

A LIFE HISTORY STUDY OF THE INDIGO
BUNTING, PASSERINA CYANEA

by

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A Report of An Original Investigation at the
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INTRODUCTION

In the summer of 1947, while a student at the University of Michigan Biological Station, Douglas Lake, Cheboygan County, Michigan, I decided, at the suggestion of Dr. O. S. Pettingill, to make a life history study of the Indigo Bunting, Passerina cyanea. My cabin-mate, Helen Ripley, worked with me on this problem and all data obtained were made available to both of us.

From June 23 to 26, we succeeded in locating several bunting territories by finding one or more singing males in an area. Then on June 29 two nests were found, on June 30 two more, and later two others. Records were kept on each of these nests until they were abandoned or destroyed, the final date for the last one being August 4.

The six nests found were designated by the first six letters of the alphabet in the order in which they were discovered. These letters are also used on the map, Figure 1, to show the location of the nests. Nest E was empty when found and remained so.

Some observations were made on five pairs of Indigo Buntings, all of them along roadsides and all but one along the Cheboygan-Fellston Road within three miles of the Biological Station camp. The other pair was about a mile from the Station on the Topinabee Road. The most detailed observations were taken on the last-mentioned,

Figure 1 -- Location of Nests
UNIVERSITY OF MICHIGAN BIOLOGICAL STATION

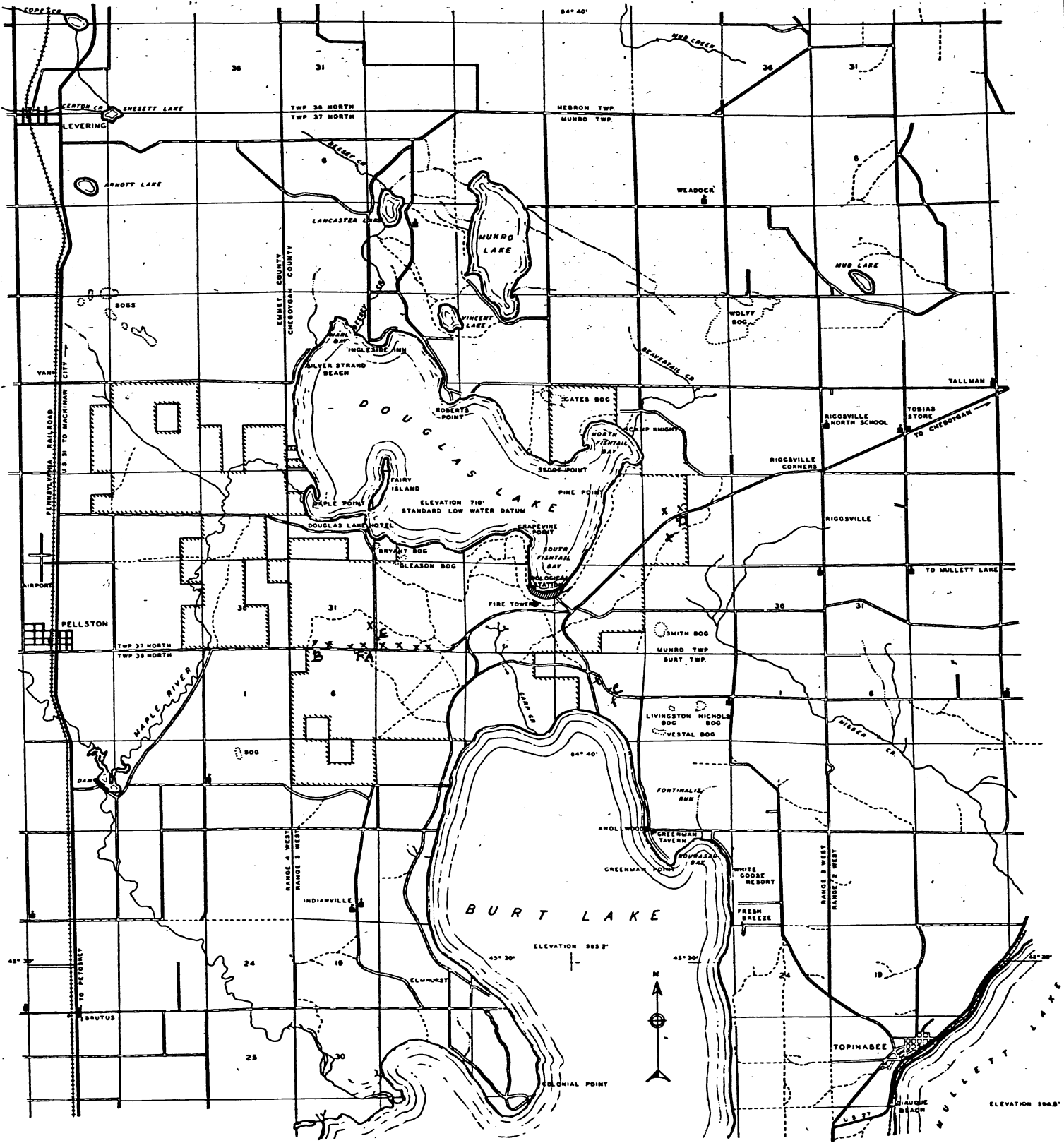
AND DEMONSTRATION FOREST
CHEBOYGAN AND EMMET COUNTIES, MICH.

X Singing Male
A, B, etc. - Nests

LEGEND
CHURCH, SCHOOLHOUSE
BOUNDARY OF UNIV. LANDS
RAILROAD

SCALE
0 1/2 1
MILES
0 1/2 1
KMS

LEGEND
PAVED HIGHWAY
GRAVELLED ROAD
GRADED ROAD
UNIMPROVED ROAD
TRUCK TRAIL



Nest C, as a blind was put up and 29 hours spent in careful observation there.

As neither Helen nor I had a car during this period, we would have been handicapped considerably in our studies of the more distant nests had it not been for cars loaned to us by our good friends and fellow students, Margaret Feigley and Robert Whiting. I wish to thank them for their generous assistance in the matter of transportation. I also gratefully acknowledge the helpful suggestions given by Dr. Pettingill and the observation data given me by Helen Ripley.

