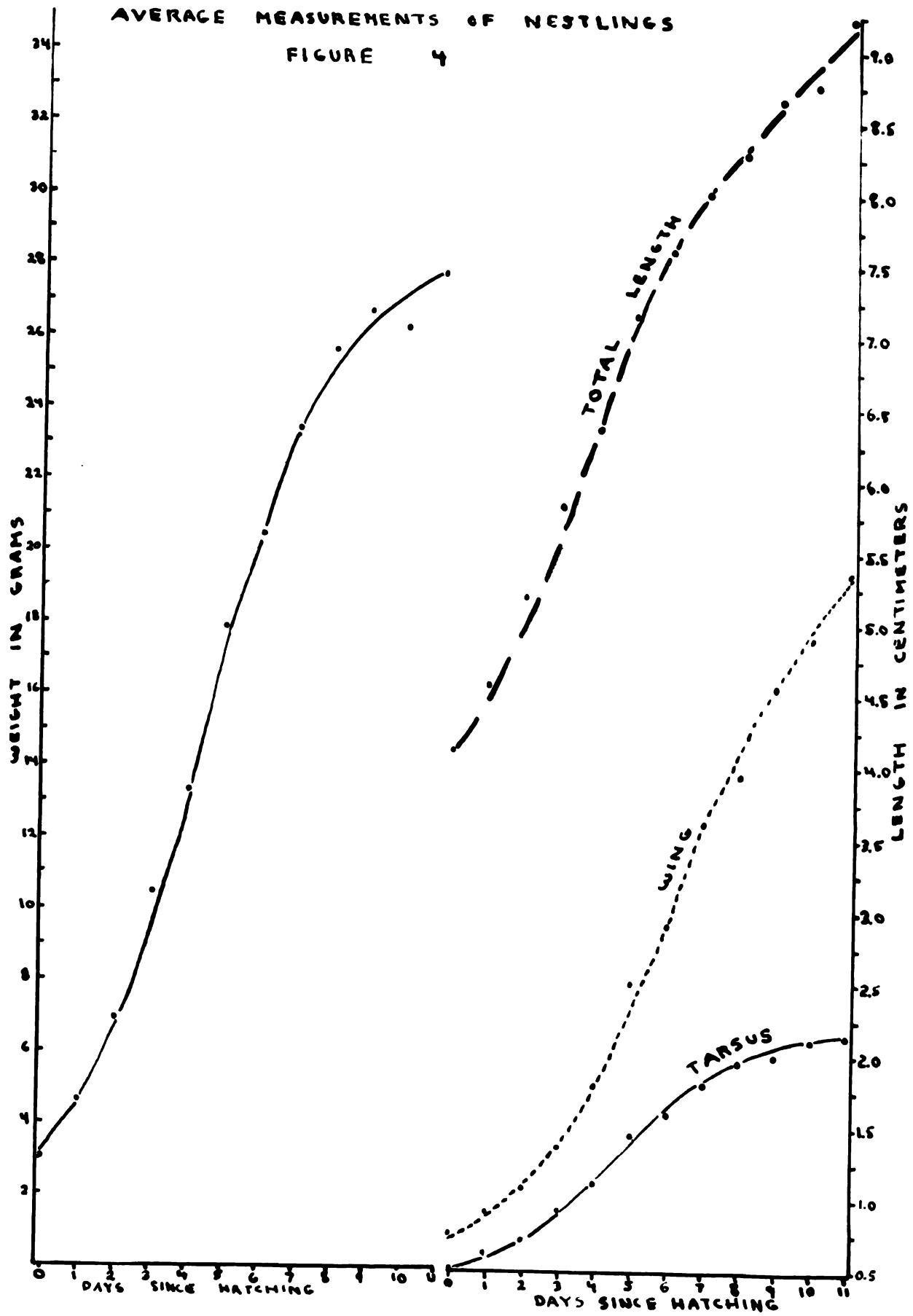


TABLE 12
DAILY PERCENTAGES OF AVERAGE ADULT
WEIGHT OF NESTLINGS

Day	Average Weight	Per Cent of Adult Weight Taken as 36.23 Grams
0	3.06 gms.	8.45 %
1	4.63	12.78
2	6.95	19.18
3	10.44	28.82
4	13.34	36.82
5	17.86	49.30
6	20.47	56.50
7	23.46	64.75
8	25.68	70.88
9	26.76	73.86
10	26.23	73.40
11	27.81	76.76

TABLE 13

ADULT WEIGHTS REPORTED IN THE LITERATURE

Source	Number	Sex	Mean	Freq. X Mean
Baldwin and Kendeigh (1938)	23	♂	34.1 g.	784.3 g.
	23		33.4	768.2
	34		36.5	1241.0
	30		35.5	1065.0
Blake (1958)	1	-	37.0	37.0
Hartman (1955)	8	♂	38.9	311.2
	9		37.7	339.3
Stegeman (1955)	5	♂	45.3	226.5
	3		40.8	122.4
Nice (1938)	13	-	35.9	423.5
Norris and Johnson (1958)	1	♂	40.0	40.0
	1		44.0	44.0
Wetherbee (1934)	11	-	38.5	423.5
Total	162			5869.1 g.
Mean Adult Weight			36.23 g.	

after hatching of appearance of these activities were as follows:

Gaping and defecating	at hatching
Preening	6 days
Cowering	6 days
Stretching legs up	7 days
Stretching wings up	7 days
Stretching sideways	7 days
Scratching head	7 days
Stretching both wings down	7-8 days
Yawning	8 days
Shaking self	8 days
Fluttering wings in begging	9 days
Pecking at objects	9 days
Fanning wings (flight maturation)	11 days
Leaving nest	11-12 days
Landing on other young	11-12 days
Bathing	13 days
Drinking	13-14 days
Antagonism note	13-14 days
Fighting	13-14 days
Singing	60 days

I found young Catbirds giving the first seep-seep begging call at three to five days. On the earliest occasions the young beg only when the adult is on the nest rim. A few days later they begin to beg while the adult is still perched nearby. At four days they were observed to open their bills and give the begging call when no adult was near the nest. By the ninth day in the nest the young are quite active. They seep loudly and stretch their necks with open bills and wing-flutter while begging. Young birds were first observed to preen at the age of ten days. Up until the age of four to six days the young would not defecate when being handled. From this age on, however, they always defecated when taken from the nest to be weighed.

CARE OF THE YOUNG

Brooding

Only the female was observed to brood the nestlings, and I found no records in the literature of a male brooding.

Length of nestling stage

The time in the nest for 15 young was exactly determined. One of them left at 8 days, two at 9 days, four at 10 days, and eight at 11 days. It appears also that at least one young in nest No. 2 and one in nest No. 3 remained until the 12th day. The range, then is from 8 to 12 days with a mean of 10.47 days and median of 11 days. Kendeigh (1952) reports two early departures at 7 and 8 days, but the majority of the young, 8 out of 14, left at 10 days. Herrick (1901) had a young bird leave the nest, perhaps prematurely, at 10 days. Schufeldt (1893) describes the departure of young birds that had been in the nest 10 to 11 days. Davis (1942) felt that the young of one nest left one day early at 11 days, and he had another brood leave at 12 days. Kendeigh reported another nestling that did not fledge until 15 days after hatching.

