NOTES ON SIX NESTS OF THE KENTUCKY WARBLER (*OPORORNIS FORMOSUS*).

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Of the six nests of Kentucky Warbler described below, one was found in Riverview Park, Hannibal, Missouri and five were found in or near Baltimore, Maryland. This ratio of one to five appears from my records to be a fair index of the relative frequency of the species in these two states. Thus I have found this warbler in but three separate Summer locations in Missouri during a period of sixteen years, while during a period of ten years in Baltimore, and with much less extensive search, I have it recorded in at least fourteen June to September locations.

The first nest, that in Missouri, is described in some detail, both as to approach and observation; subsequent experience with the other nests was on the whole somewhat similar to this. Throughout a number of Summers I had seen a pair of Kentucky Warblers along the Woods Drive, Riverview Park, and naturally supposed they nested in that vicinity. Having the good fortune to be in Hannibal early in June, 1923, I decided to find this particular nest, if it required the exclusion of all other bird-study. As a matter of fact the nest was found with little difficulty.

The male's vigorous, vibrant song is usually to be heard some distance away, and since it is his habit to sing from the same thicket, even from the same perch, for long periods, he is not a hard bird to find. The song is quite constant in number of syllables for a given male, but varies from five to eight syllables in different males. The one I was observing along the Woods Drive had a song of six syllables, which he delivered with unflagging emphasis for hours on end.

On the first morning of my search I located the male singing among lower branches of a hickory tree on the steep hillside below the Woods Drive. I came within a few yards of him before he left off singing and began his loud call of alarm and protest. His mate joined him at once, and the two of them, finally seeming to agree that I was just a cow or something, drew closer and closer to inspect me. I sat down among the buckbrush and remained as motionless as possible, whereupon the male, leaving his mate in the hickory boughs, flew to a haw-tree at my back and came so near I could have touched him. But I knew the female was my only lead to the nest.

After some fifteen minutes of scolding the male returned to his hickory perch and resumed his six-syllable song, his mate the while picking at insects in a leisurely vireo fashion. I watched her intently, but in a sudden flight she was gone. Her direction was diagonally down the hillside and

toward the upper end of the ravine, but how far she went I did not know. The male also changed his perch to the drooping boughs of an elm directly across the ravine. I crept down the hill in the general direction taken by the female, and reached the rock-strewn waterway in the depth of the hollow before my presence attracted further attention.

This time the protest was violent. The female, rather perfunctory with her scolding before, was now flipping her tail and voicing hysterical disapproval, all of which encouraged my belief that the nest was somewhere near at hand. Again I sat down to wait, this time with an unobstructed view of many yards up and down the watershed. The female continued to scold long after her mate had returned to his singing, but at last she flew to a little pool up-stream a ways, took a few dips of water and went directly to a clump of vines thickly entwined about the partially eroded roots of a large elm. A more snug, inaccessible place for a nest would be hard to imagine. It was well above arm's reach up a sheer rock wall, and to approach it from above one would have to crawl out beside the elm on a ledge of clay and top-soil that seemed ever on the point of precipitating itself, the elm, the vine and other vegetation into the stream beneath. Incidentally that is just what happened a few months hence.

A ladder would have been most acceptable in the circumstances, but since I was not accustomed to carry a ladder in my field equipment, I had to use the only instrument at hand, a broom-stick with a large iron nut twisted on the cut end. With this I hewed away sediment and soil from various crevices of the rocks until I could scale the few feet that allowed me to view the inside of the nest with a pocket mirror. The nest, a gross structure of leaves with inner laminae of grasses and rootlets, contained five whitish eggs thickly and in part coarsely speckled with liver-brown.

Since my hewn steps in the rocks were something of a permanent improvement, I had ready access to the nest thereafter, barring a right awkward fall one wet morning. The mother was a very close brooder, being invariably on the nest when I paid my visits, morning, afternoon or evening. On no occasion was the male seen to brood, though he was always in attendance. Also hours of watching failed to disclose him bringing food to his mate. The female soon became accustomed to my intrusions, even remaining in the vine while I held my mirror above the nest.

On the seventh day of observation the nest contained four young and one egg, which latter was doubtless addled, since the next day I found it in large fragments on a bare ledge of rock, while the nest still contained four young. There appears to be a distinct difference in the treatment of shells from fertile and addled eggs. I searched diligently for pieces of shell from the four fertile eggs on the very morning they hatched, but not a trace of shell did I find anywhere in the vicinity of the nest.