ENVIRONMENT

The area where this study of the Indigo Bunting was made is in the northern part of the lower peninsula of Michigan. It is of glacial origin and much of it is covered with lakes and bogs, but there is a considerable area of sandy uplands which were once covered with forests of pine or hardwood. These forests were destroyed by lumbering operations late in the 1800's, following which there were extensive fires. A part of the area was burned as recently as 1923, but most of it was last burned much longer ago.

As a result of the burning there is now a fairly good forest cover of aspens, Populus grandidentata and Populus tremuloides, and their associates, the red maple, Acer rubrum, white birch, Betula papyrifera, and northern oak, Quercus borealis. This forest growth is highly

avored by the mild summer climate and ample rainfall well distributed throughout the year.

The roadsides through the aspen-forested areas seem to be favorite nesting places for the Indigo Buntings, doubtless because they provide the particular type of situation usually selected by the birds, namely, many clumps of low bushes in the open but in close proximity to the higher trees of the forest.

Typical roadside vegetation here is bushy and made up of young aspens, red maples, sumac, Rhus glabra borealis, and some wild cherry, Prunus pennsylvanica, at a higher level with a lower shrub layer composed of blackberry, Rubus allegheniensis, common bracken, Pteris acuilina, Diervilla, Diervilla lonicera, and some wild red raspberry, Rubus strigosus. Common ground plants are grasses such as the blue grasses, Poa pratensis and P. compressa, clovers, Trifolium pratense, T. hybridum, T. repens, wild strawberry, Fragaria virginiana, Canada goldenrod, Solidago canadensis, sweet clover, Melilotus alba, and occasional patches of club moss, Lycopodium tristachyum and L. lucidulum.

The small trees and shrubs, blackberry and raspberry bushes, and the bracken make a rather complete cover at a height of from 18 to 36 inches above the ground, thus affording protection for the nest and for the activities of the female bunting. Some of the ground plants supply nesting materials.

TERRITORY

On June 25, when I was trying to locate nesting areas, I found three male Indigo Buntings darting across the Pellston Road and back repeatedly. Judging by the amount of blue in the plumage, these males were two adults and one first-year male. I did not see any direct attack upon one by another, but there was much flying and singing by all three. After this date I saw only one adult male in this particular area, but he was observed there frequently throughout the summer. I saw no other activity that seemed to be connected with the establishment or maintenance of territory.

I did not make a special attempt to study the extent of territory, but noticed that each male seemed to range around a favorite singing perch located near the center of his territory and overlooking the nest site. Though one perch seemed to be favored by each male, many other high points were used as perches while singing.

We found it convenient to use the numbered telephone poles, spaced about 130 feet apart along the Pellston Road, as markers for the location of nests and singing perches. By counting the spans between the poles nearest to the nests or favorite singing perches, I estimated that the territory of the Indigo Bunting here averaged about 520 feet in diameter.

The map, Figure 1, shows the approximate locations of the centers of territories occupied by singing males

during the period of observation. Nests were found in six of these territories. Although the rest of them were searched from one to four times, no nests were found in them.

MATING AND NEST-BUILDING

Because of the cold, wet spring season this year, it was past the middle of May before many buntings were seen in southern Michigan in their northward migration. It was probably the last week in May before they arrived in the Douglas Lake area. Mating was no doubt completed before I started my study and as all the nests, when found, had full clutches of eggs, it was too late for me to watch nest construction.

NESTS

Site

The Indigo Bunting is what might be called an "edge" bird because it frequents the brushy openings along the edges of woods. In choosing a place for the nest, the bunting seems to prefer a dense clump of bushes, placing the nest within two or three feet of the ground. This clump of bushes is usually within 20 feet of the woods and often very near the road. Road-sides in the Douglas Lake area offer not only the low brush near the woods, but also electric power and telephone wires for convenient singing perches for the male buntings.

Locating Nests

Finding the nests was not easy, even though it is

simple enough to locate a male Indigo Bunting in its territory. The problem is well presented by Forbush (1929), who wrote, "When the union has been consummated, the nest built and the eggs laid, the mated pair seem to dwell in different zones. The female quietly incubates or keeps largely to the bushes near the ground, where, modestly clad, and unobtrusive, she is seldom seen; while the brilliant male sings conspicuously, high in the tree-top or from the roof or chimney top; nevertheless he sometimes relieves the female on the nest."

Neither Helen nor I ever saw a male Indigo Bunting approach the nest closer than about 15 feet and then when there were young in it. The only assistance given us by the male bird in our search for nests was an occasional utterance of a few scolding "chips" when we entered the area.

All the nests were found by making a systematic search of all vegetation in each territory that was four feet or less in height. No doubt some nests were overlooked, for, according to Forbush (1929), nests may be placed as high as 10 to 12 feet from the ground. Malcolm Lowther, who studied nesting Indigo Buntings in the Douglas Lake area in 1945, reported finding one nest at a height of five feet.

In three cases the females were flushed from the nests by our searching activities and thus aided us in determining their locations. They remained on the nest

until one of us was very close, then flew off under the vegetation for a distance of 10 to 25 feet and started chipping. I noticed, moreover, that when they were disturbed subsequently the females almost invariably left their nests by going away under the Pteris and other low vegetation to some distance before making an appearance or uttering a sound.

Shape and Dimensions

Table 1 shows the height of nests from the ground, the dimensions, and the types of plants used for support. The nests were all cup-shaped and supported by having the rim and sides of the nest bound to the supporting plants. In each case a crotch was chosen, but no support given from directly below. It will be noted that two nests were supported by bracken along with some other plant. These two nests, A and F, were fairly close together and I at first thought Nest F to be the second nest of the pair at Nest A, inasmuch as Nest A had been destroyed a few days after the young hatched. Further data on Nest F, however, convinced me that the time between the destruction of Nest A (July 8) and the hatching of the eggs in Nest F (July 26) was too short to allow for nest-building, egg-laying and incubation.

Further study of the data presented in Table 1 reveals that four of the six nests were oval in outline rather than round. The shape seemed to depend upon the relative positions of the plant parts used to support the nest. Nests A and F both showed a decided tilt, but the others remained quite level.

Table 1 -- Nests-- Size, Support.