Attentiveness and inattentiveness

Table 14 tabulates the proportion of the total observation time spent in brooding for each day of nest life at five nests watched during the brooding stage. The percentage of observation time the female spends in brooding

TABLE 14

PROPORTION OF THE TOTAL OBSERVATION
TIME SPENT IN BROODING

Day of Nest Life	Total Observation Time	Total Time Spent in Brooding	Percentages of Total Time Spent in Brooding
0	354 min.	183.0 min.	51.70 %
1	399	244.5	61.28
2	439	170.5	38.84
3	312	198.5	63.62
4	412	93.5	22.69
5	643	213.0	33.13
6	236	62.5	26.48
7	480	119.5	24.90
8	310	10.0	3.15
9	425	16.5	3.88
10	240	none	0.0
11	220	none	0.0

ranges from 51.70 per cent on the day of hatching to a high of 63.62 per cent on the third day, to 5.88 per cent on the ninth day, and to a low of zero per cent on the tenth and eleventh days. Grouping the days into four periods, the percentage of time spent in brooding is 53.86 per cent for days zero through 3, 26.80 per cent for days 4 through 7, 3.52 per cent for days 8 and 9, and zero per cent for the last two days. Gabrielson (1913) determined the average brooding time to be 50.8 per cent. At the beginning of brooding the female spent 77.58 per cent of the observation time on the nest, and he found that this time decreased each day to about 30 per cent as the young became older. Ken-deigh (1952) reported that brooding decreased from 62.1 per cent of the daytime hours on the day of hatching to 51.7 per cent on the first day and to 20.9 per cent on the second day.

Considering all the days of brooding together gives an average of 1.5 attentive and 1.6 inattentive periods per hour. Table 15 lists the number of attentive and inattentive periods and their hourly rate for each day of nest life.

Table 16 shows the attentive periods and Table 17 gives the inattentive periods observed during this study. From the day of hatching through the third day, the attentive periods are longer than the inattentive ones. After the third day, the inattentive periods are longer. These periods are based only on intervals of known length. The

TABLE 15

HOURLY RATE OF ATTENTIVENESS AND INATTENTIVENESS
FOR EACH DAY OF NEST LIFE

Day of Nest Life	Total Observ. Time	Total No. Att. Periods	No. Att. Per./Hr.	Total No. Inatt. Periods	No. Inatt. Per./Hr.
0	354 min.	11	1.86	10	1.69
1	399	20	3.00	20	3.00
2	439	9	1.23	9	1.23
3	312	9	1.73	8	1.54
4	412	9	1.31	10	1.46
5	643	17	1.59	16	1.49
6	236	5	1.27	6	1.53
7	400	17	2.13	19	2.33
8	318	1	0.19	3	0.57
9	425	4	0.56	2	1.13
10	240	0	-	all	-
11	220	0	-	all	-
Total	4018	102		109	
$\bar{X}$			1.5		1.6

TABLE 16

ATTENTIVE PERIODS IN MINUTES FOR
76 PERIODS OF KNOWN LENGTH

Day Of Nest Life	0	1	2	3	4	5	6	7	8	9	10	11
	33	14	23	30	6	11	3	9.5	10	4	0	0
	6	6	3	25	33	7	25	9		7		
	5	3	12.5	21	6	11	5.5	9		2.5		
	3	8.5	8	28	15	10	4	12		2		
	11	8.5	27	27.5	24.5	8		6.5		2		
	5.5	6	14	25.5		6		16.5				
	3	6	65			14		5				
	10	0.5				22		2				
		7.5						2				
		10						13				
		5						5				
		2						15				
		13						1				
		47						15				
		13						1				
		19.5										
		42										
Sum	84.5	211.5	152.5	157	84.5	89	37.5	121.5	10	17.5	0	0
Number	8	17	7	6	5	8	4	15	1	5	0	0
Mean	10.56	12.44	21.79	26.17	16.9	11.13	9.38	8.1	10	3.5	0	0

TABLE 17

INATTENTIVE PERIODS IN MINUTES FOR 75 PERIODS
OF KNOWN LENGTH AND TWO ADDITIONAL
PERIODS OF UNKNOWN LENGTH

Day Of Nest Life	0	1	2	3	4	5	6	7	8	9	10	11
	10.5	22.5	3.5	12	11	14	93	8	163*	9.5	all	all
	3	5	10	13	52	9	12	25	115*	9		
	18	1	8	6	10	19	2	19		47		
	10	7	13	10	37	9	41.5	20		41		
	3	5	16	13.5	64.5	29.5		12.5				
	7.5	4	25	22.5		17.5		14				
	1	9	15	52		85		7				
	7	5				23		12				
	1	3.5				59		23				
		12.5						7				
		1.5						17.5				
		3						9.5				
		14						34				
		1										
		11										
		19.5										
		8										
Sum	61.0	132.5	95.5	109	174.5	188.5	154.5	208.5	278	106.5		
Number	9	17	7	7	5	9	4	13	2	4		
Mean	6.78	7.79	13.64	15.57	34.9	20.94	38.63	16.04	139	24.93		

*Period of unknown length

average inattentive period of the eighth day, however, is an exception; this figure is based on two periods of unknown length.

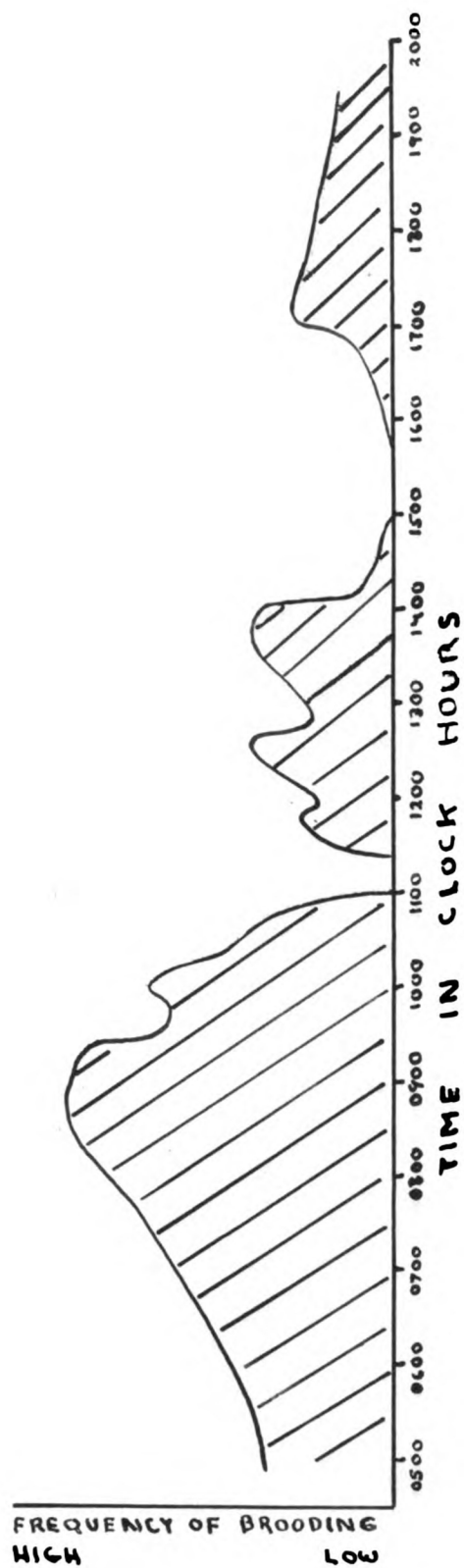
The data on attentiveness and inattentiveness, rate of these periods, and the per cent of observation time spent in brooding are grouped in Table 18 according to the four periods mentioned above. Both the length of each attentive period and its rate function together to result in the successive drop in the percentage of observation time spent in brooding for each of the four periods.