The burden of feeding the young was assumed very unequally by male and female. The male continued to devote most of his waking hours to musical exercise, and only rarely passed on a small moth or fly to his mate. I tried repeatedly to ascertain by field-glass just what foods the female brought, but this was on the whole a fruitless undertaking. An assorted diet of bugs, flies, worms and grubs is as accurate as I can report.

The young were nest-fed eight and a half days. On the day they left the nest I visited them about nine o'clock in the morning, and found all four crying lustily, but the mother was not feeding them. I watched for more than an hour, during which time she frequently came to the vine with tempting food, but she kept clear of the nest and eventually ate the food herself. Before I left one youngster had managed to get up on the brim of the nest, and was promptly rewarded with a choice portion of dragonfly, strangely enough this time by the male, who was taking particular interest in the launching of his family. When I returned at two in the afternoon, the nest was empty, but all four of the little powder-puffs were accounted for in nearby shrubbery.

I saw them almost daily thereafter, and as late as seventeen days after leaving the nest they were still being fed occasionally by their mother and father. It seems remarkable that the father should have taken such an active part in the after-nest care, when he took almost no part in feeding the nest-young. I noticed that he seldom sang during the time he was caring for the young.

This brings up a question which thus far remains unanswered for me. During late July I found the male in full song again, and with the same vigor and steadfastness of June. The female and three of the young, now fine large birds, were located some distance down the ravine, and the female evinced no more than the usual friendly curiosity. If she had a nest anywhere in the neighborhood, she certainly left it for very long periods, and showed no anxiety about it. It may well be that she had become so used to my presence she no longer 'viewed with alarm' my almost daily visits. But the fact remains that I did not find a second nest of this pair, and I saw nothing whatever of a second brood. And this has been precisely my experience with other pairs of nesting Kentucky Warblers. I cannot say from first-hand information that certain of the other nests were not second ones, since in truth the last two of them were mid-July records.

The first nest found in Baltimore (1925) was in a dense undergrowth near a damp meadow adjoining the Catholic Colored Orphanage directly north of the municipal Stadium. This entire region, save the Orphanage and Stadium, has in recent years been so radically transformed for residential purposes that I could not now venture a guess as to where the nesting site or even the thicket used to be. This nest was built on the ground

in such a tangle of honeysuckle and locust sprouts that with the female leading me straight to it I still had difficulty finding it. The nest itself was set in a thick felt of leaves, and was lined with grasses, bits of raw cotton and cotton string and a narrow band of so-called "baby ribbon." Certain dump-heaps at that time not far away doubtless accounted for these artificial materials. The eggs, four in number, were ashy, sprinkled evenly with cinnamon. On the third day of observation (June 16) the nest was occupied by four young, and on the sixth day it was empty. That same day both male and female were found in another strip of woods adjoining the damp meadow, and the male was singing right heartily. My reasons for assuming that this was the pair whose nest had been robbed were two: first, my repeated visits to this last named strip of woods had not until then disclosed a pair of Kentucky Warblers, or even a single one; second, the male found singing there that day had the same seven-syllable song that characterized the owner of the nest, there being a short extra syllable uttered as a kind of fillip at the end of the song. Both male and female showed the usual curiosity when I came near them, but neither did any serious scolding. I watched the pair for more than two hours, without finding anything to suggest renewed nesting activity at that time. A second nest may have been built by this pair later in the Summer, but up to June 25 when I left Baltimore no nest was found. When I returned in September the birds were still using in this woods, but no young were observed anywhere in the vicinity. September 27 was the last date of record for this pair.

The third nest was found June 3, 1927, on a thickly wooded hillside just off the Providence Road back of the future campus of Goucher College, Towson, Md. A considerable expanse of marshy land lies on the other side of the road at the foot of the hill. I had seen Kentucky Warblers for a number of years, along this woods—various paths and roadways, leading where I do not know, made the thicket quite accessible. On this particular morning I had started at sun-up with the purpose of finding a warbler nest, if a warbler could be found. As usual in this locality one of the first notes to greet me as I climbed the hill was that of the Kentucky Warbler. When I stopped to find the singer, he obligingly came more than half way to meet me, and was soon joined by his mate. But neither of them seemed especially anxious about anything. I sat down to wait, as usual, but this time I had a real problem ahead of me.

After formalities of curiosity toward the intruder, the female made a sudden dash for the male and the two of them romped hither and yon through the woods and at last disappeared among the cat-tails and tall grass of the marsh across the road. Such swift ending of high hopes gave no promise of the interesting situation that was to develop in connection with this case.

