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SURVIVAL AND REPRODUCTION IN A SONG SPARROW POPULATION DURING ONE SEASON*

BY MARGARET MORSE NICE

The Song Sparrow (*Melospiza melodia melodia*) is the dominant avian species in the pioneer weed association on the east bank of the Olentangy River between the Doddridge Street and Lane Avenue bridges in Columbus, Ohio; sixty-four pairs lived on approximately fifty acres in April, 1930. Near the river and on the bluff to the east are cottonwoods, sycamores, buckeyes, elms, silver maples, and hackberries. Shrubs are almost wanting except for large patches of elder. The chief weeds are sweet clover, cow parsnip, teasel, dandelion, burdock, golden rod, Canada thistle, and giant ragweed.

In 1930 I made a study of the Song Sparrow population most conveniently situated from our house, obtaining data on the success of the first brood in the case of forty pairs, of the first and second broods with thirty pairs, and a complete record of sixteen pairs. As the season progresses, the difficulties of keeping track of a large number of birds increases, due to the rankness of the vegetation and the subdued activity of the birds themselves. Twenty-seven of the males and twenty of the females were marked with aluminum and celluloid bands,¹ in most cases the birds having been trapped on their respective territories. Some males that were not banded were distinguishable by their songs, while other birds were known by position, for each pair for the most part stays closely throughout the season within the two-thirds of an acre or so which it calls home.

The accompanying map shows the territories of forty pairs on approximately thirty acres as affairs stood the last of May. Each pair is designated by a field number which has no connection with the band number; the field number followed by *m* refers to the male. Each female is named by the number of her first mate followed by *f*

*Read before the Seventeenth Annual Meeting of the Wilson Ornithological Club at Cleveland, Ohio, December 29, 1930.

¹See Burkitt, J. P., *British Birds*, 1924, Vol. 17, p. 295; and Butts, W. K., *Bird-Banding*, 1930, Vol. 1, No. 4, pp. 158-163.

and the year—as 4/29; if there were more than one mate in a season a letter is added as 18/30*a*, 18/30*b*. The details of this scheme of nomenclature as well as my technique in finding nests has been discussed elsewhere.² The boundaries of the territories were not rigidly fixed, each pair trespassing on the land of its neighbors' and many disputes being staged, but in general they stay about the same throughout the season.

SURVIVAL

In the fall and winter the Song Sparrow is admirably protected by his coloration and his habit of diving into cover upon suspicion of danger, in this locality being noticeably more cautious than the Junco or Tree Sparrow. But from February or March through June, the male, busied with affairs of his territory, comes boldly into the open to sing or quarrel, while both parents expose themselves recklessly when concerned over the safety of half grown young. An unexpectedly large mortality of nesting adults was found.

On April 15 there were thirty pairs on the twenty acres nearest us—all the birds on the map north of and including 12, 30, 2, and 7, but not 44.³ But by early July there were only twenty-five pairs and (one-sixth)—one-fourth of the whole number. Five new females and two new males had come in. Three pairs were lost outright—7, 16, and 46. There were two re-matings of neighboring widows and widowers—26*m* and 27*f*, 30 *m* and 13*f*. 20*m* lost his mate in late May and never procured another, although he stayed on his territory to the end of June and was again singing there from September 28 to October 14. 29*m* came May 21, carved out a new territory and was soon joined by a female. 47*m* appeared in mid-June, but remained a bachelor. 4 *m*, on the other hand, had three different mates in 1930. Where both birds survive, Song Sparrows normally keep the same mates throughout the season; primarily, I believe, because so preeminently rooted to the soil, secondarily, because of their habit of often starting another brood as soon as the first is out of the nest.

REPRODUCTION

NEST STATISTICS. Sixty-one nests were located while occupied and three others later in the season. A second nest was never placed in close proximity to the first, the distance between succeeding nests two lone males. Ten females had been lost (one-third), and five males ranging from 32 to 190 feet, the average of twenty-four cases being

²*Bird-Banding*, 1930, Vol. 1, No. 4, pp. 177-181.