Both Gabrielson (1913) and Kendeigh (1952) agree that the brooding activity in a normal day fell into three periods. The first was from 0430 to 0730 during the coolness of the morning. The second lasted from 1030 to 1400 while the sun was more directly on the nest. The third was from 1630 until dark during the evening coolness. Figure 5 illustrates the relative amounts of brooding observed during this study. As can be seen, brooding did fall into three major groups but with their limits differing somewhat from those determined by Gabrielson and Kendeigh. The first and most active brooding period began around daylight and continued to around 1045. The second period began about 1130 and continued until 1400. The third began at approximately 1700 and lasted until dark. It should be pointed out that the determination of such periods of relative brooding activity are biased by what time of day most of the observation was done. No pre-planned attempt

TABLE 10

BROODING ACTIVITY DURING THE FOUR PERIODS
OF THE NESTLING STAGE

Periods in Days	Length Att. Period in Min.	Att./Hr.	Length Inatt. Period in Min.	Inatt./Hr.	Per Cent of Observation Time in Brooding
0 - 3	17.74	1.96	10.95	1.87	53.26
4 - 7	11.30	1.55	27.63	1.72	26.00
8 - 9	6.75	0.33	81.97	0.35	3.52
10 - 11	none	-	all	-	0.0



AMOUNT OF BROODING DURING AN AVERAGE DAY

FIGURE 5

was made to equalize the periods of observation throughout the day, but an attempt was made to study the nest at least some through all hours of daylight. Just how large a factor such bias was is not known; however, it is felt that the apparent high activity of the first period and the relatively lower activity of the third period might have been in part a reflection of such bias.

Behavior during brooding

When approaching the nest, the female utilizes the same routes she established during incubation. As in incubation, she sometimes comes to the nest with great hesitancy. On one occasion the female of nest No. 12 made seven approaches and subsequent retreats before coming to the nest on the eighth try. The female may come quietly, but particularly if the male remains nearby, she approaches with soft or soft, wheezy mews, or more often with quitts. On 72.04 per cent of all instances where the female came to the nest to brood, she fed at least one young before brooding. The remaining times she did not feed, although occasionally she still had food in her bill. Sometimes the female would come to the nest to feed and then remain perched on the rim for as long as from 12 to 21 minutes before leaving or from 14 to 15 minutes before brooding. Up through the seventh day after hatching, the female broods more often than she leaves; on the eighth and ninth days she leaves more often than she broods; and from the tenth day on, she always leaves after feeding. As was

observed at times during incubation, the female will sometimes be heard to mew on the nest.

During a 30-minute thunderstorm, the female of nest No. 19 showed no special behavior while brooding the young for the entirety of the period. The female of nest No. 12 left the nest during a short early morning shower.

Gabrielson (1913) writes that on days of steady rain of several hours duration, the young were brooded most of the time. Both Whittle (1923) and Bailey (1933) observed that the female shaded the young with widespread wings when the nest was exposed to direct sunlight. No female was observed in this study in such a protective posture, but no nest under close observation during brooding was located where it was exposed to the direct rays of the sun. Bailey also describes the female assuming a widespread-wing posture "with feathers drawn close, bill pointed straight up and eyes shut" during a hailstorm.

While the female is brooding, the male still sings normal-volumed phrases. Occasionally it is a long territory-type song, but more often just a short phrase is sung. Davis (1942) also states that the male sang occasionally during the brooding period.

Females were observed to leave the nest in five different situations. As in incubation, the female left the nest after an approaching male gave a vocal signal, and these cases composed 77.27 per cent of all observed departures. The remaining four situations made up 22.72 per

cent of all departures and included 10.23 per cent after the unsignalled arrival of the male, 2.27 per cent due to the female's leaving the nest with egg shells, 2.27 per cent due to the female's being flushed by or deliberately flying at an intruder, and 7.95 per cent due to unknown causes. The most frequent signals were the quiet song, which comprised 38.23 per cent of all signals heard; and the quitt call, which made up 44.12 per cent. The male of nest No. 12 used the quiet song most frequently while the male of nests No.'s 3 and 19 and the male of nests No.'s 4 and 17 used the quitt call the most. Out of the 77 times the male arrived, with or without a prior signal, the female gave a quitt or mew when leaving the nest 47 times (61.04 per cent). Quite often the female of nest No. 19, upon the signalled approach of the male, did not leave but moved only up on the rim. These were not counted as departures, except in three cases when she subsequently left the nest. This failure to depart completely occurred 14 times at this nest or 45 per cent of the times the male signalled. These data on the females' departures at the five nests observed closely during brooding are in Table 19. Whether departing immediately or after some delay, the female usually leaves over the same route each time.

As the male comes to the nest, he usually uses the same route for every approach, and his is separate from that regularly used by the female. He usually gives a vocal signal whether the female is at the nest or not.

TABLE 19

ACTIVITY ASSOCIATED WITH THE DEPARTURE OF THE
FEMALE FROM THE NEST DURING BROODING

Nest No.	Times ♀ Leaves	Female Leaves		Type of Signal Used					♀ Quitts or Mews After ♂'s Signal or ♂'s Arr.
		No Signal by ♂	After Signal by ♂	Long quiet	Long alarm	↑ ↓	Long alarm normal	Long alarm	
3	1	0	1				1		
4	8	D - 1 M - 2 U - 3	2	1				1	1
12	52	D - 0 M - 5 E - 1 U - 5	41	25		7	9		32
17	6	D - 1 E - 1	4			4			3
19	21	M - 1	20		1	19			11
Total	88	D - 2 M - 9 E - 2 U - 7	68	26	1	30	10	1	47
Per Cent		22.72	77.27						

D - disturbed, M - unsignaled approach of Male, E - egg
shell removal, U - unknown.

Sometimes the female does not leave as the male comes to the nest with food, as in this case at nest No. 12;

"Male singing quietly to south at 0831 - one phrase. Male perched in honeysuckle with food at 0832, wing fluttering. Female with food flew from west past the male to the east and then to the southeast perch. Fed young from the southeast rim and then onto the nest to brood at 0834. Male then came to perch just north, then just above nest, still with food. Female quirt-ing on nest. Male moving about with food, wing fluttering and quitting.....Male to perch just north..female gave a quirt....male flew to honeysuckle.. ..male returned twice to perch just north, then to just above nest.....female reached out and grabbed some food from male, then male fed remaining part to her. Male left immediately".

On several occasions the male and female came to the nest simultaneously with food, perching on different sides of the rim. Both adults fed the young, then the male left immediately. The female remains, removes the fecal sac if there is one, then leaves or settles down on the nest to brood.

The male was observed to feed 177 times while the female was not at the nest. Following these feedings, he leaves the vicinity of the nest 37.29 per cent of the time or assumes the guard perch 62.71 per cent of the time. Sometimes the male would remain on the nest rim as long as 11 minutes before leaving. He is usually silent as he goes to one of his guard perches, the same ones used during incubation; but 25 per cent of these times he gave some sort of vocalization immediately. The male of nest No.'s 4 and 17 and the male of nest No. 12 occasionally went to the nest, did not feed, but assumed the guarding position. It was noted that guarding activity wanes during the last two

days of the brooding period. Table 20 contains data on the activity of the male immediately after feeding.

