

There is a correlation between the size of the gonads and plumage changes.

Given enough time, any intensity sufficient for the survival of the birds will produce nuptial plumage provided that they have the optimum period.

The optimum light intensity is about 126 foot-candles.

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NEST LIFE OF THE EASTERN YELLOW WARBLER

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INTRODUCTION

THE data on which this paper is based were obtained from a careful study of forty-one nests of the Eastern Yellow Warbler (*Dendroica aestiva aestiva*), carried out during the summers of 1938 and 1939 at the Iowa Lakeside Laboratory, on West Okoboji Lake. The labora-

tory grounds where these nests were found is a restricted area with no domesticated animals. During the summer of 1938, nine nests were located in bushes of wolfberry (*Symphoricarpos occidentalis*) and three in young saplings of box elder (*Acer negundo*). These nests had an average height of two and one-half feet from the ground, with a range of two to four feet. One other nest was found in a cottonwood (*Populus deltoides*) at a height of about ten feet. In 1939, eighteen nests were located in bushes of wolfberry, five in young saplings of box elder, two in wild gooseberry (*Ribes gracile*), one in wild currant (*Ribes floridum*), and one in an introduced species of honeysuckle. The average height of these nests was also two and one-half feet from the ground, ranging from one and one-half to five feet. Another nest was built in a box elder at a height of about fifteen feet.

Nests were marked by driving a common lath into the ground nearby with attached linen shipping tag representing the nest number.

In 1938, daily observations on nests were begun on June 14, at a time when one nest contained young. In 1939, daily observations on nests were begun on June 6, with two nests containing young. With this and other recorded data on time of egg laying, the bird life in the summer of 1939 was over a week in advance of 1938. The reason for this may have been a drier and earlier spring in 1939.

Data include part-time observation on one of the nests while being built, with a total of forty under daily observation until after the fledglings had left the nest. The nest in the box elder was visited only occasionally because it was difficult to approach. The main objectives in this project consisted of weighing and measuring a large number of eggs, as well as weighing some of the young for a period of days to determine their gain in weight. This gain in weight was checked against nests containing a varied number of young, as well as gain in weight of first- and last-hatched young in a nest. A check was also made to determine the size of the first- and last-laid egg of a nest, in order to find out if the first egg laid would be the first to hatch.

Weighing of eggs and young was carried on in the field with a small balance reading directly to one-tenth of a gram. The balance and a circular spirit level were fastened inside a plywood box with only one side open. A coiled spring with attached hook was fastened inside the box and used for holding the balance beam and pans in a fixed position while traveling in the field. The box and its contents were mounted upon a wooden photographic tripod. Since the entire

apparatus weighed only five and one-fourth pounds, it was convenient for carrying.

Egg measurements were made in a small three-sided wooden box having a base with a mounted metric scale reading directly to one-tenth of a centimeter. With the use of a sliding wooden block, readings could readily be taken from the mounted scale. In manipulation of eggs and young, great care was exercised to avoid injury to either. It was found very convenient to use a common teaspoon in transferring eggs to and from the nest. Also, the spoon was helpful in lifting young from the nest, and to avoid any great temperature change the spoon was always carried in the side trouser pocket next to the body. Filter paper folded in the form of a cup was used as a receptacle for the young while on the balance.

NEST BUILDING

One nest was discovered in the first stages of construction, and from that time on it was watched on an average of two hours a day for four days until it was completed. Observations were made from about 7:30 A. M. to 8:30 A. M. and from about 6:30 P. M. to 8:00 P. M. In addition to this it was viewed occasionally throughout the day. Construction was first observed at 7:45 A. M., on June 12, 1939, when a female Yellow Warbler was seen carrying a tuft of plant-down into a small box elder sapling. Upon examination, a mass of plant-down about one and one-half inches in diameter was found at a measured height of two feet three inches from the ground in the fork of the sapling. During an hour of observation the female continued to carry plant-down at intervals of about four minutes although once it did not bring any material for twenty minutes. At noon the plant-down mass had increased to about three inches in diameter and was more compactly pushed into the fork. By 6:45 P. M., there were many strands of plant fibers and grasses woven around and through the plant-down in such a way as to wrap and bind the plant-down around the small twigs of the fork. The nest was just assuming a cup-shaped structure. The female was now bringing large loads of a mixture of grasses and plant fibers and working at a rate of about one trip every four minutes. This first day's building was completed at 7:55 P. M. The nest was now partially surrounded with woven plant fibers and grasses with a slight formation of a rim.

At 7:30 the next morning, building was again in progress but at a slower rate. There was a soft intermittent rain and both birds spent much time in a nearby tree as if feeding. Only six trips of the

female at very irregular intervals were observed in an hour. The material brought still consisted of fibers and grasses and by noon the nest had acquired a pronounced cup-shape due to the rim being built up higher. This rim consisted of plant fibers and grasses woven partly into the original down but mostly into the sides and around the top. At 6:45 P. M., the nest appeared completed with a well-formed cup, plant-fiber and grass rim, and a plant-down floor. However, the female was later observed bringing more plant-down. This she continued to do at about six-minute intervals until 7:45 P. M. The nest at this time had not undergone further changes, but the cup was almost filled with loose plant-down.