³46 was present, but 29 was not; the former's territory lay between 26 and 27 and was appropriated by 26 after the disappearance of 46 and his mate.

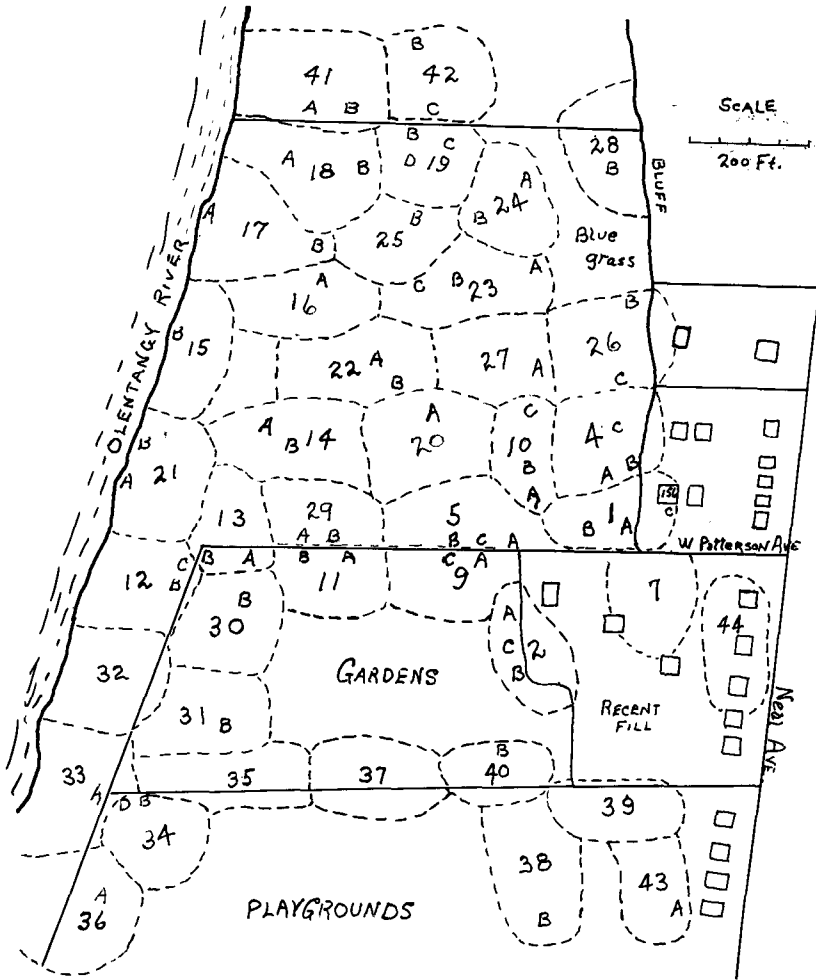


FIG. 13. Map of the Song Sparrow territories.
The letters A, B, C, represent the first, second, and third nestings.

84 feet. The sixty-four nests are classified in Table I as to height from the ground and excellence of concealment, while data on the number of eggs is given in the case of thirty-seven nests. All nests of the first attempt were placed on the ground, half of the second attempt and a third of the third attempt being in the same position; the average height of all the nests of each attempt increased with the advance of the season.

TABLE I
Song Sparrow Nests in 1930.

| | HEIGHT | | | CONCEALMENT | | | | SIZE OF SETS | | | |
|----------------------|--------------------|----------------------------|-----------------------|------------------|------|------|------|-------------------------|-------|-------|------|
| | Per cent on ground | Height of others in inches | Average height of all | Numbers of Nests | | | | No. of Nests Containing | | | |
| | | | | Excelnt. | Good | Fair | Poor | 5eggs | 4eggs | 3eggs | Avg. |
| First Attempt | 100 | - | 0 | 17 | 3 | | 2 | 7 | 7 | 0 | 4.5 |
| Second Attempt | 50 | 3-15 | 3 | 17 | 1 | 8 | 1 | 7 | 7 | 2 | 4.3 |
| Third Attempt | 33 | 5-30 | 7.5 | 7 | 3 | 1 | 1 | 0 | 3 | 3 | 3.5 |
| Fourth Attempt | 0 | 6-10 | 8.5 | | | | 2 | 0 | 1 | 0 | 4.0 |
| Total | | | | 41 | 7 | 11 | 5 | 14 | 18 | 5 | 4.2 |