The male's guarding activity continues to be similar to that during incubation. The male may remain quiet at one perch or move about between several guard perches. The males were observed to gape, preen, quirt, and whispering during the guarding periods. The male also wing flutters in similar circumstances as in the incubation stage. Davis (1942) mentions that he observed the wing-fluttering behavior to continue during brooding. A new activity, however, is food gathering. The male does not guard as tenaciously as he did during incubation, but leaves the guard perch to collect food in the immediate vicinity of the nest. He then goes to the nest and feeds, and then reassumes the guarding activity.

As the female approaches the nest while the male is in the guard position, he sings or gives a call note 80.34 per cent of the time. The most frequently used vocalizations were the quiet song and the quitt call note. After the arrival of the female in the vicinity of the nest, the male leaves directly from the nest area, usually with a quitt, 31.20 per cent of the time. On the other occasions he flies near the female or she flies near him, and they remain close to one another for a few minutes before she goes to the nest. The male of nest No. 12 was the only one that was occasionally heard to sing, most often the quiet song, after the female had settled down to brood the

TABLE 20

ACTIVITY OF THE MALE IMMEDIATELY AFTER FEEDING
(FEMALE NOT PRESENT) - THE GUARDING POSITION

Nest No.	Times ♂ Fed and ♀ Not at Nest	After Feeding		♂ Sang Imm. After at Guard	♂ to Nest Did Not Feed, but to Guard
		Leaves	To Guard		
3	37	32	5	5	0
4	14	4	10	10	2
12	50	9	41	0	10
17	6	1	5	5	3
19	70	20	50	3	0
Total	177	66	111	28	15
Per Cent		37.29	62.71		

young. Table 21 gives the activity of the male at the guard perch upon the arrival of the female at the five nests studied closely during brooding.

Feeding and Food

Feeding activities

Both the female and the male feed the young in the nest. In 403 observed feeding operations in which the sex of the adult was known, the male fed 221 times and the female fed 182 times. Table 22 gives the breakdown of these feedings according to the age of the young. There is only a general relationship between the differences of the number of times the male and female fed and the amount of time spent by the female in brooding (See Table 18). From the day of hatching through the third day, the male fed an average of 5.5 times more than the female. In the second period of brooding, although the female is now brooding only 26.80 per cent of the observation time as compared to 53.36 per cent in the first period, the average difference remains about the same, 6.5 times in favor of the male. In the third period during the eighth and ninth days, when the female is spending only 3.52 per cent of the observation time in brooding, the difference drops to an average of 2.0. Not until the tenth and eleventh days, during which time the female was not observed to brood at all, did the female feed the young more times than the male (6.5 more times).

Herrick (1901) states that the male rarely came to the

TABLE 21

ACTIVITY OF THE MALE UPON THE ARRIVAL OF THE
FEMALE WHILE THE MALE IS GUARDING

Nest No.	When ♀ ♂ Did Not Sing	Came ♂ Sang	If ♂ Sang, Used a					♂ Leaves		♂ Sang After ♀ on Nest
			♀ ♀	♂ ♂	quiet song	normal- vol. song	quit	Direct	To Near ♀	
3	0	6			5	1		6		
4	3	5			5			8		
12	14	43		7	20	10	6	49	2	13
17	2	6		4			2	4	4	
19	4	34	5	4	3	1	21	28	10	
Total	23	94	5	15	33	12	29	95	22	13
Per Cent	19.66	80.34						81.20	18.80	

TABLE 22

NUMBER OF FEEDINGS BY ADULTS DURING
THE DAYS OF NEST LIFE

Day	0	1	2	3	4	5	6	7	8	9	10	11
Male	3	10	15	15	28	31	13	29	26	25	10	16
Female	0	9	7	5	13	22	7	28	23	24	20	19
Difference	3	1	8	10	10	9	6	1	3	1	10	3
Average Difference For Each Period	5.5				6.5				2		6.5	

nest, but that when he did he would pass the food on to the female who in turn fed the young. As has been shown above, the male is quite a regular and active visitor to the nest during the brooding stage both during the guarding activity and to feed the nestlings; but I did witness the male feeding the female who in turn fed the young on numerous occasions at several nests. It is more a case, however, of the female taking the food from the male rather than the male feeding her. The following notes were taken at nest No. 19 on July 29, 1958, and are representative of this behavior.

"At 0821 female came from southeast quitting. Male quitting - male flew to southeast, quitting as female came to perch just southeast, then to just north, to north rim, hesitated just a moment. Did not feed, had no food as far as I could see, and settled down on nest facing east at 0822. Male just south at 0825 with food, quitting. Then to just north, to north rim. Female up on west rim and took some of the food from the male. Male fed what was left and female also fed young. Male left over west rim. Female remained on west rim momentarily, then back down onto nest to brood at 0826."

I observed such behavior by the female at the nest 28 times - twice at nest No. 12, twice at nest No. 17, and 24 times at nest No. 19. It was never observed at nests No.'s 3 or 4, the other two of the five nests under close observation during the nestling stage. At nest No. 19 the male and the female were both there at the same time on 27 instances. On 24 of these the female got at least some of the food from the male. Sometimes this passing of food to the female does not take place right at the nest. On one occasion at nest No. 19 when the young were four days old, the

female was off but nearby the nest as the male came with food. The male fed the female, who then went to the nest to feed the nestlings. Again when these young were 10 days old she had just fed them as the male came to a perch near the nest with food. The female left the nest to perch near the male, took the food from him, and returned to feed the young again. On another day the male came to the nest while the female was on the rim, but he successfully dodged her thrust and fed the young himself. The female, however, took the food out of the bill of the young he had just fed and refed it to the same or a different nestling. Another time, in attempting to dodge the female's thrust at the food he was carrying, the male dropped it into the nest whereupon the female immediately retrieved it and fed the young. And yet on another occasion the male successfully fed one young, but as he brought his head out of the nest with the remaining food in preparation to feed a second, the female grabbed what was left and fed it herself.

When the nestlings apparently did not open their bills at the approach of an adult, the latter gave the quirt call repeatedly until the young usually opened their bills to receive the food.

If the female came to the nest with food, but did not feed; she settled down to brood with the food still in her bill. She usually still had the food in her bill when she left, but twice she ate it while on the nest. Another time, after setting on the nest with food in her bill, the

young began to "seep" after she had been on the nest 7.5 minutes. She stood up, quirted, fed the young, and then settled back down. Only once, when the female did not feed the young, did she eat the food before settling on the nest to brood. The male was observed to fail to feed two times. Both times he ate the food before leaving the nest area.

The average interval between feedings by the adults is 10.04 minutes. Table 23 lists the average interval between successive feedings according to the day of nest life. The longest average interval was 19 minutes and occurred on the second day. The shortest interval, 6.02 minutes, was recorded on both the eighth and eleventh days. Considering the rate of feeding as indicated by the interval between feedings and according to the four periods of brooding, it can be seen that the rate generally increases through the first two periods, days zero through seven, and then levels off at an interval of 6.33 to 7.17 minutes during the last two periods, days eight through eleven. Herrick (1901) reports the rate of feeding to be about once every 3.5 minutes. Kendeigh (1952) states that the rate remains uniform from day to day, being the lowest during the hottest hours of the day. Gabrielson (1913), however, also believes that the daily number of visits does tend to increase with the age of the nestlings.

In food gathering, adults have been observed to cross neighboring territories. Most food, however, was collected within the territory in the near vicinity of the nest.