Nest	Height from Ground	Inside Diameter	Outside Diameter	Depth Inside	Depth Outside	Supporting Shrub
A	18 in.	$2\frac{1}{2}$ - $2\frac{3}{4}$	$3\frac{3}{4}$ - $4\frac{1}{4}$	$1\frac{1}{2}$	3	Acer rubrum, Pteris
B	$22\frac{1}{2}$ in.	$2\frac{1}{2}$	4	$1\frac{1}{2}$	$2\frac{1}{2}$	Blackberry
C	13 in.	$2\frac{1}{4}$ - $2\frac{3}{4}$	$3\frac{1}{2}$ - 4	$2\frac{1}{2}$	$2\frac{3}{4}$	Blackberry
D	15 in.	2	3	$1\frac{3}{4}$	$2\frac{3}{4}$	Acer rubrum
E	29 in.	$1\frac{3}{4}$ - 2	$2\frac{3}{4}$ - $3\frac{1}{4}$	$1\frac{3}{4}$	3	Raspberry
F	27 in.	2 - $2\frac{1}{4}$	$3\frac{1}{2}$ - 4	$1\frac{3}{4}$	3	Black berry, Pteris

All dimensions are given in inches.

Materials

The materials used in the six nests were much the same, the bulk of each consisting mainly of plant fibers and dead, gray leaves of birch and maple. Some of these gray leaves were on the outside of every nest, a few festooned from the outer surface, many of them woven into the nest structure. Along with the leaves were small, dry weed stems, particularly the old flower stalks of goldenrod, Solidago canadensis, and peppergrass, Lepidium virginicum, the former numerous in Nests B and E and the latter in Nest C. Binding materials used were fibers from dead weed stalks and spider webs.

One nest, C, contained some birch bark and Nest F, the last found, contained a piece of snake skin, part of it woven in and the rest, about one and a half inches long, hanging on the outside. All the nests were lined with grass. Nest C also had a few hairs inside the grass lining.

EGGS AND INCUBATION

We measured one egg of the Indigo Bunting. It was 21 mm. long and 14 mm. in diameter. The eggs are very pale blue in color and look very fragile in the nest. As incubation progresses one end of the egg becomes darker. This is due, I believe, to the changes in the contents, which are partially visible through the thin, lucid shell of the egg.

Forbush (1929) gives the incubation period of the Indigo Bunting, as reported by Burns (1915), to be 12 days. We had no opportunity to determine this.

In the five occupied nests that we found, clutches of four, one bunting egg and two cowbird eggs, three, three and four eggs, respectively, were incubated. As all of these clutches were complete when the nests were discovered, we had no opportunity to observe egg-laying. As previously mentioned, neither did we have a chance to get first-hand information on incubation period.

However, we were able to watch the process of incubation in Nest C for a time and our daily inspection of all the nests convinced us that incubation was carried on entirely by the female Indigo Bunting. In the early stages, the female flushed from the nest rather easily at our approach. Once hatching started, however, they were quite reluctant to leave the nest, often remaining until we nearly touched them. Meanwhile the male sat and sang from a perch nearby or occasionally gave a few warning "chips" at our approach to the nest.

On July 3, three days before hatching started in Nest C, I observed the female attentive for a period of 53 minutes consecutively and inattentive for 41 minutes. On July 4, Helen observed Nest C from 8:45 until 11:05 A.M.. There were three attentive periods of 33, 27, and 15 minutes and two inattentive periods of 19 and 20 minutes, respectively. The average length of period of attentiveness was 32 minutes, of inattentiveness, 27 minutes, for these two forenoon periods of observation.

On July 6, just after the first egg had hatched in this same nest, I found the female attentive for three periods of 23 minutes, six minutes, and three minutes,

and inattentive for three periods of three minutes, three minutes, and seven minutes, respectively. This was between 8:29 and 9:11 A.M. and the weather was cloudy with some light rain.

From these meager records it may be assumed that the female bunting is both attentive and inattentive for longer periods before hatching starts than after the first bird is out of the egg.

The presence of the two cowbird eggs in Nest B appeared to make no difference to the female bunting. Incubation progressed normally until the cowbird eggs hatched. Two days later there was also a young bunting in the nest.

YOUNG AND THEIR DEVELOPMENT

Although I arrived at Nest C very soon after the first egg hatched, I did not watch the hatching process in any of the nests. By checking each nest daily, however, we were able to determine the dates of hatching for all the eggs. The number in each nest and the dates of hatching are summarized in Table 2.

Young Indigo Buntings, when first hatched, look very tiny and helpless in the nest. They are pinkish-orange in color, almost bare, but with bits of gray natal down on some of the feather tracts. There are large bulges on the sides of the head for the eyes, which are closed and membrane-covered at first.

Some of the young birds observed just lay limp in the nest the first day after hatching, making no visible response to any movement of the nest or noise caused by

Table 2 -- Hatching Dates

Nest	No. of Eggs	Dates of Hatching
A	4	July 3- 1; July 4- 3.
B	2 cowbird; 1 bunting	July 9- 2 cowbird; July 11- 1 bunting
C	3	July 6 - 1 before 8:20 A.M., 2 after 9:15 A.M.
D	3	July 6- 3
F	4	July 26- 3; July 27- 1.

our presence. Others, however, stretched up their necks and opened their mouths the first time we approached the nest after they had hatched.

The most noticeable change in appearance for the first two or three days was in the size of the young birds, their bodies remaining quite bare and the eyes closed. At the age of four days I noticed at least one bird with eyes open and at five days of age, all had them open.

At four days of age, the large wing feathers were showing under the skin and a day later there was some indication that these feathers were emerging from their sheaths. Pin feathers also appeared along other feather tracts, particularly on the back. At six days the feathers were out of the sheaths and enlarging. At seven days, they showed further development and at eight days of age the young were able to flutter to the ground and move along there, although much of their body surface still looked bare. The young left Nest F at seven days of age, doubtlessly frightened out by some intruder. One of them was seen the following day fluttering along the ground, but with insufficient feather development to lift himself from it.

At Nest D the birds were eight days old, at Nest C nine days old when they became frightened by our presence and left the nest suddenly. Feather development in those cases was sufficient to allow for only very short flights in a downward direction or a foot or so close to the ground.

For the first four or five days the most common movements of the young buntings were those of stretching the neck or opening the mouth for feeding, and those used in defecation. There was some stirring and changing of position in the nest. These movements gradually increased until at the age of eight days there was a good deal of stirring around in the nest, stretching and preening by the young birds.