On the third day there was a cold rain which lasted until noon. The afternoon was partly clear, but later in the day a drizzling rain fell. Very few observations were made on the nest, and the only time the warblers would appear was when the author approached within a few yards of the nest. By 8:00 P. M., no progress in nest building was apparent since the preceding evening. The cup of the nest was still partly filled with loose plant-down which appeared damp but not soaked with the rain.

By 8:00 on the fourth morning, the plant-down inside the nest was smoothed out and contained a few strands of fine grasses. The female was sunning herself on a nearby weed stalk and hovered close to the nest. She did not carry any nest material at any time during the day's observation, but at nightfall it seemed as if the nest contained a little more plant-down which covered all exposed grasses. During the evening observation, both birds seemed to be content for they were feeding and chirping in close company in a large tree within twenty yards of the nest. At 6:30 A. M., the following day, one egg was found in the nest.

During all the observations on the building of this nest the male at no time was seen to bring any nest material. However, since there were many hours during the day when no observations were made, it is possible that he might have helped at some time. While the female was busy carrying the nest material the male was constantly present in nearby bushes or trees chirping softly and at times would burst into song. He appeared to be feeding frequently. Once he sang for twenty minutes at four- to five-minute intervals and then began feeding again. The presence of an observer at a distance of about thirty-five feet from the nest may have had some effect upon his actions since he did not take part in the nest building, but he never complained audibly after the observer was seated and quiet in the observation spot.

The dates of the beginning of construction and the dates the first eggs were laid were obtained for two other nests, and the time which elapsed in both cases was four days. From these data and from the observations described above it seems as if four days are probably required from the beginning of nest building to the laying of the first egg. However, one other nest was found in a completed condition and it was five days before it contained an egg. The following day it contained two eggs but was deserted five days after the appearance of the first egg.

Examination of twenty-eight nests revealed many variations in the linings: thirteen nests had a lining of fine grasses; five of grasses and few feathers; five of plant down and grasses; two of plant down only; one of plant down, grasses, and hair; one of plant down, hair, and feathers; and one of grasses and hair. All except six had a pronounced outer covering of plant fibers and a few grasses. Of these six, four were surrounded with plant down and plant fibers, and the two others had a large amount of plant down toward the bottom on the outside of the nest. The inside diameter measured at the rim of all twenty-eight nests was one and three-quarter inches with a variation of not more than one-sixteenth of an inch. After the young hatched and were becoming fledglings the nests in many cases became distorted due to the crowding of the young and to weathering.

Some variation in the height of the nests was also noted. This depended upon whether the nest was placed in the forks of bushes and saplings or if it was mostly attached to a main branch of a partly forked plant. In cases of attachment to a main branch of a partly forked plant there was usually a small amount of plant fibers or plant down streaming down from the nest, but the nest proper always assumed a well-formed cup-shape. Some nests placed in narrow forks as found in wolfberry bushes were cone-shaped, due to the nest material being placed down in the very fork and built up from this point. This formed a higher nest than those built in a wide fork. In narrowly forked plants the nest was seldom attached to the forks, while in slightly forked branches the nest material was woven around one or more of the branches. This weaving of nest material around a branch was especially noted where the nests were built in gooseberry or currant bushes, for then one side of the nest was heavily wrapped around one stem which served as the main support. The height of nests also depended upon whether or not Cowbird eggs had been deposited in them; under the former conditions there were many two-story nests. On examination of all forty-one nests studied, those

which were parasitised by Cowbirds had one or two Cowbird eggs deposited in them during varying stages of nest construction. Eggs appeared so deep in some nests that they must have been deposited there before completion of the original nest lining. In one case a Cowbird egg was found lying at the bottom of a nest in the fork of a wolfberry and so sparsely surrounded with plant material that it was partially visible from the outside. No information was obtained concerning the method of deposition of the Cowbird eggs in the nests. Parasitism of nests by Cowbirds has been discussed by Friedmann (1929), Roberts (1932), Shaver (1918), and Stephens (1917).

Of the thirteen nests studied in 1938, one contained Cowbird eggs buried with two of the warbler eggs. A second story was built to this nest which later contained three warbler eggs. Two other nests each contained a buried Cowbird egg. Another nest contained a buried Cowbird egg and the second and final story contained one Cowbird and two warbler eggs. In 1939, of the twenty-eight nests studied, eight contained one or more Cowbird eggs. Seven of these contained a buried Cowbird egg. One had two exposed Cowbird eggs and two warbler eggs, but three days after the second Cowbird egg was deposited one warbler egg disappeared and one the following day the second warbler egg disappeared. The next day the nest was found torn apart and the two Cowbird eggs were lying on the ground uninjured.

In all nests of 1939, there was not a single case of the warblers using the previous year's nests. In fact, only one of the previous year's nests was found. All other nests had disappeared. The cause for the disappearance of the nests was not determined, but they were probably destroyed by wind or other elements. The nest which remained was the one in the cottonwood tree in which only a small amount of weathered plant down was left attached in a small crotch.