As I continued up the hill I flushed another male Kentucky Warbler. He was in full brilliant plumage, but he did not act as most males of this species do. Apparently he had no curiosity at all, but flew directly away from me up the path and resumed his feeding on the ground, uttering the while a most extraordinary sort of call-note, in vigor quite equal to that of the first male, but in tonal quality flat and uneven. Still it served me well, because it drew the rompers back to the hillside. So there I was with two male warblers and a very facetious female, and no clue whatsoever to a nest.

The next hour or more the female spent in boisterous sallies, now after one male, now after the other; frequently all three would become involved in a variety of cross-tag. At intervals the first male would stop long enough to sing a few phrases of his fine song, the usual six-syllable arrangement delivered in a loud, clear voice. The second male, too, did what he could in this way, but his voice, while loud enough, was harsh and cracked, and his song, if such it may be called, was wholly cacophonic.

As I was nearing my last shred of patience and was about to return home, the first male launched a particularly vicious attack on the second, and the two of them went screeching and yodelling down the hill, across the marsh and out of sight. The female at this juncture dropped quietly down a steep gutter of the hill and for the moment was lost. But the top-foliage was so dense that there was little in the way of ferns or ground coverage, save here and there vines of wild grape growing over prone trunks of trees. I was just in time to see her enter one of these vines, and since she did not move about as if feeding, I concluded that the nest was there. So it was, the usual bulk of leaves piled on the ground against an enormous lichen-covered log and deeply sheltered by fronds of fern and grape. This was without doubt the most elegantly constructed nest of the whole series reported here. Its interior was oval, about 2 by $1\frac{1}{4}$ inches, the long axis parallel to the side of the log, and the lining of grasses, rootlets and hair was extended over the bowl in canopy fashion, a treatment especially adapted to placement of the nest against, and under the log.

On the first morning of observation there was but one egg; the next morning at about eleven o'clock there were three, my inference being that on the first morning I had disturbed the female when she was about to deposit her second egg. On the fourth day at 2.15 p.m. there were still three Warbler eggs, and this time a Cowbird egg. I have yet to see a Cowbird in that vicinity; nevertheless there were Cowbird eggs. To remove the alien egg offered certain difficulties, since the bowl of the nest was deep and the canopy rendered use of a spoon quite awkward. I made a trip home for a cotton applicator and a stick of sealing wax. By placing a globule of melted wax on the tip of the applicator and then resting the waxed tip on

the Cowbird egg until the wax hardened, I was able to lift the egg out of the nest without so much as touching nest or Warbler eggs. On the fifth day this same manipulation had to be repeated to remove a second Cowbird egg. On the sixth day the fourth and last Warbler egg had been deposited. These eggs were distinctly different from others of this species I have seen, in that they had something in the nature of a circlet of umber spots around the larger end while the rest of the surface was almost free of markings. The ground color of these eggs was white with a faint tinge of blue.

Since I was unable to visit this nest daily, my records do not show the exact period of incubation. The full set of four eggs was in the nest on June 14, but at my next visit, June 17, I found three young in the nest and large fragments of a single egg-shell on the ground near-by. This again appears to have been a case of an addled egg, such as I observed in the first (Missouri) nest. Unfortunately I had to leave Baltimore on June 20, without even a parting visit to this nest.

The most interesting circumstance connected with this nest was the presence of the extra, or second, male. During the incubation period this male was a constant attendant, and frequently brought food to the female, this of itself being not in the best tradition for males of the species. The first male, as usual singing with utter abandon, gave little heed to the second, his rare and rather awful attacks being his only expression of interest. I never witnessed the outcome of these attacks, since the headlong chase invariably brought up somewhere in the marsh across the way. The unusual solicitude of the second male for the brooding female, his apparent fear of physical encounter with the first male, and his wholly inadequate vocal attainments strongly suggest that he was a sex-intergrade with some radical insufficiency or maladjustment of the endocrine system. This is the only case I have encountered with this species, and one of the few I have found anywhere of unmated "helpers at the nest," as delightfully described by Skutch[1] in reference to certain Central American birds.

The fourth nest was of particular interest because I was able to observe it in process of construction and through the entire period of incubation. It was located just off a narrow strip of oak grove back of the Edgewood Sanitarium, Bellona Avenue, Baltimore. An area on the other side of the grove was usually damp, doubtless was at one time a swamp, and a drainage ditch ran through it parallel to the grove.