Nestling Indigo Buntings seem fairly quiet before leaving the nest, but become more vocal afterwards. A few very faint cheeps were heard first at the age of two days. On the seventh and eighth days there was a somewhat louder cheeping or chattering during feeding time and while the female remained at the nest. No notes of fear or alarm were heard from any of the young birds until the time of nest-leaving. Then there was a loud, frightened chatter as they left the nest, suddenly, in several directions.

At Nest D the young birds left the nest at 7:00 P.M., July 14, when I went there for the daily observation. As I parted the maple branches above the nest to see the birds, there was a sudden loud chattering and three young buntings erupted from the nest in three directions, a very startling performance to the observer. On the following day Helen observed a similar performance at Nest C. In each case the young birds went only six or eight feet from the nest, but fluttered along to greater distances when pursued. Both families of young buntings were later seen in areas not far from the nests.

At 11 days of age, the young from Nest C were found to be well feathered and capable of flight for spans of 20 feet or more. Tails were still short. The plumage showed a good deal of streaking, especially on the breast, and the general color at this stage was a brownish gray. No attempt was made to follow these birds after July 17.

All the young buntings seen after leaving the nest were near or on the ground in brushy places, well hidden by the vegetation.

Young Cowbirds

The development of the young cowbirds in Nest B was not studied in detail, but I made a few observations. On July 14, when they were five days old, the feathers were showing some expansion beyond their sheaths. In attempting to move one of the cowbirds to learn whether the young bunting was still in the nest, I provoked a squawk of protest from the cowbird.

At the age of seven days they were well covered with feathers and left the nest the following day. Afterward I heard their "begging" calls from the surrounding shrubbery as the female Indigo Bunting brought them food.

PARENTAL CARE

The story of the care given to young buntings by the parents is a very one-sided affair as we observed it at these five nests. It is a story of constant attention and sometimes seemingly supreme effort on the part of the female and practically no effort, but some attention and fuss, on the part of the male. Nests C and F were both

observed for several hours on more than one day while the young were in the nest and not once did the male come nearer the nest than 15 feet, and then only for defense. All other nest activities were carried out very ably by the female.

Brooding

Soon after the hatching of the eggs the female removed the egg shells from the nest by dropping them over the side or carrying them away. Almost immediately she started feeding the young, although at first she brought only small portions of food and at rather long intervals. Much brooding was done at this stage, the time spent on the nest diminishing as the birds developed.

On the day when the eggs in Nest C were hatching the female spent about 72% of the observed time on the nest and 28% off. The following day, after all three birds had hatched, 51 % of the $4\frac{1}{2}$ hours of observed time was spent on the nest. When the young were two days old, only 10% of the $1\frac{1}{2}$ hours time was spent on the nest; when three days old, 16% of the two hours and 19 minutes of time was spent on the nest.

Observations were made from dawn to dusk on July 14 at Nest C when the young were eight days old. I was in the blind at 4:35 A.M. on that day and alternated with Helen in shifts of about four hours each until 8:30 P.M., when all activity had ceased for the day. Our observations indicate that the female remains on the nest all night. During the 15-hour day, she brooded the young for only one hour and nine minutes, about 7.5% of the time.

The weather was rather variable on this full day of observation. In the early morning it was cloudy and rainy, a light sprinkle of rain falling from 5:00 to 5:15 A.M. At 7:48 A.M. the sun came out, the sky cleared and it was bright until afternoon. At 3:26 P.M. there was another very light rain, but by 4:30 the sky was clear again and there was a slight breeze. The minimum temperature for the day was 64° F. and the maximum 80° F. Barometric pressure was 29.25 inches.

Nest C was so well shaded by the overhanging foliage that even at midday there seemed to be no need for further protection from the sun by the parent bird. The young were similarly protected from the light rain that fell both morning and afternoon. The morning shower came while the female was still on the nest, but she left before the rain had stopped. Practically all of the brooding done on that day was before 6:30 A.M. or after 5:30 P.M.

Feeding

Although Forbush (1929) states that the male Indigo Bunting may help feed the young, neither Helen nor I ever saw an instance of it, either at the nest or after the birds left. Feedings at Nests C and F are summarized in Table 3. As is to be expected, the number of feedings per hour increases as the young birds develop and the intervals between feedings become shortened.

It may be that the feedings at Nest F show a natural variation among individuals, or it may be that the presence of the car I used as a blind upset the feeding routine somewhat. At any rate, the number of feedings per hour at

Int ervals Between Feedings	Average Length of Interval Minutes	Extremes- Minutes
11	20.2	3 - 39
4	11.2	5 - 15
12	11.6	1 - 29
118	7.5	1 - 38
7	18.7	4 - 37
11	15.4	5 - 35

Table 3 -- Feedings.

Nest	Date	Age of Young	Time of Day	Total Time Hr./Min.	Temperature Range for Day Degrees F.	Weather Notes	Total Feedings
C	July 7	1 da.	8:40-11:36 A.M. 1:53-3:20 P.M.	4/23	59-78		2
C	July 8	2 da.	12:30-2:00 P.M.	1/30	60-83		6
C	July 9	3 da.	1:43-4:13 P.M.	2/30	61-85	Bright, warm.	3
C	July 14	8 da.	4:30 A.M. to 8:30 P.M.	15/55	65-80	Cloudy, light rain, clear.	9
F	July 30	4 da.	2:47-5:00 P.M.	2/13	75-91	Warm, humid.	3
F	July 31	5 da.	10:17-11:34 A.M. 1:53-3:40 P.M.	3/14	51-65	Windy.	3

that nest was fewer than might be expected for birds of that age, and the intervals between feedings correspondingly longer.

The method of feeding seemed to vary little. The female bunting perched on the rim of the nest, poked the insect into an open mouth, where it usually disappeared at once. If it didn't, she picked it up and stuffed it into another mouth. A few times I saw the female at Nest C apparently pick the food into smaller parts and distribute the pieces to two or three birds. This was done only the first two or three days.

As to the kind of food given, I noticed some small larvae being fed to the very young birds. After the first day, larger morsels were brought in. Not all food was identifiable at the distance from which observations were made, but practically all that we could identify was of insect origin, most of it winged insects. There were a few larvae, pale green in color, some white grubs and one or two white masses that looked like spider egg cases. Grasshoppers, both green and brown, seemed to be the favorite food.