TABLE 23

AVERAGE LENGTH IN MINUTES OF THE INTERVALS
BETWEEN FEEDING ACCORDING TO THE
DAYS OF NEST LIFE

Day Of Nest Life	0	1	2	3	4	5	6	7	8	9	10	11
Average Interval	7.5	19	14.21	11.67	10	10.35	11.39	8.34	6.02	7.63	8.32	6.02
Number of Obsrv. Intervals	1	16	19	16	42	44	13	52	43	43	23	33
Average Interval For Each Period	13.10				10.02				6.03		7.17	

Food

Numerous studies have been made on the food of nestlings and of adults. Judd (1900) examined the stomachs of 14 nestlings and found their food to be 4 per cent vegetable and 96 per cent animal material, the latter primarily of ants, beetles, caterpillars, spiders, and grasshoppers. Gabrielson (1913) gives a detailed list of foods he observed being fed to the young. Although some food that was fed the young in this study was recorded in my field notes, I made no real effort to determine the exact nature of the food given the nestlings. The food of the adults is split about equally between insects and fruit. Table 24 tabulates food studies reported by Beal (1897), Judd (1897, 1900), and Purdum (1902). Barrows (1912) reports after Forbes that the fruit content of the food increases more and more as the season progresses. In May the food is 100 per cent insectivorous, then in June insects comprise only 64 per cent, and by July the insect portion is down to 15 per cent. There are two reports of the Catbird eating bees (Grant, 1945; Wood, 1930), and Phillips (1927) recorded a Catbird observed to wade into shallow water at a fish hatchery and catch $1\frac{1}{2}$ inch trout fry.

Nest Sanitation

If a fecal sac was voided after feeding, it was either carried away or eaten. The carrying away of a fecal sac, however, was not observed until the fifth day of nest life. On the eighth day the sac was carried away about as often

TABLE 24

FOOD OF THE ADULT IN OTHER STUDIES

Source	Number of Stomachs Examined	Animal	Vegetable
Beal (1897)	213	44% { 3/4-ants, beetles, caterpillars, & grasshoppers 1/4-bugs, miscell. insects, and spiders	55% { 1/3-cultivat- ed fruit 2/3-wild fruit
Judd (1897)	200	50% all insects	50% all fruits
Judd (1900)	11	9% unspecified	91% all fruits
Purdum (1902)	192	47%* { 24%-beetles 10%-ants 5%-caterpillars 4%-grasshoppers 4%-spiders and myriapods 2%-bugs 5%-miscellaneous	55%* { 15%-cultiv. fruit 35%-wild fruit 2%-misc.

*Purdum also counted 1% as mixed mineral matter

as it was eaten. From the ninth day on, it was more often carried away than eaten, but eating of the excreta was observed on every day except the tenth. Gabrielson (1913) states that up to the sixth day the fecal sac was devoured; from the sixth day on, however, some were eaten while others were carried away. The proportion carried away increased toward the end of nest life. He found the fecal sac to be removed 19 times and eaten 54 times, or 2.84 times as often. I observed the fecal sac to be carried away 35 times and eaten 122 times or 3.49 times as often.

If the young do not void after feeding, the adult may perform some other action such as poking in the nest, merely waiting or leaving immediately. Rand (1942) believes that fecal sac removal is a complimentary action to feeding, and the adult will substitute some other activity such as pecking the young or poking in the nest if no sac is voided by the young. My observations do not support Rand's belief. In 411 feeding operations that were observed at the nest, the following subsequent behavior was noted:

If a fecal sac was voided -	
ate fecal sac 122 times	29.28%
carried sac away 35 times.....	8.52%
If a fecal sac was not voided -	
substituted some other behavior 44 times..	10.71%
poked or pecked in nest 33 times...	8.03%
brooded 10 times.....	2.43%
left with egg shell 1 time.....	0.25%
hesitated or waited some at the nest 103	
times.....	25.06%
left immediately 104 times	25.70%

Not known if sac was voided or not..... 0.73%

After only 10.71 per cent of all feedings did the adults substitute some other behavior, while 25.06 per cent of the time they merely waited, and 25.30 per cent of the time they left immediately. Table 25 tabulates these data for each day of the brooding stage. On two occasions when both the male and female fed at the nest together, only one sac was voided. The male tried to get the excreta, but both times the female got it. The male then left immediately.

Nest Helpers

I have no observations of other individuals of the same or different species helping the adults with their nesting activities. There are several instances, however, reported in the literature. Weatherbee (1930) reports a situation where a Robin nested a few feet from a Catbird's nest. The Robin was found incubating on the Catbird nest numerous times; and after the young Catbird's eggs hatched, the young were regularly brooded and fed by the adult Robin. After the female Cardinal had disappeared, Brooks (1922) observed a Catbird feeding the Cardinal's young until they were able to fend for themselves. In this instance the male Cardinal tried unsuccessfully to drive the Catbird away. Hayward (1937) reports a Catbird feeding a half-grown Flicker (Colaptes auratus).

Sometimes other Catbirds came to the vicinity of the nest to join the adults in alarm calls as I checked the young. In only one instance out of the seven where a

TABLE 25

NEST SANITATION ACTIVITY FOR EACH DAY OF NEST LIFE

Day	Times Fed	Ate Sac	Took Sac	Poked	Brooded	Took Shell	Hesitated	Left Imm.	Unkwn.
0	4				1	1	1	1	
1	19	12			6		1		
2	24	6		1	3		10	4	
3	23	11		2			7	3	
4	50	23		6			15	6	
5	54	18	2	5			22	7	
6	21	8	1	3			6	3	
7	60	30	2	2			16	7	3
8	52	9	8				2	33	
9	50	4	12	14			14	6	
10	30		2				4	24	
11	24	1	8				5	10	
Totl.	411	122	35	33	10	1	103	104	3

Catbird trespassed onto the territory of another in this type of situation did the male of the territory drive off the intruding bird. On three occasions at two different nests a Brown Thrasher (Toxostoma rufum) that was nesting nearby came to the nest, giving a call similar to that of the quirt of the Catbird, while I was checking the Catbird's nest. In another instance at nest No. 20 an Ovenbird (Seiurus aurocapillus) was attracted by the fuss of the adults around the nest while I weighed the nestlings. The Ovenbird gave loud chips.

FLEDGING

Only at nest No. 19 was the normal departure of the young observed. In every other case the young exploded from the nest on my morning weighing rounds. In these explosive departures the young fly off in all directions to perch near or on the ground. Some scurry under some kind of cover in the ground litter, and others remain perched in the open under the nesting thicket. If the young can be found, they are easily caught and brought back to the nest. Some young, when placed in the nest again, would remain there; others immediately left the nest again. In all cases where the young stayed in the nest after being replaced, they were gone from the nest by the end of the day.

In the two days preceeding the departure, the young are quite active in the nest, moving about and fluttering their wings. In departing from the nest the young move up on the rim and then out onto the nearby branches. They move about very little and flutter their wings to help maintain their balance. The adults continue to come to feed them at their perches near the nest. Five days after fledging was the latest that fledglings were found in the immediate vicinity of the nest.

RENESTING

Of the seven pairs that were successful for a first nesting, five renested. Only nest No. 7 and nest No. 10 were not followed by a second nesting. The adults in these two cases were gone from the territory soon after fledging of the first brood. The time between broods was counted from the day of fledging of the first brood to the laying of the first egg in the second nest. The distance between the first and second nest was paced off in a straight-line direction. The five second nestings were as follows:

No. 12 followed No. 2 by 11 days and was 30 feet away.
No. 19 followed No. 3 by 14 days and was 315 feet away.
No. 13 followed No. 5 by 10 days and was 60 feet away.
No. 18 followed No. 6 by 11 days and was 65 feet away.
No. 14 followed No. 8 by 8 days and was 150 feet away.