Territories appeared definitely proclaimed, for males and females were often seen driving an intruding warbler from the vicinity of a nest. This was especially noted in 1939 in one area having six nests in a group of wolfberries which grew in clumps of about fifteen to thirty feet in diameter. Each clump contained but a single nest. The distances between nests were stepped off as follows: nest 22 to nest 44, twenty-four yards; nest 44 to nest 24, eighteen yards; nest 24 to nest 23, nineteen yards; nest 24 to nest 25, nineteen yards; nest 25 to nest 26, thirty-three yards; and nest 26 to nest 27, thirty yards. An adjoining area outside the laboratory grounds contained as many or more clumps of wolfberries, but the height of these bushes was

lower because of the grazing of cattle in the summer of 1938. In 1939, there were no cattle in this adjoining area but the warblers did not use this area for nest building. The wolfberries, however, seemed tall enough for nests as compared with those used in other areas. Therefore, it is possible to conclude that although the warblers are hostile to their own species and have definite territories they still desire a certain amount of companionship. In a grove of underbrush and box-elder trees two nests were found in box-elder saplings fourteen yards apart. In an open area three other nests, one in a wolfberry, one in a wild currant, and the other in a box-elder sapling, formed a triangle nineteen by twenty by thirty-three yards. There appeared to be many other nesting sites in these areas from which the birds could choose. Apparently they may desire companionship to some extent and still maintain a certain yardage for territorial claims.

EGG LAYING

From observations on nest building it appeared that egg laying began on the day following or possibly on the same day that the nest was completed. Since the last stages in the nest building were so slow it was difficult to tell when the last few strands of nest material were added so that the nest could be called a finished product. For instance, it was thought that the nest described above, which was closely observed during building, was finished on the fourth morning, but not until that evening was it realized that a small amount of material had been added during the day. Therefore a still smaller amount of material might have been added on the fifth morning just before egg laying, but this does not seem probable. From these observations and from the fact that in two other nests the first eggs were laid on the fifth day, it seems probable that the first egg is laid the day after completion of the nest. At least, this seems to be true for the three nests observed.

In none of the daily trips was any evidence found that two eggs were laid on the same day. In 1939, on four different days, two trips were made to each nest, one in the morning and one in the late afternoon, and in no case was an egg found to have been laid in the afternoon.

Normally there were three to five eggs per nest. This statement does not include those cases in which a nest was deserted or destroyed before the apparent completion of egg laying or where the presence of Cowbirds' eggs caused burial of warblers' eggs. Some of the nests when first found contained young, but by considering each young as

representing an egg and by including the buried warbler eggs as well as the eggs in the destroyed or deserted nests, the number of eggs laid were as follows: one nest, with six eggs; thirteen, with five eggs; eighteen, with four eggs; seven, with three eggs; and two, with two eggs. The average was four eggs per nest. Chapman (1907) and Pearson (1936) have also recorded nests with six eggs.

In four nests (39, 42, 43, 47), eggs were laid at a rate of one egg per day until a clutch of four was completed. Two other nests (4, 23) with three eggs each, had an interval of two days between the laying of the second and third eggs. Of two nests (18, 44) which were destroyed, one (18) had intervals of one day each between the laying of the first, second, and third eggs, and the other (44) had an interval of one day between the first and second eggs. Egg laying had progressed to such an extent in the remaining nests when first discovered that it was not possible to check the intervals.

In color, the eggs ranged from grayish to bluish white, and were more or less thickly speckled with brownish shades. The speckling in many cases was denser at the larger end and frequently formed a wreath. In some cases the first, the last, or the intermediate eggs of a nest were slightly more speckled or wreathed, so no definite relationship was observed which showed a change in speckling or forming of wreaths on the first or last eggs of a nest.

The length of seventy eggs was found to vary from 20.5 to 15.5 mm. The arithmetical mean was 17.32 mm., with a probable error of ± 0.08 mm. Width of eggs in the region of the greatest diameter ranged from 16.0 to 12.3 mm., with an arithmetical mean of 13.29 mm. and a probable error of ± 0.06 mm. Chapman (1920) gives egg dimensions as 0.70 x 0.50 inches (17.78 x 12.70 mm.).

There was only one nest (33) which had all eggs of the same dimensions. It contained three eggs which were 17.8 x 13.5 mm. One nest (37) of five eggs contained two which were 16.2 x 12.8 mm.; and one each which were 15.8 x 12.6, 16.1 x 12.8, and 16.5 x 12.8 mm. A nest (47) of four eggs had two eggs 18.0 x 13.8 mm.; the other two, 18.1 x 13.4 and 17.8 x 13.8 mm. One nest (34) which held six eggs contained an abnormally large egg which was 20.5 x 16.0 mm. This egg weighed only 0.5 gm. and was the largest one found. Upon examination it was found to contain nothing but a small amount of yolk. Other eggs of this nest were: 16.8 x 13.0, 17.0 x 12.5, 17.0 x 13.0, 17.5 x 13.0, and 18.0 x 12.8 mm.

Table 1 shows the linear and weight relations of the eggs of nests (39, 42, 43, 47) which contained four eggs each, laid on successive

days. Gentian violet was used to mark the eggs. A dot on a side denoted the first egg; a dot on the large end, the second; a dot on the small end, the third; and a dot on both the large and the small end, the fourth. These data indicate that the weight of eggs increases from the first to last laid and the only exception is the fourth egg of nest number 47. This egg weighed slightly less than the third-laid egg although they were of the same dimensions. All eggs of nests