Nest Sanitation

All cleaning of the nest was done by the female bunting. I saw her eating the fecal sacs at first, but on the third day she was carrying the sacs away from the nest. The nest was cleaned immediately after feeding, but not every time. On an average, a fecal sac was removed every fourth or fifth feeding, although this was done in a very irregular fashion. No excreta accumulated in or around any

of the nests. I saw no indications of nest parasites, either.

Defense

The matter of nest defense was the one activity in which the male Indigo Bunting participated. When we were hunting for the nests both the male and the female scolded at our presence. Sometimes the male would utter some warning "chips" before we flushed the female from the nest. At other times he joined her in a scolding duet. We learned to distinguish between the chipping of the two sexes as his note seemed somewhat louder and heavier than hers.

After the young were hatched the male was more concerned than before with the safety of the nest. When I attempted to establish myself in the Pteris a few feet away from Nest F for some observations without a blind, I soon found I had made an error in thinking matters might proceed normally in the bunting family under those conditions. The female scolded from various positions in the lower branches of neighboring trees, the male hopped around in the branches a little higher, frequently uttering a series of chips so rapid that they formed a rattle, and presently an ovenbird joined in the chorus of protest, darting back and forth on a nearby limb with tail and crest high, sounding off with sharp notes similar to those of a startled chipmunk.

My observation problem that day was solved by resorting to the use of the car as a blind. It was parked in a side road near the nest and a "tunnel" cut through the vegetation. While I was making the necessary arrangements, I had an opportunity to observe another method of defense

used by the female Indigo Bunting which I thought very interesting.

After clearing out between the nest and car, I settled myself in the car to await developments. A few minutes passed. Then I saw the female alight on the nest and realized that there were still some partial obstructions to my vision. After allowing the bird what I thought was sufficient time to feed the young, I left the car to remove a few more leaves from the "tunnel". As I moved forward I noticed that the female was still at the nest, so looked more carefully while I stood at a distance of about 12 feet from her. There she sat on the edge of the nest, facing me, apparently "frozen". For ten minutes I watched her from my position, then slowly moved a few feet nearer. After another five minutes had elapsed I moved up to within six feet of the nest. Although there was some movement of the young, there was absolutely no sign of movement of any sort on the part of the parent bird for 22 minutes.

As a strong gust of wind shook the nesting bush, she turned her head from side to side, then flew away, still holding in her beak the grasshopper she had brought to feed!

I finished the clearing out and returned to the car. After another ten minutes of scolding she again came to the nest and fed the young. A little later there was another twelve-minute period of complete inactivity on her part. Surely this type of behavior serves to prevent detection of the nest by predators and other intruders.

After the young left the nest, both birds of each pair were much perturbed when I came near the young birds. There was scolding, chipping, flying back and forth in the bushes, and the rattling call I had heard previously. The latter was heard only at Nest F where both parents used it the day after the young had been frightened from the nest. I had found the nest empty the night before and was attempting to locate the young when I came near enough to send one of them chattering and fluttering over the ground. Then I heard the "rattle" from both parents and witnessed a fine display of injury-feigning on the part of the female. She flew to a piece of brush only a few inches from the ground, fluffed out the feathers of her usually trim brown body, allowed her wings to droop and then vibrated them rapidly, tipping her body from side to side. This performance was repeated twice from two other low branches, all places being away from the young bird.

Whenever the parent buntings both took part in the defensive acts, I noted that it was the female who came closer to danger and took the seemingly greater risks. The male, though often vociferous and nervous, remained at a safer distance.

NESTING SUCCESS

Although every Indigo Bunting egg found in the five nests hatched, one complete family of young was destroyed and the young bunting disappeared from the nest having

Table 4-- Nesting Success

Nest	No. of Eggs	No. Hatched	Total Success	% Success
A	4	4	0	0
B	1 bunting 2 cowbird	1 2	0 2	66.7
C	3	3	3	100
D	3	3	3	100
F	4	4	4	100
Totals	15 bunting 2 cowbird	15 bunting 2 cowbird	10 bunting 2 cowbird	66.7 100

the cowbirds. Table 4 gives the data on the nesting success. With nests so close to the ground, it seems likely that the buntings suffer frequently from depredations.

SUMMARY

Nesting activities of the Indigo Bunting, Passerina cyanea, were studied at five nests near the University of Michigan Biological Station, Cheboygan County, Michigan, in the summer of 1947.

Indigo Buntings are frequent along the roadsides and in brushy, cut-over areas of the Douglas Lake region. Their nests are placed low in thick clumps of maple, blackberry or raspberry bushes near aspen forests.

Eggs are laid in June or early July in clutches of three or four and incubated by the female bunting.

Young of this species develop rather rapidly and leave the nest at the age of eight or nine days. Predators may destroy them before that time.

All parental care while the young Indigo Buntings are in the nest is given by the female bird. She broods and feeds the nestlings and removes wastes.

The male bunting sings from many perches in his territory, but apparently assists only in the defense of the nest.

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A Life History Study of the Indigo Bunting

By Hazel L. Bradley

INTRODUCTION

In the summer of 1947, while a student at the University of Michigan Biological Station, Douglas Lake, Cheboygan County, Michigan, I decided, at the suggestion of Dr. O. S. Pettingill, to make a life history study of the Indigo Bunting, *Passerina cyanea*. My cabin-mate, Helen Ripley, worked with me on this problem and all data obtained were made available to both of us.

From June 23 to 26, we succeeded in locating several bunting territories by finding one or more singing males in an area. Then on June 29 two nests were found, on June 30 two more, and later two others. Records were kept on each of these nests until they were abandoned or destroyed, the final date for the last one being August 4.

The six nests found were designated by the first six letters of the alphabet in the order in which they were discovered. Nest E was empty when found and remained so.

Some observations were made on five pairs of Indigo Buntings, all of them along roadsides and all but one along the Cheboygan-Pellston Road within three miles of the Biological Station camp. The other pair was about a mile from the Station on the Topinabee Road. The most detailed observations were taken on the last-mentioned, Nest C, as a blind was erected and 29 hours were spent in careful observation there.

Visiting the nesting areas was facilitated by cars loaned us by fellow students, Margaret Feigley and Robert Whiting. I gratefully acknowledge these loans as well as the helpful suggestions given by Dr. Pettingill and the observation data given me by Helen Ripley.

ENVIRONMENT

The area where this study of the Indigo Bunting was made is in the northern part of the lower peninsula of Michigan. It is of glacial origin and much of it is covered with lakes and bogs, but there is a considerable area of sandy uplands which were once covered with forests of pine or hardwood. These original forests were destroyed by lumbering operations late in the 1800's, following which there were extensive fires.