Although these birds began to nest in mid-April when the vegetation had hardly started, the earliest nests appeared to be better hidden than the later ones, concealment according to my point of view being excellent in 77 per cent of the first attempt, 63 per cent of the second, and 58 per cent of the third. The favorite situation was under prone weed stalks. Taking the nests throughout the season, fourteen were found in this position; the other most usual sites were, under Canada thistle, seven cases; in miscellaneous weeds, seven; in weeds and stalks, six; in weeds and grass, five; in blue grass, five.

There was some correlation between excellence of concealment and success of the nest, since 56 per cent of this class raised young, while this was true of but 35, 36, and 40 per cent of those rated good, fair, and poor respectively. However, there was not necessarily any consistency in the same bird, for the first nest was sometimes well hidden and the second conspicuous, or the reverse might be true. Of the twenty females of which two to three nests were found, none built nests that were consistently poor or mediocre in concealment. One built two which I considered fair and good respectively; another built three nests which were rated good. Eighteen scored excellent in from one to three cases, but eight of them had one nest apiece which rated fair, and three of them had nests which rated poor.

As to the numbers of eggs, only those nests are included in the table where the set was known to be complete and that contained no Cowbird eggs. In eighteen cases four eggs were laid, in fourteen

cases five, and in five cases three. The first two attempts average much the same in size, but in the third there was a decrease.

SUCCESS AND FAILURE OF NESTS. Of the first attempts of forty pairs of Song Sparrows, the young of fifteen nests left in safety, while all the others came to premature ends, giving 37.5 per cent of success. The fate of seventy-nine nests of the thirty pairs is shown in Table II.

TABLE II
Success and Failure of the 79 Nests of the 30 Pairs.

| | Numbers | | Per Cent | |
|------------------|---------|---------|----------|---------|
| | Success | Failure | Success | Failure |
| 1st Attempt..... | 10 | 20 | 33.3 | 66.6 |
| 2nd Attempt..... | 12 | 15 | 44.4 | 55.6 |
| 3rd Attempt..... | 7 | 10 | 41.2 | 58.8 |
| 4th Attempt..... | 3 | 2 | 60.0 | 30.0 |
| Total | 32 | 47 | 40.5 | 59.5 |

The data are complete for the first two broods, but not for the last two; there were three attempts whose outcomes were unknown and a possibility of five other attempts, none of which could have succeeded. Here, as with the data on the forty pairs, there is some evidence of a greater mortality among early nests than later ones, the percentage of success in the first attempt being only 33.3, but for the whole season 40.5.

Table III gives the complete record of sixteen pairs that survived the season.

TABLE III
Complete Record of 16 Pairs that Survived the Season.

| Numbers of Pairs | Number of Successes | Number of Failures |
|------------------|---------------------|--------------------|
| 1 | 0 | 4 |
| 2 | 1 | 3 |
| 6 | 1 | 2 |
| 1 | 2 | 2 |
| 5 | 2 | 1 |
| 1 | 3 | 0 |
| — | — | — |
| 16 | 22 | 29 |

The most common experience—shared by six pairs—was one success and two failures, two successes and one failure being the lot of five pairs. One pair had four failures and no success; one had no failure and three successes. (In 1929 one of the two pairs I studied experienced two failures followed by two successes, the other one failure and then three successes; the first raising five young, the second nine). Four pairs made four attempts and twelve pairs three attempts. The percentage of success was 42.3. Each pair averaged 1.4 successful attempts; 1.8 unsuccessful attempts.