I first saw the Kentucky Warblers in this neighborhood during late May, 1929, and was especially attracted by the eight-syllable song, there being an additional short note at the end of the second and third phrases. On the evening of May 30 I had just engaged a seat at the end of a vegetable

[1] Skutch, A. F., The Auk, vol. LII, p. 257. 1935.

garden overlooking the grove and was for the moment preoccupied with the number and general prosperity of rats at a nearby dump, when a female Kentucky Warbler appeared on a fence paling but a few feet away and began to sort wisps of grass. The male was nowhere to be heard at the time, and the female took not the slightest notice of me. She carried her grass to a fence corner of the garden and began arranging it. A more ill-advised site for a nest I could not fancy. There was no grace of logs or lichens, ferns or vines, no shelter of any kind, in fact nothing but a heap of clods and leaves raked from the garden. Where these filled an angle of the fence paling at the garden corner she was beginning to line a nest.

With the purpose of offering her a choice of artificial materials, I worked till dark assembling bits of plain and colored string, thread, cotton and wool, and such fragments of ribbon and rayon as I could find. The next morning I was on hand early to await results. I could hear the male some distance away, but it was a full half-hour before the female put in her appearance. When she did, she carried grass, made several trips for grass before taking any notice of my bargain counter display. Finally she became interested in a bit of brown sweater wool, which she promptly conveyed to the nest. Then followed white string, green string, yellow ribbon and the like, taken with little or no deliberation. A piece of pale blue rayon gave her pause, but after shredding it a while she took it on to the nest. However, she eschewed all materials of carmine, scarlet and purple. By the evening of that day the nest was apparently complete.

For two days thereafter I saw nothing of the female, though the male continued to sing from his favorite perch in the lower boughs of an oak. On the third day I still saw nothing of the female, but found an egg in the nest. Each day after that an egg was deposited, until there were five. This, I supposed, was the complete set, but two days later a sixth egg was laid. These eggs, almost perfectly ellipsoidal, were grayish white, finely and sparsely flecked with chestnut. The incubation period was thirteen days, during which the female as usual brooded closely and the male was almost constantly in song. All six eggs hatched, but on the next day there were only four young in the nest, on the third day only one, and on the fourth day the nest was empty. I have no direct evidence in the case, but the very exposed position of the nest and the plenitude of rats offered an incriminating nexus.

The fifth and sixth nests were both mid-July records of 1933. The fifth was found July 13 on the same hillside and not far from the same site as the third, which latter I always recall as the nest with the unmated helper. This time there was no such helper present on the single occasion of my visit to the nest, but the male had an unusual, as it were incomplete, song of five syllables, loud, uneven and not of a quality to be called musical.

It is of course tempting to assume that this was the unmated male helper of six years ago, now become sexually adequate. While this is to a degree plausible, the meager evidence at hand surely does not establish such a conclusion.

The nest contained three well-fledged young; and the mother, but not the father, was fully occupied with their food problems. This nest, unlike the beautiful structure I had seen there in 1927, was just a double handful of leaves with a shallow bowl of grass, and was placed on a slab of rock at the base of a persimmon sapling, with fair shelter on one side from some large-leafed vine of a kind unknown to me. Since more than a week elapsed before I could return to this locality, there was no further need of visiting the nest. I found the male, now singing only occasionally, and the scolding female in the marsh across the road. After a brief wait I located two of the young.

The sixth nest was found July 18th in a narrow ravine that leads diagonally from Stoneleigh swimming pool to Stevenson's Lane. The Kentucky Warbler was to my best knowledge a new-comer in this locality. Since for three years I had lived but a few blocks away, and was accustomed to visit this shady retreat almost daily during the summer, I can say with assurance that until then no Kentucky Warblers had nested there within the period of my sojourn. I found the nest, as usual, by hearing the male and following the female. It was at the edge of a thicket in a clump of grass overhanging the foot-high earthen bank of the stream. The grass thereabouts was long and densely matted, so that in this one instance there was no foundation of leaves. The nest was merely a thick welt of rootlets and grasses, with bits of cotton and hemp twine woven in, and a few 'clippings' of green newspaper by way of foundation.

On the first day of observation there were two eggs, and in as many days two more were added to complete the set. These eggs were very similar to those of nest 4 in being almost perfectly ellipsoidal, and were thinly sprinkled and streaked with olive brown; the streaks and coarser markings prevailed at one end. By reason of this pattern of marking and the great convenience of having a nest so near home, I was able to keep close records of the daily position of the eggs. To facilitate this part of the observation I numbered each egg with brown ink, applying this with a small brush at the more accessible pole of the egg. By these means I found that each egg was turned on its long axis once, sometimes twice, every twenty-four hours, and that the relative position of the eggs to each other was variously altered from time to time. But watch as long and closely as I might, I never happened to see the female in the act of turning the eggs.