As a result of the burning there is now a fairly good forest cover of aspens, (*Populus grandidentata* and *Populus tremuloides*) and their associates, the red maple, (*Acer rubrum*), white birch, (*Betula papyrifera*), and northern oak, (*Quercus borealis*). The roadsides through the aspen-forested areas seem to be favorite nesting places for the Indigo Buntings, doubtless because they provide the particular type of situation usually selected by these birds, namely, many clumps of low bushes in the open but in close proximity to the higher trees of the forest.

Typical roadside vegetation here is bushy and made up of young aspens, red maples, sumac, (*Rhus glabra borealis*), and some wild cherry, (*Prunus pennsylvanica*), at a higher level with a lower shrub layer composed of blackberry, (*Rubus allegheniensis*), common bracken, (*Pteris aquilina*), *Diervilla*, (*Diervilla lonicera*), and some wild red raspberry, (*Rubus strigosus*). Common ground plants are grasses such as the blue grasses (*Poa pratensis* and *Poa compressa*), clovers (*Trifolium pratense*, *Trifolium hybridum*, *Trifolium repens*), wild strawberry (*Fragaria virginiana*), Canada goldenrod (*Solidago canadensis*), sweet clover (*Melilotus alba*), and occasional patches of club moss (*Lycopodium tristachyum* and *Lycopodium lucidulum*).

The small trees and shrubs, blackberry and raspberry bushes, and the bracken make a rather complete cover at a height of from 18 to 36 inches above the ground, thus affording protection for the nests and for the activities of the female buntings. Some of the ground plants supply nesting materials.

On June 25, while hunting nesting areas I came upon what appeared to be two adult males and one first-year male Indigo Bunting, darting back and forth across the Pellston Road, following one another but making no direct attacks. After this only one adult male was seen in this territory, so this behavior may have been an instance of defense of territory.

No particular attempt was made to study extent of territory, but I observed the favorite singing perches and the distances the males seemed to range from these, to estimate that the territory of the Indigo Bunting here approximated 520 feet in diameter.

MATING AND NEST-BUILDING

When the nests were found all had full clutches of eggs, so I concluded that mating had been completed before June 30. I had no opportunity to watch the construction of the nest.

NESTS

Site

The Indigo Bunting is what might be called an "edge" bird because it frequents the brushy openings along the edges of

woods. In choosing a place for the nest, the bunting seems to prefer a dense clump of bushes, placing the nest within two or three feet of the ground. This clump of bushes is usually within 20 feet of the woods and often very near the road. Roadsides in the Douglas Lake area offer not only the low brush near the woods, but also electric power and telephone wires for convenient singing perches for the male buntings.

Locating Nests

Finding the nests was not easy, even though it was simple enough to locate a male Indigo Bunting in its territory. The problem was well presented by Forbush (1929), who wrote, "When the union has been consummated, the nest built and the eggs laid, the mated pair seem to dwell in different zones. The female quietly incubates or keeps largely to the bushes near the ground, where, modestly clad and unobtrusive, she is seldom seen; while the brilliant male sings conspicuously, high in the tree-top or from roof or chimney top."

The only assistance given us by the male bird in our search for nests was an occasional utterance of a few scolding "chips" when we entered the area. All the nests were found by making a systematic search of all vegetation in each territory that was four feet or less in height. No doubt we overlooked some nests, for, according to Forbush (1929), nests may be placed as high as 10 to 12 feet from the ground. Malcolm Lowther, who studied nesting Indigo Buntings in the Douglas Lake area in 1945, reported finding one nest at a height of five feet.

In three cases the females were flushed from the nests by our searching activities and thus they aided us in determining the nest locations. Each remained on the nest until one of us was very close, then flew off under the vegetation for a distance of 10 to 25 feet and started chipping. Subsequent disturbances brought about similar behavior on the part of the female buntings.

Shape and Dimensions

Table 1 shows the height of nests from the ground, the dimensions, and the types of plants used for support. The nests were all cup-shaped and supported by having the rim and sides bound to the supporting plants. Each was in a crotch, but no support was given from directly below.

It will be noted that two nests, which also showed a decided tilt in position, were supported by bracken along with some other plant. These were fairly close together and Nest F was found some days after Nest A had been torn apart, so these may possibly have belonged to the same pair.

Four of the six nests were oval in outline rather than round, as shown by the data in Table 1. The shape seemed to de-

pend upon the relative positions of the plant parts used to support the nest.

Table 1—Nests—Size, Support

Nest	Height from Ground	Inside Diameter	Outside Diameter	Depth Inside	Depth Outside	Supporting Shrub
A	18 in.	2½-2¾	3¾-4¼	1½	3	Red Maple
B	22½ in.	2½	4	1½	2½	Blackberry
C	13 in.	2¼-2¾	3½-4	2½	2¾	Blackberry
D	15 in.	2	3	1¾	2¾	Red Maple
E	29 in.	1¾-2	2¾-3¼	1¾	3	Raspberry
F	27 in.	2 -2¼	3½-4	1¾	3	Blackberry, Pteris

All dimensions are given in inches.

Materials

The materials used in the six nests were much the same, the bulk of each consisting mainly of plant fibers and dead, gray leaves of birch and maple. Some of these gray leaves were on the outside of every nest, a few festooned from the outer surface, many of them woven into the nest structure. Along with the leaves were small, dry weed stems, particularly the old flower stalks of Canada goldenrod and peppergrass, (*Lepidium virginicum*). Binding materials used were fibers from dead weed stalks and spider webs.

One nest, C, contained some birch bark and Nest F contained a piece of snake skin, part of it woven in and the rest hanging on the outside. All the nests were lined with grass. Nest C also had a few hairs inside the grass lining.

EGGS AND INCUBATION

We measured one egg of the Indigo Bunting. It was 21 mm. long and 14 mm. in diameter. The eggs are very pale blue in color and look very fragile in the nest. As incubation progresses one end of the egg becomes darker, probably due to the changes in the contents, which are partially visible through the thin, lucid shell of the egg.

Forbush (1929) gives the incubation period of the Indigo Bunting, as reported by Burns (1915), to be 12 days. We had no opportunity to verify this.