The actual numbers of young raised (i. e. that left the nest in safety) by fifteen pairs⁴ that survived the season were as follows: 0, 2, 2, 3, 3, 3, 4, 4, 4, 4, 5, 6, 7, 7, 10—a total of 64, an average of 4.3 a pair. The last four figures represent two broods each, hence eighteen broods were raised, averaging 3.6 young to a brood. Mr. E. M. Nicholson⁵ reports that on forty acres in England 169 adults of eight species raised 299 young, giving an average of 3.6 young per pair.

Of the 61 nests that were located, 17 came to their ends while containing eggs, and 15 while containing young. At least 240 eggs were laid in the 61 nests (although the number should have been about 255); 151 young were hatched in 44 nests; 102 young were fledged in 29 nests. Thus in 72.1 per cent of the nests young were hatched, in 47.5 per cent they left in safety. Of the eggs, 63.0 per cent hatched, and 42.5 per cent were fledged. (It is interesting to compare these figures with those given by Nicholson for a 20 acre tract: 687 were eggs laid in 156 nests; 420 hatched—61.1 per cent; 300 fledged—43.7 per cent). The average number of eggs in the nests was 3.9, the average number of young raised in the 29 successful nests 3.5.

In order to trace this shrinkage between the number of eggs laid and the number of young raised per successful nest, let us examine the matter of full and partial successes. In 24 successful nests in which I am sure of the quota of eggs, 99 eggs were laid and 88 young raised—an average of 4.1 eggs and 3.7 young per nest. In 15 of these nests 63 eggs were laid and 63 young fledged—an average of 4.2 eggs and young each; but in 9 nests 36 eggs were laid and 25 young fledged—an average of 4 eggs and 2.8 young each. The loss in these 9 nests was 30.6 per cent, in the whole 24 it was 11.1 per cent.

This loss is largely due, not to outside factors (except for one young bird crushed by a Cowbird nest mate), but to imperfect functioning of parental behavior. Four eggs failed to hatch, one because infertile, the other three being addled. In two cases this latter condition was the fault of the nest; in the first an egg had slipped into a depression, in the other the nest had been pressed out of shape by the growth of the thistle in which it was placed.

⁴Nine of these two sets—the 16 pairs and the 15 pairs—were the same, the others different, for in some cases the total number of young was not known, as a nest had not been found, although parents were observed feeding young out of the nest; and in the other cases I have full data as to the successes, but am not sure how many failures occurred.

⁵Encycl. Brit., 14th Ed., 1930, Vol. 3, p. 634.

Two young in one nest apparently perished while hatching. One six-day nestling was found dead outside the nest, presumably pulled out by a parent. Two in a nest died of starvation, apparently as a result of poor care by the parents; (the male was a young bird and the female probably was also; this was their only success this season). The last nestling was deserted by its parents and allowed to perish after the other young had left. I had banded this brood in the morning at the age of nine and ten days amid great parental excitement; three dispersed and were cared for by the adults some twenty yards to the east during the next two days, but one remained in the nest. By afternoon it was calling loudly and the next morning was dead. It may have been that the parents were so conditioned by their fright at the nest, that they would not return to it despite the pitiful cries of the offspring.⁶

THE YOUNG AFTER LEAVING THE NEST. Mortality during the fourteen to eighteen days of parental care after the young have left the nest is a hard matter to keep track of, since the fledglings are adepts at hiding in the weeds. In only a few cases did I use colored bands on the nestlings, so that even when I saw grown young being fed, it was not often possible to discover whether or not all of the brood had survived. I know that three broods were wiped out a few days after leaving the nest, but some at least of nineteen broods were reared to independence. In three cases I know they all survived, and in two cases at least six out of nine birds. On eight broods I have no data.

CAUSES OF MORTALITY

Under possible causes of mortality let us consider the weather; parental efficiency; man; introduced enemies; and natural enemies.