TABLE 1

Nest number	Day laid	Dimensions	Weight of egg (grams)	Before incubation	
				Total weight of eggs (grams)	Average weight per egg (grams)
39	1	16.0 x 13.0	1.275	5.20	1.30
	2	16.8 x 13.0	—		
	3	17.2 x 12.9	—		
	4	17.7 x 12.8	1.35		
42	1	17.1 x 13.5	1.50	6.30	1.575
	2	17.3 x 13.3	—		
	3	17.5 x 13.8	—		
	4	18.0 x 14.0	1.75		
43	1	16.8 x 13.0	1.40	6.10	1.525
	2	16.5 x 13.1	1.45		
	3	17.2 x 13.3	1.60		
	4	17.8 x 13.1	1.65		
47	1	18.1 x 13.4	1.525	6.40	1.60
	2	17.8 x 13.8	1.60		
	3	18.0 x 13.8	1.65		
	4	18.0 x 13.8	1.625		

numbers 39 and 42 were not weighed, but because of their relative increase in linear measurements it could be assumed that there was also an increase in weight. Measurements on these nests also show that as an egg becomes longer it does not necessarily become wider. This was noted in each of the four nests. Therefore it is possible that rapid egg laying or nests of many eggs may show a greater variation in size. This was noted in the nest (34) of six eggs which contained the large abnormal egg, but the interval of egg laying in this nest was not known. In the nest (33) with three eggs of identical size there was an interval of two days between laying of the second

and third eggs, but information was lacking on the interval between the first and second eggs.

The clutch of eggs in three nests (42, 43, 47) was weighed daily after the laying of the last egg until hatching. It was found that they decreased in weight but at no definite rate each day, for on some days there was no weight difference detected. Table 2 shows that the percentage of weight lost from the time of the last-laid egg until hatching was very nearly the same for the eggs of all three nests.

TABLE 2

Nest number	Number of eggs	Average weight per egg (grams)		% of weight lost per egg
		After last laid egg	Just before hatching	
42	4	1.575	1.413	10.22
43	4	1.525	1.350	11.49
47	4	1.600	1.425	10.94

INCUBATION

Brooding of eggs was performed entirely by the female. Every visit to the nests would flush the female or find her in the vicinity of the nest, while it would be some time before the male would appear from a distance. In one case the male did not appear for an interval of half an hour. However, the male was in sight and was attentive during the feeding of the young. The male birds used trees or bushes as watch-towers from which they would alight in the case of approaching enemies or of signals from the female. On three different nights three nests were visited and the female was seen brooding, at times with her head tucked 'under' her wing. A blind was also erected at one nest (47) before the young hatched, and it was found that at varying intervals throughout the day, for four days before hatching, the female did all the brooding. She would leave the nest at intervals of about fifteen to twenty minutes, presumably for feeding. The writer had the pleasure of seeing the male feed the female while brooding eggs, but this was never seen while she brooded the young.

By carefully watching the marked eggs as well as eggs of other nests, it was found that they began hatching within a range of eight to ten days from the time that the last egg was laid. The average was nine days. There was an average of eleven days from the time the last egg was laid until the last young hatched, with a range of eleven to twelve days. In three nests (4, 23, 33), containing three

eggs each, there was an interval of eleven days from the time the last egg was laid until the last young hatched. The interval of hatching for the first young of one nest (33) was eight days; for the other nests (4, 23), nine days. The interval of hatching for the second young in one nest (4) was ten days; for the other nests (23, 33), nine days. This may mean that some brooding is done before all eggs are laid. An interfering factor could be due to one nest (33) having two eggs when found and three days elapsed before the third egg was laid. In the other nests (4, 23) there was an interval of two days between laying of the second and third egg. Of the four nests (39, 42, 43, 47) of Table 1 containing the marked eggs which were laid in successive days, the one nest (39) was dispossessed (cause unknown) of the first three eggs laid, a few days before hatching. The fourth egg hatched in eleven and one-half days from the time it was laid. In another nest (42) the first egg became addled but the second and third hatched in ten days from the time of laying of the last egg; the last-laid egg hatched in twelve days. In another nest (43) the first and second eggs hatched in ten days from the laying of the last egg; the third and the fourth, in eleven and one-half days. In the remaining nest (47), the first and second eggs hatched in nine days from the laying of the last egg; the third, in nine and one-half days; and the fourth, in eleven days. After the laying of the first egg in each of two nests (42, 43) there was a cold rain and at 10:00 A. M. the females were not on the nests but let the eggs become cold. Even considering this, the above variations in the incubation period for the first- and last-laid eggs may still indicate that brooding may start before all eggs are laid.

In the above calculations on incubation it was assumed that all eggs were laid during the hours of 3:00 A. M. to 8:00 A. M.; and as mentioned before, there were no indications of egg laying in the afternoon. Out of one hundred and nineteen hatched eggs, nine were hatched in the afternoon. One hundred and ten were hatched at night or in the early morning.

FEEDING

The feeding of young was shared by both adult birds. After the young hatched the female was always present in the nest vicinity, and was usually seen in the same clump of bushes where the nest was located, or in nearby foliage. While she was gleaning food from the lower branches, the male would flit along the top branches, seemingly with less vigor, in a search for food. Although he searched for food and would make many trips to the nest, his main duty seemed to

consist of a constant chirping about the nest site while his mate searched diligently.