In the five occupied nests that we found, clutches of four eggs, one bunting egg and two cowbird eggs, three, three and four eggs, respectively, were incubated. We watched the process of incubation in Nest C for a time and made a daily inspection trip to each of the others. Apparently incubation was carried on entirely by the female bunting. In the early stages of incubation, the females flushed from the nest rather easily.

Once hatching started, however, they were quite reluctant to leave, often remaining until we nearly touched them. Meanwhile the males sat and sang from perches nearby or occasionally gave a few warning "chips" at our approach to the nests.

A few meager observation records on Nest C, taken during two forenoon periods before the eggs hatched and one after, seem to indicate that the female bunting is both attentive and inattentive for longer periods before hatching starts than after the first young bird is out of the egg.

The presence of the two cowbird eggs in Nest B appeared to make no difference to the Indigo Bunting. Incubation progressed normally until the cowbird eggs hatched. Two days later there was also a young bunting in the nest.

Table 2—Hatching Dates

Nest	No. of Eggs	Dates of Hatching
A	4	July 3—1; July 4—3.
B	2 cowbird, 1 bunting	July 9—2 cowbird; July 11—1 bunting
C	3	July 6—1 before 8:20 a.m., 2 after 9:15 a.m.
D	3	July 6—3
F	4	July 26—3; July 27—1.

YOUNG AND THEIR DEVELOPMENT

Although we did not watch the hatching process, daily inspection of each nest gave us the dates of hatching for all of the eggs. The number in each nest and these dates are summarized in Table 2.

Young Indigo Buntings, when first hatched, look very tiny and helpless in the nest. They are pinkish-orange in color, almost bare, but with bits of gray natal down on some of the feather tracts. There are large bulges for the eyes, which are closed and membrane-covered at first.

The most noticeable change in appearance for the first two or three days was in the size of the young birds, their bodies remaining quite bare and the eyes closed. At the age of four days, at least one bird had its eyes open and at five days of age, all had them open.

At four days of age, the large wing feathers were showing under the skin and a day later there was some indication that these feathers were emerging from their sheaths. Pin feathers also appeared along other feather tracts, particularly on the back. At six days the feathers were out of the sheaths and enlarging. At eight days of age, the young were able to flutter to the ground and move along there, although much of their body surface still looked bare.

For the first four or five days the most common movements of the young buntings were those of stretching the neck or opening the mouth for feeding, and those used in defecation. There was some stirring and changing of position in the nest. These movements gradually increased until at the age of eight days there was a good deal of stirring around in the nest, stretching and preening by the young birds.

The young left Nest F at seven days of age, doubtlessly frightened out by some intruder. One of them was seen the following day fluttering along the ground, but with insufficient feather development to enable him to lift himself from it. At Nest D the birds were eight days old, at Nest C nine days old when they became frightened by our presence and left the nest suddenly. Feather development in those birds was sufficient to allow for only very short flights in a downward direction or for a foot or so close to the ground.

Nestling Indigo Buntings seem fairly quiet before leaving the nest but become more vocal afterward. I heard a few faint cheeps on the second day after hatching. Later there was a somewhat louder cheeping or chattering during feeding time and while the female remained at the nest. The young birds uttered no cry of fear or alarm until the time of nest-leaving. Then there was a loud, frightened chatter as they left the nest, suddenly, in several directions.

The young birds left Nest D at 7:00 p.m., July 14, when I went there for the daily observation. As I parted the maple branches to see the birds in the nest, there was a sudden loud chattering and the three young buntings erupted from the nest in three directions, a very startling performance. On the following day Helen observed a similar performance at Nest C. In each case the young birds went only six or eight feet from the nest, but fluttered along to greater distances when pursued.

At 11 days of age, the young from Nest C were found to be well feathered and capable of flight for spans of 20 feet or more. Tails were still short. The plumage showed a good deal of streaking, especially on the breast, and the general color at this stage was a brownish gray. No attempt was made to follow these birds after July 17.

All the young buntings seen after leaving the nest were near or on the ground in brushy places, well hidden by the vegetation.

Young Cowbirds

The young Cowbirds in Nest B appeared to develop normally and left the nest on the eighth day. Afterward I heard their "begging" calls from the surrounding shrubbery as the female Indigo Bunting brought them food.

PARENTAL CARE

The story of the care given to young buntings by the parents was a very one-sided affair as we observed it. We watched Nests C and F for several hours on more than one day while the young were in the nest and not once did the male come nearer the nest than 15 feet, and then only for defense. All other nest activities were carried out very ably by the female.

Brooding

Egg shells were removed by the female, who dropped them over the side of the nest or carried them away soon after the young hatched. Feeding started almost immediately, but only small portions were brought and at rather long intervals. Brooding occupied much of the female's time.

On hatching day at Nest C, the female bunting spent about 72 percent of the observed time on the nest, the following day 51 percent and the fourth day only 16 percent.

Observations were made from dawn to dusk on July 14 at Nest C when the young were eight days old. I was in the blind at 4:35 a.m. on that day and alternated with Helen in shifts of about four hours each until 8:30 p.m. when all activity had ceased for the day. The female apparently remained on the nest all night, but during the 15-hour day she brooded the young for only one hour and nine minutes, about 7.5 percent of the time.

The weather was rather variable on this full day of observation. In the early morning it was cloudy and rainy, a light sprinkle of rain falling from 5:00 to 5:15 a.m. At 7:48 a.m. the sun came out, the sky cleared and it was bright until afternoon. At 3:26 p.m. there was another very light rain, but by 4:30 the sky was clear again and there was a slight breeze. The minimum temperature for the day was 64° F. and the maximum 80° F. Barometric pressure was 29.25 inches.

Overhanging foliage gave so much protection to the nest that the young seemed not to need any more from the parent bird during either sunshine or shower that day.

Feeding

Although Forbush (1929) states that the male Indigo Bunting may help feed the young, neither Helen nor I saw any instance of it, either at the nest or after the birds had left it. Feedings at Nests C and F are summarized in Table 3. As is to be expected, the number of feedings per hour increased as the young birds developed and the intervals between feedings became shortened.