THE WEATHER. Three ways in which weather might influence the nesting Song Sparrows are: the destruction of eggs and young

⁶For instances of young perishing through misadventure in hatching see Nelson (*Bird-Banding*, 1930, Vol. 1, pp. 1-12); and Harding (*Bull. North-eastern Bird-Banding Assn.*, 1929, Vol. 5, pp. 77-80). Stephens describes how a Red-eyed Vireo, trying to jerk a worm out of the mouth of one of its young, pulled the latter out of the nest (*Bull. Lab. Nat. Hist., Univ. Iowa*, 1919, Vol. 7, No. 3, pp. 25-38). As to fright at the nest preventing a parent returning to care for young, see Bigglestone (*Wilson Bulletin*, 1913, Vol. 25, pp. 49-67) for this behavior in a male Yellow Warbler after a snake had taken one of his young. Two somewhat similar instances have come to my notice: a black snake was killed by us after it had eaten two of a brood of Robins, but neither parent came back to the remaining young. Song Sparrow 27m was so disturbed by my placing a drop trap over his nest containing seven-day young that he deserted and never returned, leaving his mate to struggle alone with the rearing of two Cowbirds.

through storms; possible lessening or change in food supply; effect on length of the breeding season.

The exceptionally dry season of 1930 was favorable to nesting, so that not a single nest nor young bird under observation came to its end through cold rains. It seems probable that a larger proportion than usual of fledglings survived after leaving the nest.

As to the food supply, two entomologists tell me that while the numbers of some insects were decreased in this region by the drought, others were increased; they believe that the insect supply was as ample as usual. Seeds of early maturing weeds were always available. The July broods of the Song Sparrows were brought off in full numbers at the normal age of nine and ten days.

The nesting season of 1930 began about ten days later than that of the previous year. In 1929 I found the first egg April 10 (laid by 1/29); in 1930 no egg was found before April 20 on which date three birds (one of them 1/29) began to lay, although in two other nests the first eggs must have been deposited April 18 or 19.

Molting began earlier in 1930 than in 1929. In the former year adults were in the midst of the molt the first half of September, eight such birds—two without tails—being noted in a willow stub by the Olentangy September 8. *4m* was in full molt September 8 and 15, but had nearly completed it September 19; he did not begin to sing freely until September 24.

In 1930 several nesting birds had started molting by July 12. On September 7 two of the banded females were entirely through the process and two days later another female and *4m* were practically through. The only unbanded molting adults noted after our return to Columbus, September 7, were single birds seen September 12 and 14. *4m* began to sing in earnest September 10. As to *1m*, he had hardly sung at all during the fall of 1929, but in 1930 he sang quite regularly in the early morning—sometimes as many as sixty-three to eighty-four songs an hour—from September 17 to October 11. In 1929 he was last seen October 14, in 1930 October 15, the other summer resident males⁷ leaving at about the same time, so migration does not seem to have been hastened by the earlier molt.

According to the United States Weather Bureau the five months of 1929 influencing the nesting season were characterized as follows (the deviation from the mean of the last 47 years at Columbus being given first): March, +8.3°, persistent and summer-like warmth from

⁷Of my 27 banded males, 12 are (or were) residents throughout the year, 13 are summer residents.

the 12th on; April, $+3.2^{\circ}$, great temperature changes; May, -2.6° , persistently cool, abundant precipitation; June, -2.2° , much cool weather with frequent storms; July, -0.7° , changeable temperature, precipitation above average.

In 1930 the weather was markedly different: March, -0.5° , changeable, precipitation below normal; April, $+3^{\circ}$, changeable, dry; May, $+2.1^{\circ}$, warm, abnormally dry; June, $+1.1^{\circ}$, one of two driest Junes in 47 years; July, $+2.1^{\circ}$, hot, especially in last half, driest July in 77 years.