At one nest (40) the male took the more active part in feeding. This nest was located in a box-elder sapling in a grove of underbrush and box-elder trees. A blind was erected at this nest two days before the eggs began to hatch. The nest had one buried Cowbird's egg and a second story contained four warbler's eggs, but two of the latter were addled. The morning the first young hatched, the blind was moved within two and one-half feet of the nest. On the following morning two young were present. Daily observations were made mainly at morning, noon, and late evening until the fledglings left the nest. On the morning that the second young was hatched there was a cold but light and intermittent rain which lasted until the middle of the afternoon. On this day, as on the previous day when the first young was hatched, the male would bring food to the nest and place it in the gaping mouth of the female who would dispense it to the young. At times the male would do the feeding, provided that the female was in a standing position which enabled him to see the young. The female would leave the nest about every ten to twelve minutes, even at times when there was a sprinkle of rain. She would usually return in about five minutes but not always with food.

After the third day of hatching, the male would give a signal each time he came to the nest, upon which the female would leave. From this time on throughout the entire nesting period of the young, the female left the nest at ten- to twelve-minute intervals even if the male did not bring food for the young. She would return at about this ten- to twelve-minute interval and usually without food. Feeding was most pronounced in early morning and late afternoon. On one day, feeding continued until 8:05 P. M., and just before this the male brought food three times at two-minute intervals.

At 8:00 A. M., on the day the first young was ten days old, it preened itself and at times stood in the nest stretching its wings. Both parents were now feeding it frequently in preference to the younger one. After fifteen minutes of observation the fledgling climbed onto the rim of the nest and stood there stretching. It remained on the rim about five minutes, when the female came with food. Instead of giving the food to the fledgling, she would call and flit from limb to limb in the sapling. Within ten minutes she had coaxed the young to the top branches of a nearby sapling, where she fed it. After this she was not seen feeding the young that remained in the nest.

The second young left at 5:00 P. M. of the same day, at a time

when it could be considered nine and one-half days old, after first going through exercises like the first-hatched young. It left the nest after being fed by the male and while the male was still standing beside the nest; the male did not seem to coax the youngster, but merely stood there and watched.

Since the female remained on the nest for the first two days while the male brought food, she was usually in a position to catch easily the excreta sacs which she swallowed. As she was in a standing position in the nest while feeding the young, the male would watch carefully for a chance to seize the excreta sac which he would then devour; this seemed to be his reward for bringing food. On the day when the first-hatched young was eight days old, the male continued to devour the excreta sacs provided that they were small, but large ones were carried away.

At another nest (47) where a blind was erected in order to watch the brooding of eggs, the greater part of the feeding of the four young was carried on by the female. The reason the male may have done the larger part of feeding at the other nest (40) could have been due to the female trying to brood the two addled eggs. These addled eggs were still in the nest until sometime during the early hours of the eighth day after hatching of the first young.

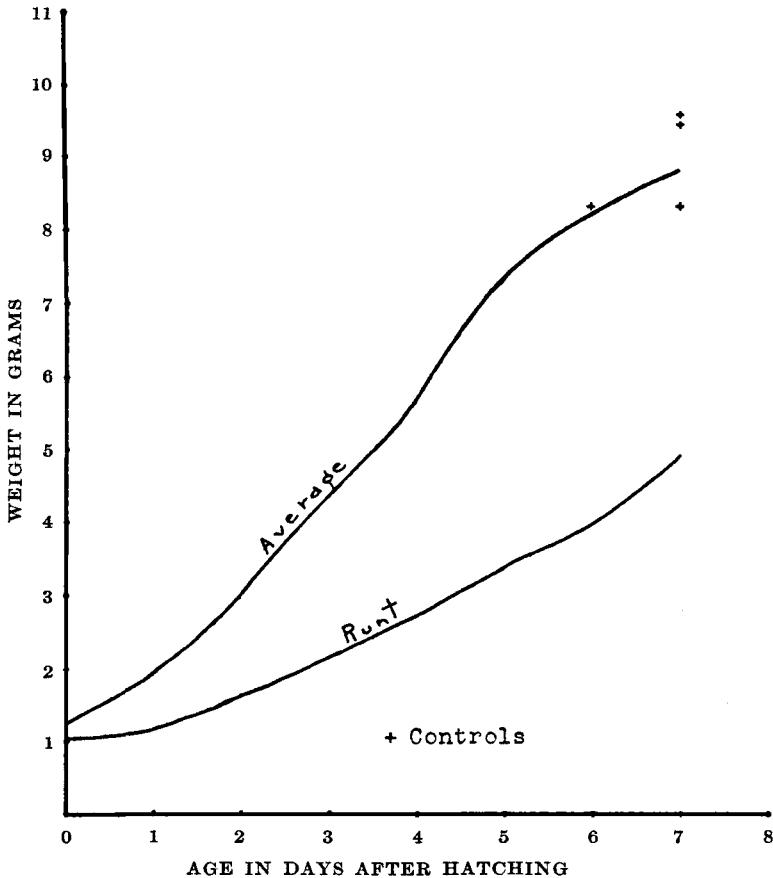
The females at both nests usually faced the most exposed side of the nest site while brooding eggs and young. Then, too, the males and females usually took a definite course in approaching the nest. Both males would sing while in the saplings in which the nests were located or while standing on the nest rim. The male at the one nest (40) sang after feeding the young and once he sang three times while standing on the rim of the nest. Mousley (1926) has also observed the male sing on the nest.

Never throughout the entire brooding of young was a male seen feeding the female. At the one nest (40) she did eat a large moth which the male brought, after she tried to feed it to the young but to no avail. The males would usually bring large mouthfuls of a mixture of foods, as insects and larvae, while the female usually brought smaller feedings which appeared to be one kind of food. Feeding of young warblers has been fully discussed by Bigglestone (1913).