The second nest then followed the first by an average of 10.8 days and was located an average of 124 feet away. Both Latham (1936) and Mousley (1917) give an elapsed time of 11 days which agrees with this study. Mousley, however, states that the second nest was 250 yards from the first; and Black (1929), reporting on three successive nests of a single pair in one season, stated that each nest was only a "few inches" from the previous one. The second nest in these five instances was built in the area in which the young of the first nest were being fed.

I have no direct evidence that the pairs in the first nestings remain mated for the second. As has been stated, the male does continue to defend the territory while the first brood is being fed. It was also observed that both

of the adults feed the young in the days following fledging. The male of territory M continued to feed the young in the area in which the female was building the second nest. The male of territory D fed an immature bird near the second nest while the female was incubating. Forbush (1929) writes that the male feeds the first brood, since the second nest is begun almost immediately after they leave the nest. I feel quite certain, in view of these observations, that the male is the same for both nestings; but I cannot say anything in this regard about the female.

There were no third nestings, and Barrows (1912) states that two broods are usual for Michigan. In South Carolina Charles (1954) reports three broods occurring and Forbush (1929) also mentions that three broods had been reported in Massachusetts.

Three instances of renesting following the failure of the first nest occurred. In one case, in territory J, the male involved was a partial albino so that his identity in connection with the two nests was certain. In the other two cases the territory of each was closely observed, and the males remained on their territories and sang regularly during the elapsed time. As in the case with the other second nestings, it is not known if the female of these renestings was the same. These renestings were as follows;

No. 1 was last in use the day the second egg was laid. The second nest, No. 22, received its first egg 42 days later and was located 203 feet away.

No. 4 was last in use on the eight day after the young were hatched. It was followed 14 days later

by No. 17, located 135 feet away.

No. 9 was last in use during incubation (exact day unknown). The first egg was laid in No. 23, 45 days later. This second nest was 60 feet from the first.

There is then an average of 33 days before the first egg in the second nest is laid, and this nest is located an average of 134.33 feet away. Charles (1954) writes that only seven days passed before the first egg in the second nest was laid after a snake ate the young of the first nest.

There is a change in the shape and size of the territory for the second nest, perhaps because the center of activity shifts. For example, in territory M, nest No. 19 was located on the opposite side of the territory from No. 3. With this change in the nesting site, the area around No. 3 which bordered territory K was relinquished to the male of that territory. Of the five normal second nestings and the three renestings after the initial nest failed, only in territory R, where the second nest was close to the first, was there no apparent shift in the size and shape of the territory.

NESTING SUCCESS

Nesting Results

Of the 23 nests under observation, 14 or 60.87 per cent fledged at least one young. Tables 26 and 27 tabulate these nesting results. Batts (1958) found 43 to 47 per cent of 53 nests successful, and Berger (1951b) had 62.5 per cent of 40 nests fledge at least one bird. In a total of 169 nests, Kendeigh (1942) reported that 70 per cent were successful. Young (1949) writes that out of 22 nests, 55 per cent were successful.

In these 23 nests 74 eggs were laid. A total of 27 eggs did not hatch as a result of the following causes:

- 3 - either infertile or died as embryos
- 17 - predation
- 2 - desertion

The 47 eggs hatching were 63.51 per cent of those laid. A comparable figure of 65 per cent is given by Young (1949), but Berger (1951b) found that in 21 nests studied, 93 per cent of the eggs hatched.

Of the eggs that did hatch, 36 or 76.60 per cent of the young were fledged. Of the 11 young lost two fell from the nest, one died from exposure and the other from exposure or predation, and the remaining nine died as a result of predation. Young (1949) reports a similar figure of 79 per cent, while Kendeigh (1942) found 65 per cent of the hatched young finally fledged.

Comparing the number of young fledged to the total eggs laid, 48.65 per cent of the eggs produced fledglings.

TABLE 26

NESTING RESULTS IN 23 CATBIRD NESTS

Period	Nest No.	Eggs Laid	Eggs Hatched	Young Fledged
First	1	2	0	-
	2	4	4	4
	3	4	4	4
	4	4	3	0
	5	4	4	4
	6	4	2	2
	7	3	2	1
	8	4	4	3
	9	2	0	-
	10	3	3	2
	11	4	3	0
Second	12	2	2	2
	13	4	0	-
	14	3	0	-
	15	4	0	-
	16	2	2	2
	17	4	2	0
	18	3	3	3
	19	3	3	3
	20	3	3	3
	21	2	1	1
	22	3	2	2
	23	3	0	-
Total		74	47	36

TABLE 27

CAUSES FOR LOSS OF EGGS AND NESTLINGS

Nest No.	Infertile or Embryo Died	Deserted	Predation	Exposure	Exposure or Predation
Eggs					
1			2		
4	1				
6	2				
7			1		
9			2		
11			1		
13			4		
14		2	1		
15			4		
17			2		
21	1				
22	1				
23	3				
Total	8	2	17		
Nestlings					
4			2		1
7				1	
8			1		
10			1		
11			3		
17			2		
Total			9	1	1

Berger (1951b), in 23 nests, reported that 65 young (92 per cent) were fledged from 79 eggs laid. Kendeigh (1942) found that 55 per cent of the eggs laid developed fledglings. Young (1949) reported that 51 per cent of the eggs eventually resulted in fledged young.

Nesting activity can be grouped into two periods according to the time of nesting, and their respective successes determined. In the first period from May 18 to July 3, composed entirely of first attempts, 30.56 per cent of the 30 eggs laid hatched. Six eggs were lost to predation, and three were either infertile or contained dead embryos. Of the 29 young hatched, 68.97 were fledged. Seven nestlings were lost to predators and two died from exposure and/or predation. The second period from June 19 to August 25 was made up of probable late first nestings or early second attempts and second nestings following a successful or unsuccessful first nest. In these nests only 50 per cent of the 36 eggs hatched, but of the 18 nestlings only two were lost, both presumably through predation in nest No. 17. This gives a fledging success of 88.89 per cent. In summary then, the success of the two nesting periods was as follows:

	Hatching	Fledging
First Period	30.56%	68.97%
Second Period	50.00%	88.89%

First nestings suffer their greatest loss from the failure of the hatched young to fledge, while later nests are

unsuccessful due to the failure of the eggs to hatch.

Predation

As has been shown predation is the major factor in the loss of both eggs and nestlings. Both Young (1949) and Batts (1958) also found this to be true. No actual instances of predation, however, were observed during the study. A red squirrel did come to nest No. 17 while the female was brooding the single remaining young, but the squirrel was driven away by the female before the nest was plundered. The young that fell out of nest No. 4 was last seen on the litter in the shallow gully under the nest with an eight-inch Milk Snake (Lampropeltis doliata) a few feet away. Apparently the snake had been attracted by the presence of the young and was perhaps anticipating a meal. I had to leave the study area before the outcome could be observed. One young of nest No. 11 was found dead in the nest early one morning with its head bitten off. Perhaps this was due to predation by owls. Both Barred Owls and Screech Owls (Otus asio) had been observed in the area during the study.