In 1929 the abnormally warm weather during the last two-thirds of March appears to have hastened the beginning of the breeding season. During the excessively dry and comparatively hot summer of 1930 the molt started about two weeks earlier than the preceding year. (Whether this was due to a change in diet, to a more direct debilitating effect of the continued heat and drought, or to some other factor, I will not venture an opinion). Thus the season of 1930 was shorter at both ends than that of 1929, and the numbers of attempts at nesting must have been reduced in consequence. The majority of the thirty pairs were through nesting by mid-July, and three or more as early as the end of June; none had young in the nest later than July 27. In a more normal season more pairs might have made fourth attempts.

EFFICIENCY OF PARENTS. So far as nest building goes, the female Song Sparrow constructs a stable, adequate structure that in the majority of cases is well concealed. Only two of the nests found were placed on insecure foundations. While feeding young, the parents are adept at keeping the whereabouts of the nest a secret. The loss of ten eggs and young in the twenty-nine successful nests may fairly be laid to the charge of parental mistakes—i. e., 8.8 per cent of the 113 eggs laid. This is substantially less than that found by us with Mourning Doves in central Oklahoma; from 261 eggs in 130 successful nests 213 young were raised, a loss of 18.4 per cent, due largely to frailty of the nest.

MAN. The influence of man has many ramifications—the clearing of the land, primarily beneficial to the species, now detrimental; the activities of his young; the introduction of new enemies; and finally, for this study, myself.

There are evidently many more Song Sparrows nesting on this flood plain at present than there could have been when it was covered with primeval forest. The northern half of the area, unprotected by dikes, is flooded nearly every year and consequently is almost use-

less for purposes of cultivation. To the south, however, people plowed up territories with entire disregard for Melospizan property rights, causing several pairs to retire to the edges of their land, and dispossessing one pair entirely with the result that the neighboring population was thrown into an uproar through the home seeking endeavors of the refugees. Some of the unmated birds that replace losses may have lost mates or territories due to human activities. In late June there were two visiting males on my twenty acres, each remaining about a week; on June 28 I banded an adult on 30's territory that I never saw again, and the same thing happened July 14 on 29's territory. The Song Sparrow is a remarkably adaptable bird and will cherish as his home places on the bluff in the southern end of this area that are nothing but masses of tin cans and weeds.

Boys are responsible for the loss of some of the adults, shooting the singing males and both parents when disturbed over young. They carried off two nests with eggs.

As for myself, I tried not to interfere with the course of events, not removing Cowbird eggs nor killing natural enemies. I did warn a man with a mowing machine away from a nest, I did bolster two insecure nests and replace three infants scattered a few inches from the rim; perhaps these good deeds counterbalanced the enemies I might have led to the nests. One set might have been deserted because of my visits, although on the whole the birds were remarkably tolerant of my interest in their doings. The nests found by me suffered fewer disasters than those that remained undiscovered; for of the fifty-seven nests of the thirty pairs that I found twenty-six, or 46 per cent, succeeded; but of the twenty-two I did not find, only six, or 27 per cent, succeeded.

INTRODUCED ENEMIES. A number of self-hunting dogs infest the area and may break up nests. Cats undoubtedly destroy both the adults and young. Rats are probably a serious factor. The contents of five nests disappeared gradually, Song Sparrow eggs being preferred to those of the Cowbird, for none of the five latter were eaten until after they hatched. Here it is probable that rats were the guilty parties. A Ring-necked Pheasant was surprised just after she had emptied a nest of two-day old infants; I suspect it was she that threw the three four-day-old nestlings out of their nest.

NATURAL ENEMIES. Crows, Blue Jays, and grackles I have never seen hunting in the low situations favored by Song Sparrows, and the same is true of the few gray squirrels present. Two pairs of Sparrow Hawks nest by the Olentangy, one fifty feet north of 41's territory

and the other opposite 32's territory, but they do not hunt on this area during the nesting season. Opossums, weasels, and snakes are rather common and doubtless take their toll.