WEIGHING

The project of weighing the young birds, as well as checking the nesting period, involved marking first- and last-hatched warblers in the nests. This marking was done on the crown or the back with

gentian violet. In order to avoid fading, the dye was replaced at intervals but this was seldom necessary. The originally dyed down usually projected above the juvenal plumage, especially on the crown, until the end of the nesting period.

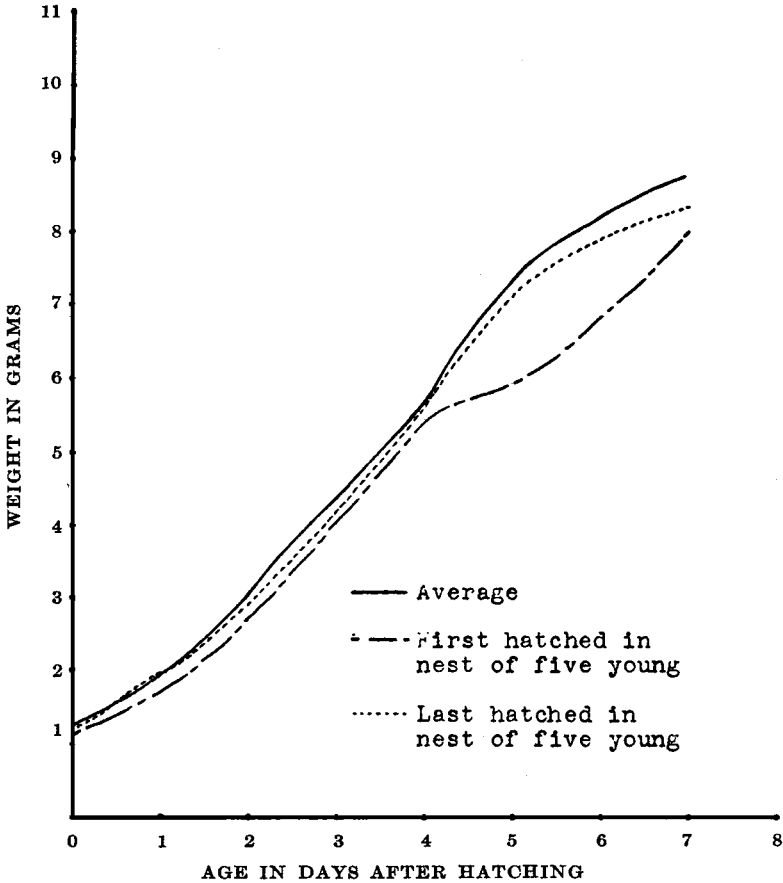


GRAPH 1

Thirty-three young in fourteen different nests were weighed. The weighing took place between 9:00 A. M. and 11:30 A. M. Fifteen were weighed on the morning of hatching, and of these, six were weighed each morning until they were seven days old. They were not weighed after seven days of age due to the possibility that they might leave the nest prematurely if disturbed. If during the first seven days of age a young bird seemed excited after being placed back in the nest after weighing, it could be calmed by covering the nest

with the hand so as to darken the interior. Soon the bird would settle into a comfortable position.

Almost immediately after removal of a young from the nest it would void its excreta, which helped to diminish the error in weighing

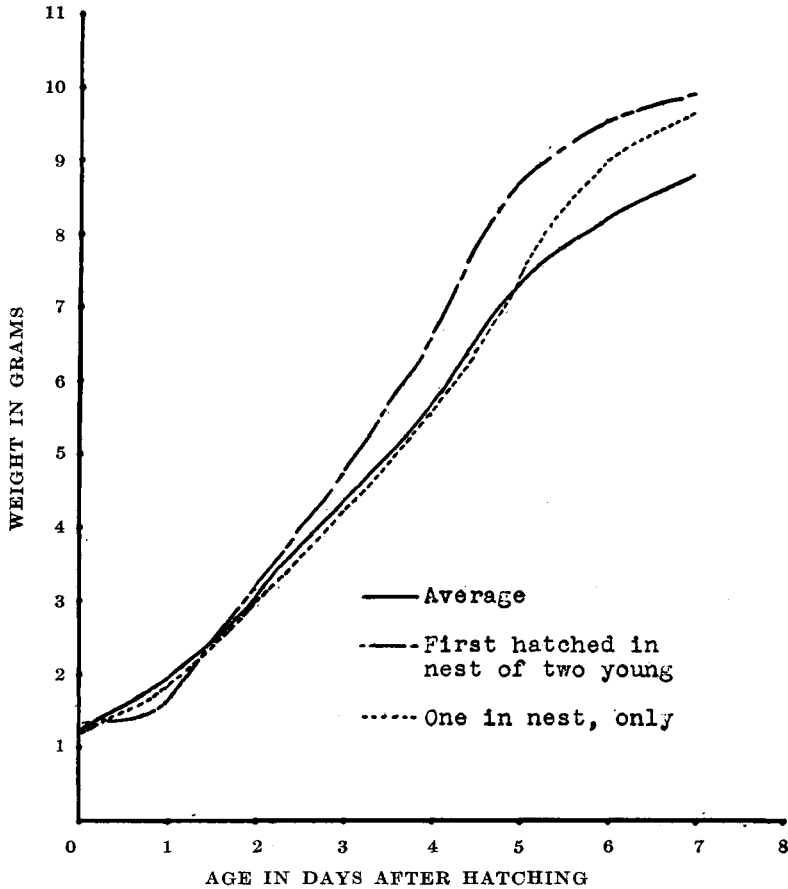


GRAPH 2

the small, young bird. Since the young birds voided their excreta sacs after handling, this does not seem necessarily due to an intensification of feeding as some have suggested. Nor would the voiding of excreta be due to a direct stimulus from feeding.