The only evidence of egg predation was the finding of broken egg shells under or near the nest. Often when eggs were missing from the nest there was no sign of them at all, the eggs apparently having been carried off.

On the day of the departure of their nest mates two young were found directly under their nests with most of the parietal and frontal areas of their skulls pecked away.

Both young killed were the runts of their broods. In one case, at nest No. 9, the young bird probably could fly, but of the four young, it had the shortest wing measurement. At nest No. 10 the nestling was the second of the three hatched, but was so retarded that the barbs of the wing feathers had not broken through the sheath, and it probably could not fly at all. It might be that both these young were killed by the adults, either accidentally or intentionally, when they failed to leave the nest, though this is purely conjecture. No such instances are recorded in the literature.

The following predators were found on the study area:

- Reptilia: Milk Snake (Lampropeltis dolia)
 Blue Racer (Coluber constrictor)
 Garter Snake (Thamnophis sp)
- Aves: Marsh Hawk (Circus cyaneus)
 Screech Owl (Otus asio)
 Barred Owl (Strix varia)
 Blue Jay (Cyanocitta cristata)
 Common Crow (Corvus brachyrhynchos)
 House Wren (Troglodytes aedon)
 Common Grackle (Quiscalus quiscula)
- Mammalia: Eastern Chipmunk (Tamias striatus)
 Red Squirrel (Tamiasciurus hudsonicus)
 Long-tailed Weasel (Mustela frenata)

Table 28 lists the various species reported in the literature as proven predators on Catbird nests.

Desertion

In the study by Young (1949), 13.04 per cent of his 22 nests were lost through desertion. I had only one case of nest desertion (4.35 per cent of all nests); and it might have been the direct result of predation, since of

TABLE 20

CATBIRD NEST PREDATORS REPORTED IN THE LITERATURE

Source	Species
Mammalia	
Batts (1958)	Gray Squirrel (<u>Sciurus carolinensis</u>)
Charles (1954)	Rat (<u>Rattus norvegicus</u>), Cat (<u>Felis domestica</u>), and "mischevous boys"
Errington (1935)	Red Fox (<u>Vulpes fulva</u>)
William and Br. Alphonsus (1917)	Cat (<u>Felis domestica</u>)
Aves	
Batts (1958)	House Wren (<u>Troglodytes aedon</u>), probable
Bent from Breckenridge (1948)	Marsh Hawk (<u>Circus cyaneus</u>)
Bent from Trine (1948)	Grackle (<u>Quiscalus quiscula</u>)
Charles (1954)	Grackle (<u>Quiscalus quiscula</u>), Blue Jay (<u>Cyanocitta cristata</u>)
Hamerstrom and Hamerstrom (1951)	Cooper's Hawk (<u>Accipiter cooperii</u>)
Howell (1951)	Duck Hawk (<u>Falco peregrinus anatum</u>)
Lee (1927)	House Wren (<u>Troglodytes aedon</u>)
Morse (1923)	Long-eared Owl (<u>Asio otus</u>)
Nauman (1916)	Blue Jay (<u>Cyanocitta cristata</u>)
Phillips (1951)	Barn Owl (<u>Tyto alba</u>)
Pinder (1923)	Screech Owl (<u>Otus asio</u>)
Warren (1890)	Crow (<u>Corvus brachyrhynchos</u>)
Young (1949)	Grackle (<u>Quiscalus quiscula</u>)

TABLE 28 Continued

Source	Species
Reptilia	
Batts (1950)	Common Garter Snake (<u>Thamnophis</u> sp.)
Clarke (1915)	Milk Snake (<u>Lampropeltis</u> <u>doliata</u>)
Laskey (1946)	Pilot Black Snake (<u>Elaphe</u> sp.)
Spencer (1920)	Black racer (<u>Coluber</u> <u>constrictor</u>)

the three eggs laid the third egg had disappeared over the night prior to finding the nest deserted. One cannot rule out the possibility that the female also might have fallen prey. No adults of other nests under observation were known to have disappeared.

Cowbird Parasitism

I observed no instances of parasitism by the Cowbird. Friedmann (1929) lists the Catbird as a very uncommon victim, stating that "the Cowbird has never been definitely reported to be successful with this bird". He also writes that the Catbird refuses to tolerate the Cowbird's eggs, throwing them out of the nest. Todd (1940) also refers to this activity of throwing the foreign eggs out of the nest. Norris (1947) found one nest out of 47 (2.1 per cent) parasitised by a single Cowbird egg which did not hatch. In a total of 71 nests, Berger (1951a) found only one nest parasitised (1.41 per cent). This nest contained two Cowbird eggs and four eggs of the host, but the Cowbird eggs disappeared two days after they were discovered. Berger planted an egg of the Cowbird in a Catbird nest, and an adult removed this egg within three minutes, flying off with it in its bill. He suggests that the Catbird may be a common host species; but since the Cowbird lays very early in the morning, the Catbird has already removed the egg before the nest is observed. Trautman (1940) had no eggs or the young of the Cowbird in 35 nests, but reported two occasions where Catbirds were feeding Cowbird fledglings

out of the nest. Nickell (1950) discovered only 0.27 per cent of 3,000 Catbird nests in southern Michigan parasitised by the Cowbird. These Cowbird eggs disappeared from most nests in less than a day, and he also believes that they are probably taken out by the Catbirds. In several nests Cowbird eggs were found partially covered by the lining material or buried two inches deep in the nest foundations. One nest, however, had two 6 to 7 day old Catbirds and one almost-fledged Cowbird.

Bent (1948) reports that the eggs of the Yellow-billed Cuckoo (Coccyzus americanus) have been found in Catbird nests, but there are no reports of a case of successful parasitism by this species.

External Nest Parasites

No study of nest parasites was made, but mosquitoes were observed to feed on the partially feathered nestlings. Turle (1930) found lice on newly fledged young, and Laskey (1944) reported heavy infestation of the nest and nestlings with mites, Mallophaga, and ticks.

POST-NESTING ACTIVITY

Dispersal of the Young

After fledging, the young remain in the immediate vicinity of the nest for five to eight days. Depending on the cover, they may remain in the nest thicket, as at nest No. 3, where the young stayed within the confines of the isolated nesting thicket up to the fifth day, or they may be found from 40 to 60 feet away. After this period, the young, accompanied by the adults, move farther away. I have recorded them at distances from 150 to 350 feet away from the nest. The young were still being fed by the adults at this distance on the twelfth to fifteenth day. With first broods this overlapped with nest-building and egg-laying activity of the female, and in cases where the sex of the adult was known, only the male was feeding the young by this time.

I have only three records of young birds any great length of time out of the nest. Two are observations of the single young of nest No. 21 seen approximately 1650 feet from the nest on the 30th and 41st day after fledging. Both times this bird was in a small group of other Catbirds (3 one time, 5 the other). The other record is of one young from nest No. 19, 350 feet from the nest on the 37th day after fledging. It was accompanied by two other unmarked young (all the young of that brood were marked).

Flocking

After the nesting activity ceases and the male no longer is singing any song, the territory is abandoned. The latest observation of an adult on its now defunct territory was twelve days after the fledging of the second brood. I found no immatures on what had been the nesting territory after the fifteenth day. Laskey (1946) states that from her banding records it appears the immatures remain on the territory after fledging, but she gives no time. Both adults and young birds congregate in low areas, such as along Vermilion Creek or in brushy, marshy flats or hollows. Although I have insufficient evidence, census figures of these loose flocks, while not discerning individuals, suggest that a particular flock is stationary, remaining in one general locality. Gill (1936a) believes these small, loose flocks are family groups, composed of the female and young and occasionally the male. The young of nest No. 21 may have been with its parents when seen again, but it was also accompanied by non-related Catbirds, and the one immature of nest No. 19 was with two other juveniles that were not nest mates. Perhaps these flocks are not always family groups as Gill suggests.