The Cowbird summers here in goodly numbers, depending on the Song Sparrow as its chief host early in the season, but later favoring the Maryland Yellow-throat also with its attentions. Twenty eggs of *Molothrus ater ater* were found in fifteen of the 61 nests; in five cases there were two eggs. Twenty-eight per cent of the first and second attempts were parasitized, 18 per cent of the third attempt; 24.6 per cent of all. Fourteen of the thirty pairs were victimized, one pair twice.

Seven Cowbird young were raised in six nests—35 per cent of success. In one nest two Cowbirds and no Song Sparrows were raised, in the others a single Cowbird with two Song Sparrows in one nest, with three Song Sparrows in each of three nests, and with five Song Sparrows in still another nest. Three Cowbird young brought death to three young Song Sparrows, in one instance crushing one of four nest mates, in the other the two Cowbirds crowding out two Song Sparrows. The quota of Song Sparrow eggs was full in three cases, was six eggs short in four cases, while as to the five other nests I do not know. Two nests were found with two Song Sparrows and one and two Cowbird nestlings respectively; here there should have been three or four more of the former species. In the twenty-nine successful nests, three to seven more Song Sparrows should have been raised without Molothrine interference, and four Song Sparrows in the nest that produced only two Cowbirds; hence without this parasite seven to eleven more Melospizan young would presumably have left the nest in safety. This season about a 9 per cent loss from otherwise successful nests is attributable to the Cowbird.

CONCLUSIONS

If we calculate on the basis of the 255 eggs that should have been laid in the sixty-one nests, we find that 38 per cent of eggs or young were eaten by enemies, 3.5 per cent carried off by boys; 5 per cent lost through Cowbirds; another 5 per cent through parental inefficiency; while 8.6 per cent (six nests) were deserted. Four or five of these last disasters were due to the death of the incubating bird. The worst enemies of the adults I believe are boys and cats; of the young, rats and cats.

The high mortality of the adults during the breeding season was unexpected, and the number of failures was often disheartening. But the period between leaving the nest and attaining independence showed

a marked degree of success. Another season might show more attempts at nesting, but greater mortality.

COLUMBUS, OHIO.

NOTES ON THE SONG AND TERRITORIAL HABITS OF BULLOCK'S ORIOLE

BY ALDEN H. MILLER

Possibly there are many students of birds who have noted the song of the female Bullock's Oriole, but it would appear from a perusal of the general accounts of the natural history of this species as set forth in the better known manuals of American ornithology that the female *Icterus bullocki* is not given proper credit as a singer. Primarily to correct this impression regarding song a short and unfortunately fragmentary observational record of two pairs of Bullock's Orioles is presented here. The songs of female orioles of other species, as for example, *I. galbula*, in some cases are well known.

In the vicinity of Pinole, Contra Costa County, California, in the winter and spring of 1930, several California Loggerhead Shrikes were under my observation for a period of six months. Incidental to this study of the shrikes other bird species came to my notice, among them several pairs of orioles. The region studied consisted of an open pasture with a number of steep-banked ravines cutting through it (see figure 14). Willows were the principal trees although a few cottonwoods, live oaks, valley oaks, and buckeye trees were present. The grass in the pasture did not attain a height of more than fifteen inches during the 1930 season. A few low tangles of rose bushes were present in the bottoms of the ravines.

Male orioles had arrived in the region under consideration on March 27, 1930, and were in full territorial song. These birds were not present on a previous visit on March 24. Songs of two males were recorded on this date at 7:45 in the morning, the method used being that employed by A. A. Saunders (New York State Museum Handbook 7, 1929, p. 140), except that absolute pitch was not recorded. The two songs were identical and could not be distinguished from songs, probably of the same males, that were uttered a month later on the same territories. On March 27 one male occupied the line of willows, territory B, to the west of the bridge shown in figures 14 and 15, while the other male occupied the two clumps of willows east of the bridge, territory A. These males were not followed closely by me at this time but each appeared to have established possession of