From 109 weighings the average rate of growth is represented in Graph 1. The young averaged, when hatched, 1.27 gms.; at one day old, 1.87; at two days old, 2.95; at three days old, 4.36; at four days old, 5.57; at five days old, 7.26; at six days old, 8.20; at seven days old, 8.78.

Two nests of two young each were used as controls and the young were weighed only once. In one nest (22) a seven-day-old young, the first hatched, weighed 8.30 gms. and its mate, the second hatched, weighed 8.30 gms. at six days of age. In the other nest (35) the bird

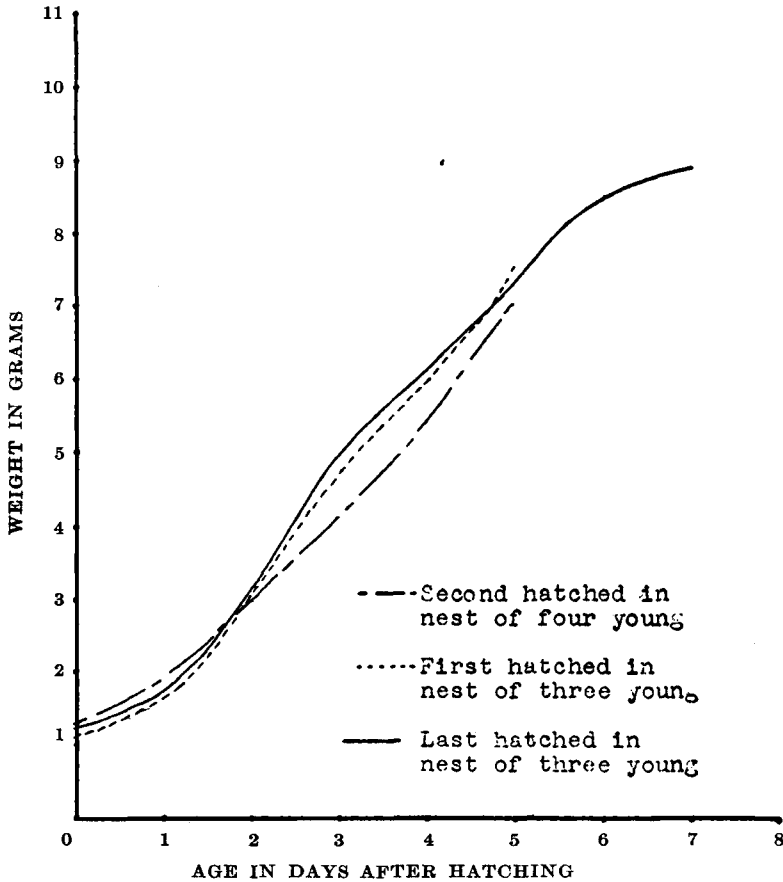


GRAPH 3

first hatched weighed 9.50 gms. at seven days of age, and its mate, the second hatched, weighed 9.40 gms. at seven days of age (Graph 1). Comparison of these controls with average weights of the young indicates that careful handling does not impair their rate of growth.

In a nest (37) of five young the first-hatched attained a weight of 8.00 gms. in seven days. It was a few hours older than two of its mates and one day older than the two others. In another nest (30) of five young the last-hatched attained a weight of 8.33 gms. in seven

days. This one was two days younger than two of its mates and one day younger than the other two. Graph 2 represents a comparison of these two nests with the average curve. In a nest (34) which contained only one young (Graph 3), the weight at seven days



GRAPH 4

of age was 9.65 gms.; while in a nest (40) of two young (Graph 3), at seven days of age, the first-hatched weighed 9.90 gms. and its mate weighed 9.15 gms. at six days of age. From these weight relations it appears that the number of young in a nest does not necessarily affect the rate of growth to any great extent. It was observed at the end of seven days that individuals in nests containing only one or two young gained weight but slightly faster than some individuals in nests of three or four young, but weighed slightly more than those in nests

containing five young (Graph 4). In nests of one or two young it appears that there is enough food brought to satisfy the young and therefore the instinct of feeding a gaping mouth may no longer be aroused in the adult, while the nests of many young cause the adult birds to work harder.

One young, which was called 'Runt,' was a very interesting case. The weight and dimensions of the egg from which this young hatched were not known. This young weighed 1.03 gms. just after emerging from the shell on a cold and rainy morning. It was the last hatched in a nest (24) of four, being one day younger than two of its mates and a few hours younger than the third mate. Besides being under normal weight, 'Runt' may have contracted a cold caused by weighing on the morning of hatching for the gain in weight each day was small as shown in Graph 1. Regardless of this young's handicaps, it left the nest the morning it was ten days old. The runt was weighed shortly after leaving the nest and tipped the scales at 7.20 gms. The weighings of this bird were not included in figuring the average rate of growth.