Fall Departure

Since my last day in the field was September 23, I do not know when the Catbirds left the study area. Barrows (1912) gives September and October and occasionally November as the months of departure in Michigan. Wood (1951)

places the usual departure time during the first and second weeks of October in southern Michigan.

SUMMARY

The nesting of the Catbird was studied in Clinton County, Michigan, during the spring and summer of 1953 on a 306.78 acre area with a vegetative cover of approximately 1/4 deciduous woodland, 1/4 woodland edge, 1/8 Cornus-Carex lowlands, and 3/8 uplands of fallow pasture, brushy abandoned fields, and several cultivated plots.

Male birds were first observed on the study area on May 6, although they had been seen in the East Lansing area five days earlier. The females arrived no more than nine or ten days later.

Three songs of the male were discerned: the normal-volumed song used most often in territory proclamation, the quiet-song used as a signal song and in territory defense, and the whisper song which was also used as a signal song. There are four categories of call notes: the mew, quirt, quitt, and ratchet-call. They are variously used by both sexes in territory defense, in nest-related activities, in communication between the pair, and in alarm situations.

The young were heard to give a food-begging and location call, a loud metallic "tsip", and a wheezy-sounding mew.

The male began to sing shortly before sunrise and has been reported by others to sing at night.

No females were heard to sing.

Song cessation was completed by the first week of

August and no second song period occurred.

Territories were immediately proclaimed through singing by newly arrived males, and chase-singing clashes occurred between neighbors along the territory boundaries. The male of an established territory defended it against other Catbirds with an advance accompanied with a wheezy mew, an attack, and a chase. Interspecific defense differed in that no wheezy mew was given prior to the attack and there was no chase. Both sexes attacked non-avian intruders with a raised-wing, tail-spread, feathers-erected display. The male sang the quiet song and both sexes mewed loudly and quirted. The display of the female, however, is less vigorous. The territory was defended until completion of the second nesting. The average size of 15 maximal territories was 3.1704 acres giving 0.315 pairs per acre. There was evidence of the existence of a small reserve of unmated males.

The only courtship display observed was the chase between the male and female.

Both adults carried nest materials during the early days of building, but the female apparently made the site selection and finished the construction. There was no prolonged period of site selection for the second nest. Measurements were taken on 24 nests and their average height was 63.88 inches above the ground. These nests were located in 14 different species of trees and shrubs, and grape vines formed a part of the base or were

immediately adjacent in all but two nests. Most were in brushy uplands, with woodland edge containing the next largest number. The nest is a three-layered structure with herbaceous materials, woody twigs, and bark as the most abundant constituents. It was always found lined with rootlets.

The number of eggs per clutch averaged 3.27. Oviposition began the day after the nest was completed and always occurred in the morning, most often between 0900 and 1000. An egg was laid each day until the clutch was complete.

Only the female incubated. Incubation time was 14 days for the first egg and 13 days for the other eggs in the clutch. The incubation period was 13 days. The eggs in one nest were incubated through the 23rd day before the nest was abandoned. Incubation did not begin until at least the second egg was laid. The average inattentive period was 12.03 minutes, while the average attentive period was 20.53 minutes. There was no daily variation in attentiveness.

The female usually used the same route in coming to the nest to incubate, often giving mew calls as she approached. The male continued to sing the normal-volumed song during incubation. The female left the nest almost half the time in response to the male's signal. The male was seen to feed the female once after she had left the nest. During the inattentive period the male assumed the guard perch 77.6 per cent of the time and maintained

it for 81.2 per cent of the unattended period. During guarding the male whisper-sang, preened, and wing-fluttered. Females were also observed to wing-flutter at other times. When the female returned, the male gave some sort of vocalization 59.1 per cent of the time before leaving and was also heard to sing 45.1 per cent of the time after the female was on the nest. The female was observed to gape while incubating on hot days.

The female apparently contributed to the hatching of the egg by pecking at the shell. Both adults rid the nest of the egg shells by carrying them away. Once, however, the female ate one half of a shell. The adults also ate the smaller bits of shell in the nest and on the natal down of the nestlings.

On the day of hatching, the young weighed 2.45 per cent of the adult weight and by the day of fledging weighed 76.76 per cent. Total length and the lengths of the wing and tarsus were taken daily. The nestlings were first heard to give the food-begging call at three to five days.

The young spent an average of 10.47 days in the nest. Brooding was done entirely by the female. She brooded 53.86 per cent of the observed time the first four days, 26.00 per cent of the time the next four, only 3.52 per cent the next two, and not at all on the last two days. The drop in brooding was a result of a decrease in the length of each attentive period and a decrease in the rate of these periods. Brooding fell into three periods during

the day. The female used the same routes she established during incubation. While the female was brooding, the male still sang the normal-volumed song but usually just a short phrase. The female left the nest after the male's signal 77.27 per cent of the time. The most frequent signals were the quiet-song and the quitt. He came to the nest over a route that is different from that used by the female, and he usually signalled whether the female was there or not. Sometimes the female did not leave as the male came to feed. On these occasions she almost always took some of his food to feed the nestlings herself. When the female was not at the nest, the male assumed the guard perch 62.71 per cent of the time. He was observed to gape, preen, quirt, and whisper-sing at the guard position and to interrupt guarding with food gathering in the immediate vicinity of the nest. He signalled again 80.54 per cent of the time the female returned.

Both adults fed the young, but the female did not feed more often than the male until the last two days of the nest life. If the nestlings did not open their bills immediately, the adults quirted. The average interval between feedings was 10.04 minutes. The feeding rate generally increased during the first eight days and then remained about the same for the last four. A review of the literature gave the proportion of the various kinds of food eaten by immatures and adults.

The fecal sac was seen to be eaten by the adults on

every day of nest life except the tenth. Beginning on the fifth day and continuing until fledging, the excreta were also carried away. From the ninth day on they were carried away more often than eaten. If there was no fecal sac voided after feeding, the adults substituted some other behavior 10.71 per cent of all post-feeding periods as compared to leaving the nest immediately 25.30 per cent of the time after feeding.

Only one brood was observed during normal departure; all other broods exploded from the nest as I came on my morning weighing rounds. Five days after fledging was the latest that the young were found in the immediate vicinity of the nest.

Second nestings followed 10.8 days after the fledging of the first brood and were located an average of 124 feet away. Renestings following the failure of the first nests averaged 33 days later and were built 134.33 feet away. There was a change in size and shape of the territory with the second nest.

Of the 23 nests under observation, 60.87 per cent fledged at least one young. Although no actual cases of predation were observed, it was the major factor in both the loss of eggs and nestlings. No cases of parasitism by the Cowbird were found.

The fledglings remained in the area of the nest for five to eight days. After this they were found 150 to 350 feet away in an area in which they remained until they were

no longer fed by the adults. One juvenile was found 1650 feet from its nest on the 30th and again on the 41st day after fledging. Another was found 350 feet away on the 37th day. Small, loose flocks of adults and young formed in the lower portions of the study area and perhaps remained in the same general location. There was no evidence to suggest that these flocks were composed of family groups. Fall departure from the study area was not observed.

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