This female emphatically disapproved of me. At first she would not return to brood as long as I was on the opposite hillside watching with a

field-glass, and I could count on frantic demonstrations from both male and female every time I looked into the nest, which unhappily was quite often. It was my impression that this female brooded much less closely than others I had seen. But after twelve days' incubation all four eggs hatched, and after ten days of nest-feeding the vigorous brood of four was brought off.

I happened to be on hand when the first youngster left the nest. The parents created an exceptional stir that morning when I came near, and must have imparted their excitement to the young ones, because all of them began to flutter and scream in unison and so violently that one was thrust over the brim of the nest into the tall grass. There he gasped and screamed and floundered for a long time before finally attaining a nether twig of the thicket, which swung his weight perilously above the brook. After numerous awkward adjustments to his perch he took off on his first flight and plumped squarely with his chin on a tiny sand-bar beneath. I thought how like this flight must have been that ill-fated venture of Leonardo da Vinci's pupil, Astro da Peretola, who, much against the master's wish, hoisted their flying contraption to a housetop and after numerous adjustments let go and promptly converted himself and the machine into a heap of débris.

This panorama of thought was rudely interrupted by a large tawny cat springing in the direction of the hapless young flyer. The cat fumbled its first pass at the bird and became so mired in the soft mud underlying the sand-bar that I had just time enough to reach the scene and deliver a broom-stick whack on the cat's lumbar region. Whereupon I too stepped half-knee deep in the mud. The whole situation was right maladroit, to say the least. But the cat retreated by leaps and bounds and the young bird struggled to another perch, from which he shortly took off again, this time making it back under his own power to his screaming parents. The condition of my footwear being what it was, I did not tarry for further demonstrations of first flights.

When I returned that afternoon I could hear desperate protests from the parent birds long before I came within sight of the thicket. My guess was that the cat had returned; in fact, anticipating just this I had borrowed a small rifle in the hope of coming to final understanding with the cat. My guess was correct, but the cat had seen me first and was already 'withdrawing to a prepared position' when I reached the thicket. In response to my one shot the cat leaped straight in the air, and then sped up the hill with such vim and vigor that I could not persuade myself to accept the understanding as final.

I had some difficulty finding the young birds. They were in the mid-upper branches of the thicket, utterly voiceless and motionless, and with all my search I could locate but three of them. The parents were much too excited to go on with feeding at that time, so I left them alone after such a

strenuous day. That day of their leaving the nest was August 11. Each day of eleven thereafter I found the brood being fed by male and female together. The last time I saw them, August 22, there were but two young. August 23 was the memorable day of the great nor'easter, when sheets of rain were whipped across the countryside by hurricane winds continuously for more than twenty-four hours. When I visited the thicket on the morning of August 24, a torrent was still pouring down the little valley, the whole configuration of the place had been changed, and the bird population had apparently been swept away. One bedraggled Flicker and a chipmunk were the only remaining wild-life I saw in the neighborhood that day.

Summary.

It appears from my records that the Kentucky Warbler is much more frequent in Maryland than in Missouri. Of the six nests of this Warbler described here, each was located near a stream, marsh or damp lowland; each of five was built on a foundation of leaves, and all were lined with grass and rootlets. In two instances artificial materials, as cotton and woolen strings, ribbons and the like, were employed for lining. Five nests were directly on the ground. There was much individual difference in the extent to which shelter was sought for the nest. In one case (No. 3) a canopy was built over the bowl of the nest, even though leaves of vine already shaded it completely; in another case (No. 4) no shelter or shade of any kind was provided.

The eggs of different nests varied both in shape and markings. Eggs of some sets were bluntly pointed at one end, i.e., were distinctly ovate; those of two sets were almost perfectly ellipsoidal. The markings of some sets were fine and sparse; those of others coarse and in parts dense; they were always in one or another shade of brown. The number of eggs in a set varied from four to six. The incubation period, fully observed in two cases, was in one twelve days, in the other thirteen. During this period the eggs, as observed in one case, were turned on their long axis at least once a day. The period of nest-feeding was in one instance eight and a half days, in another ten days.

The male sang almost constantly during the periods of brooding and nest-feeding, but helped with care of the young when they left the nest. The song was usually one of six syllables, but whatever its variation it was constant for a given male. One male had a song of seven syllables, a short note being added to the third phrase; another had an eight-syllable song with short notes added to the second and third phrases. In one case there was an unmated male "helper at the nest," whose song was uneven and harsh. Six years later in the same locality there was a male with an unmusical song of five syllables.

No known second nests of this Warbler were found. From the six nests described here four broods were brought off. This ratio of successful nests is doubtless much too high for ground-nesting birds, if considered in series large enough for significant statistical treatment.

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