YOUNG WARBLERS

The Yellow Warblers are hatched naked except for a scanty amount of down and are an interesting sight with their large bulging eyes and abdomen. It was observed that the eyes were commencing to open on the third day after hatching. By the fifth day the young can completely open their eyes, but in many cases would immediately close them when the nest was approached. At this age they would also duck down into the nest as if trying to hide. A slight tapping on the nests would cause a rapid outstretching of necks with open mouths. Signs of the pangs of hunger appeared greatest in the smallest young. This young bird seemed justified in its signs of hunger for it was usually crowded down in the nest by its larger mates, but since the youngest of many nests gained weight at the same rate as others of a nest it is difficult to explain why the youngest would always act so hungrily. It is possible that the older young could distinguish the adult birds from a mere tapping, while the younger had not reached this stage of distinction.

The young warblers normally remained in the nest for a period of eight to ten days, with an average of nine and one-half days. This nesting period was independent of the number of young present in a single nest. Crowded nests of five appeared more restless, which may have caused them to leave the nest sooner. In two nests of five young each, all the young birds left in eight to nine days, while in a

nest with only two, located in the shade of a grove, they remained for eleven days. Other nests of only two young were deserted in eight to ten and one-half days. Young left the nests containing three within nine to ten days. Young in nests of four left in nine to eleven days. In the nest which contained only one young, the fledgling left in ten days. The oldest fledgling was one of the first to leave in all nests observed. In seven instances, a nest mate a day younger than the oldest bird left on the same day as the older.

At the end of the nesting period, a bird's first adventure was to perch on a small branch about six inches from the nest. On many visits a young bird which seemed to have just left the nest was found in the same position, which was in a spot protected from the sun. If the nest were in a position where the direct rays of the sun would strike it the young were very restless.

After all the young left a nest, the parent birds could be found feeding them in the immediate vicinity of the nest for a period of about three days. After this time the birds became more dispersed from the nesting site, but could still be found in the vicinity for a week or ten days.

After observing the used and also the deserted nests, it was found that in many cases the nests would be disordered as if an intruder had been looking for hidden eggs. This occurs from one to ten days after the nest has been abandoned. On later observations, six nests had been completely torn apart with debris from the nests hanging from the small twigs or lying upon the ground. There was no occasion for observing evidence of a second brood.

Tables 3, 4, and 5 represent the mortality rate of the Yellow Warbler, which is the calmest in disposition of the entire warbler family. Of the 168 eggs in forty-one nests, 119 eggs, representing 70.83%, hatched. Thirty-four eggs, representing 20.24%, disappeared due to wind, abandonment of nest, and unknown causes. Fifteen eggs, representing 8.93%, were added, two of which were buried with a Cowbird's egg. Of the 119 nestlings, twenty-eight disappeared. This represents 16.66% of all eggs laid. Four of them were seen dead in the nests. The others disappeared from unknown causes. Therefore a total of 91 fledglings, representing 54.17% of the original 168 eggs, left the nest.

It would be interesting to carry on a weighing project of the adult warblers. This could easily be done by slowly building a wire trap around the nest. Then the female could be weighed during the different stages of brooding and at the departure of the fledglings. The male could possibly be weighed at the beginning and at the end of

TABLE 3

Eggs	Hatched		Failed to hatch			
			Disappeared		Addled	
	Number	%	Number	%	Number	%
168	119	70.83	34	20.24	15	8.93

TABLE 4

Nestlings	Disappeared		Left nest as fledglings	
	Number	%	Number	%
119	28	23.53	91	76.47

TABLE 5

Hatched:	
Survived as fledglings	54.17%
Missing fledglings	16.66%
	70.83%
Not hatched:	
Disappeared	20.24%
Addled	8.93%
	29.17%
	100.00%

the feeding period. By making these weighings it would be possible to note what loss of weight, if any, is encountered during the stages of nest life. Also, in this way, a check could be made to see what difference in loss of weight, if any, is encountered by adults rearing a large or a small brood. Baldwin and Kendeigh (1938) have given the average weight of two adults as 9.6 gms., for the month of May.

The writer wishes to express his appreciation to Dr. Robert L. King, of the State University of Iowa, for much help and valuable suggestions in carrying on this work. (All nests numbered 1-20 were observed in 1938. All nests numbered 21-48 were observed in 1939.)

SUMMARY

Forty-one nests of the Yellow Warbler were studied.

Nest building is carried on for four days.

Not more than one egg is laid per day. Last-laid eggs weigh more than first-laid eggs.

Seventy eggs were weighed and the linear measurements taken. Eggs averaged 17.32 mm. in length, and 13.29 mm. at greatest width. The average weight per egg at the end of egg laying was 1.57 gms., and the average weight per egg just before hatching was 1.40 gms.

Eggs decrease in weight during incubation.

All brooding is performed by the female.

The average incubation period is eleven days.

Males sing on the nest often, after having fed the young.

The young averaged, when hatched, 1.27 gms.; at one day old, 1.87 gms.; at two days old, 2.95 gms.; at three days old, 4.36 gms.; at four days old, 5.57 gms.; at five days old, 7.26 gms.; at six days old, 8.20 gms.; and at seven days old, 8.78 gms.

Fledglings in nests containing five young leave the nest sooner than those of nests having one or two young.

The last hatched of any nest may gain weight as rapidly as the first hatched.

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