The number of feedings per hour at Nest F, fewer than might be expected for birds of that age, may have been due

Table 3—Feedings

Nest	Date	Age of Young	Time of Day	Total Time (M/°H)	Temp. Range for Day (Degrees F.)	Weather Notes	Total No. Feedings per Hour	Intervals Av. Length Between of Interval Extremes—			
								Minutes	Minutes		
C	July 7	1 da.	8:40-11:36 A.M. 1:53-3:20 P.M.	4/23	59-78		12	2.8	11	20.2	3-39
C	July 8	2 da.	12:30-2:00 P.M.	1/30	60-83		6	4	4	11.2	5-15
C	July 9	3 da.	1:43-4:13 P.M.	2/30	61-85	Bright, warm.	13	5.2	12	11.6	1-29
C	July 14	8 da.	4:30 A.M. to 8:30 P.M.	15/55	65-80	Cloudy, light rain, clear.	119	7.9	118	7.5	1-38
F	July 30	4 da.	2:47-5:00 P.M.	2/13	75-91	Warm, humid.	8	3.5	7	18.7	4-37
F	July 31	5 da.	10:17-11:34 A.M. 1:53-3:40 P.M.	3/14	51-65	Windy.	13	4	11	15.4	5-35

to an upset feeding schedule brought about because of the presence of the car I used as a blind.

The method of feeding seemed to vary little. The female bunting perched on the rim of the nest, poked the insect into an open mouth, where it usually disappeared immediately. If it didn't, she picked the food up and stuffed it into another mouth. A few times during the first two or three days I saw the female at Nest C pick the food into smaller pieces and distribute them to two or three birds.

Some small larvae were fed to the very young birds. Practically all the food that we could identify was of insect origin, most of it winged insects. There were a few pale green larvae, some white grubs, and one or two white masses that looked like spider egg cases, Grasshoppers, both green and brown, seemed to be the favorite food.

Nest Sanitation

All cleaning of the nest was done by the female bunting. I saw her eating the fecal sacs at first, but on the third day she was carrying the sacs away from the nest. These were removed immediately after feeding, on the average every fourth or fifth feeding. No excreta accumulated in or around any of the nests. I saw no indications of nest parasites.

Defense

The matter of nest defense was the one activity in which the male Indigo Bunting participated. When we were hunting for the nests both the male and the female scolded at our presence. Sometimes the male would utter some warning "chips" before we flushed the female from the nest. At other times he joined her in a scolding duet. We learned to distinguish between the chipping notes of the two sexes as his note seemed somewhat louder and heavier than hers.

After the young hatched the male's interest in nest safety seemed to increase. One day I attempted to observe Nest F without a blind by crouching in the bracken ferns a few feet away. The female started to scold from the lower branches of neighboring trees, the male hopped around in the branches a little higher uttering a series of chips so rapidly as to form a rattling sound, and presently an ovenbird joined the chorus of protest, darting back and forth on a nearby limb with tail and crest high and sounding off with sharp notes similar to those of a startled chipmunk.

My observation problem was solved that day by resorting to the use of the car as a blind. It was parked in a side road near the nest and I cut a "tunnel" through the vegetation. While I was doing this, I had an opportunity to watch another method of defense used by the female Indigo Bunting which I thought very interesting.

After clearing out between the nest and car, I settled myself in the car to await developments. A few minutes passed. Then I saw the female alight on the nest and realized that there were still some partial obstructions to my vision. After allowing the bird what I thought was sufficient time to feed the young, I left the car to remove a few more leaves from the "tunnel". As I moved forward I noticed that the female was still at the nest, so looked more carefully while I stood at a distance of about 12 feet from her. There she sat on the edge of the nest, facing me, apparently "frozen". For ten minutes I watched her from my position, then slowly moved a few feet nearer. After another five minutes had elapsed I moved up to within six feet of the nest. Although there was some movement of the young, there was absolutely no sign of movement of any sort on the part of the parent bird for 22 minutes.

As a strong gust of wind shook the nesting bush, she turned her head from side to side, then flew away, still holding in her beak the grasshopper she had brought to feed!

I finished the clearing out and returned to the car. After another ten minutes of scolding she again came to the nest and fed the young. A little later there was another twelve-minute period of complete inactivity on her part. Surely this type of behavior serves to prevent detection of the nest by predators and other intruders.

After the young left the nest, both birds of each pair were much perturbed when I came near the young birds. There was scolding, chipping, flying back and forth in the bushes, and the rattling call I had heard previously. The latter was heard only at Nest F where both parents used it the day after the young had been frightened from the nest. I had found the nest empty the night before and was attempting to locate the young when I came near enough to send one of them chattering and fluttering over the ground. Then I heard the "rattle" from both parents and witnessed a fine display of injury-feigning on the part of the female. She flew to a piece of brush only a few inches from the ground, fluffed out the feathers of her usually trim brown body, allowed her wings to droop and then vibrated them rapidly, tipping her body from side to side. This performance was repeated twice from two other low branches, all places being away from the young bird.

Whenever the parent buntings both took part in the defensive acts, I noted that it was the female which came closer to danger and took the seemingly greater risks. The male, though excitable and often vociferous, remained at a safer distance.

NESTING SUCCESS

Although every Indigo Bunting egg found in the five nests hatched, one complete family of young was destroyed and the young bunting disappeared from the nest having the cowbirds.

Table 4 gives the data on the nesting success. With nests so close to the ground, it seems likely that the buntings suffer frequently from depredations.

Table 4—Nesting Success

Nest	No. of Eggs	No. Hatched	Total Success	% Success
A	4	4	0	0
B	1 bunting	1	0	
	2 cowbird	2	2	66.7
C	3	3	3	100
D	3	3	3	100
F	4	4	4	100
Totals	15 bunting	15 bunting	10 bunting	66.7
	2 cowbird	2 cowbird	2 cowbird	100

SUMMARY

Nesting activities of the Indigo Bunting, *Passerina cyanea*, were studied at five nests near the University of Michigan Biological Station, Cheboygan County, Michigan, in the summer of 1947.

Indigo Buntings are frequent along the roadsides and in brushy, cut-over areas of the Douglas Lake region. Their nests are placed low in thick clumps of maple, blackberry or raspberry bushes near aspen forests.

Eggs are laid in June or early July in clutches of three or four and incubated by the female bunting.

Young of this species develop rather rapidly and leave the nest at the age of eight or nine days. Predators may destroy them before that time.

All parental care while the young Indigo Buntings are in the nest is given by the female bird. She broods and feeds the nestlings and removes wastes.

The male bunting sings from many perches in his territory, but apparently assists only in the defense of the nest.

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