

A STUDY OF HENSLOW'S SPARROW IN MICHIGAN

JEROME D. ROBINS

As with many birds of secretive habits and irregular distribution, the Henslow's Sparrow (*Passerherbulus henslowii*) is insufficiently known. Our knowledge of this species is best summarized by Graber (1968), which is based on her observations and those of Hyde (1939) and Sutton (1959*a, b*). The present study focused on the population structure and nesting biology in 1966 at Kalamazoo, in southwestern Michigan.

METHODS

The study area is a 30-acre brome grass-alfalfa-red clover hayfield marked off into a grid by stakes set at 100-foot intervals (described in detail by Brewer et al., 1969). Censuses of singing males were made on 65 different days between the first of May and mid-September. During each census the locations of birds were marked on maps which reproduced the grid as well as the outstanding vegetational features.

Territories were mapped using only the singing locations recorded for the various males. No additional types of territorial defense were observed and human disturbance caused the birds to go out of their territories. Male G was chased continually for 45 minutes to determine how far he would go from his territory of 2.4 acres (as previously determined by mapping song posts). The resultant area was 5.9 acres with the greatest linear distance away from his territory being 780 feet. Singing locations were connected by straight lines to form polygons which correspond to the "utilized territories" of Odum and Kuenzler (1955). (The areas of the polygons were determined by use of a planimeter.)

Observations of nine nests were made from blinds placed on the ground five feet from the nests. Since records of attentiveness and inattentiveness were not random (they began and ended with the beginning or ending of an attentive or inattentive period) and because unequal numbers of sessions and recesses were collected, percentage attentiveness was calculated by use of Skutch's (1960:8) formula:

$$\text{Percentage attentiveness} = \frac{\text{Mean attentive period}}{\text{Mean attentive period} + \text{Mean inattentive period}} \times 100.$$

Fourteen males, 10 females, 18 nestlings and 2 juveniles were banded and individually marked with celluloid leg bands.

BREEDING SEASON HABITAT

The habitat requirements of Henslow's Sparrow seem to include or, at least, be related to the following features: (1) an intermediate moisture range; very wet or dry areas are avoided; (2) vegetation dominated by herbaceous plants particularly grasses or sedges which is dense or, at least, with frequent dense patches. At Kalamazoo, territories were smaller and more numerous on the north portion which had the densest vegetation; (3) presence of litter; and (4) singing perches. Over most of the season at Kalamazoo,

the birds sang just below the top of the general vegetational cover. Invading woody plants and grid stakes provided perches above this level but they were used only infrequently. During the initial part of the breeding season, however, clumps of dead vegetation standing above the new grass were often used as singing perches.

ESTABLISHMENT AND MAINTENANCE OF TERRITORIES

Males initiated their primary song upon arrival and ceased singing about mid-September. First arrival occurred on 22 April in 1966 and 30 April in 1967. The latest observation in 1966 was on 16 October, but the last identification of a marked individual was on 17 September.

Sutton (1959*b*) stated that territorial defense included frequent chasing by the males. During extensive observations at Kalamazoo I saw no such incidents. Territorial disputes between adjacent males were limited to "formal songfests." "Singing" and "song" are here used to refer to the vocalization given by the male represented as *tsi-lick* by Peterson (1947:231). There was no tendency for adjacent males to come to their nearest borders for a duel. In cases where one male moved near the border of its territory and that of a nearby male, the latter usually continued singing at the same location, even if on the opposite side of its territory. The average distance between simultaneously singing males on adjacent territories was 216 feet ($N = 107$). With these observations as a basis, territories are here considered to be any area within which a given male sang.

Four continuous day-long song counts were made in an attempt to determine the amount of time males devoted to singing at various stages of the breeding cycle (Table 1). All the songs of three males in nearby territories were included in each song count. The first two song counts (10 May and 26 May) represent periods when the birds were in the earliest stages of the breeding cycle. The greatest amount of time devoted to singing was in the early morning and early evening. Initiation of steady singing occurred about one-half hour before sunrise and most birds stopped singing about one-half hour after sunset. The increase in singing which occurred from early to late May may have been influenced by the increase in the total number of birds present as well as by behavior related to the nesting cycle itself. Almost no singing was observed between 21:00 and 04:00. On 26 May continual song by all three males under study ended by 20:38. Male E, however, began singing at a rate of eight to nine songs per minute at 21:45 and continued beyond 23:00 when I left. This was the only time a Henslow's Sparrow was heard singing regularly after nightfall between the first of May and mid-September (over 55 observations). The lack of nighttime singing was surprising in that several observers have heard this species sing during the night (see Graber, 1968).

TABLE 1

MEAN NUMBER OF SONGS PER HOUR FOR THREE MALE HENSLOW'S SPARROWS AT FOUR PERIODS DURING THE BREEDING SEASON

The individuals and the total number of songs for each were: 10 May (D:67, E:1960, F:1322); 26 May (E:2103, H:2214, J:1546); 18 July (I:500, J:2099, S:4962); and 15 August (H:746, J:1679, R:223).

Hour	10 May	26 May	18 July	15 August
00:00	4	—*	—	—
01:00	3	—	—	—
02:00	3	—	—	—
03:00	2	2	2	—
04:00	100	312	204	—
05:00	438	517	370	307
06:00	156	40	255	175
07:00	76	38	252	38
08:00	57	75	181	56
09:00	11	147	148	0
10:00	41	67	14	13
11:00	1	5	40	50
12:00	0	25	34	0
13:00	0	—	29	1
14:00	1	—	93	7
15:00	1	—	57	0
16:00	1	56	106	15
17:00	1	185	137	1
18:00	1	161	223	0
19:00	75	71	201	195
20:00	138	63	174	24
21:00	2	35	—	—
22:00	4	152	—	—
23:00	1	—	—	—
Total	1117	1951	2520	882
Sunrise	05:25	05:10	05:20	05:48
Sunset	19:50	20:08	20:14	19:41

* A dash means no observation was made.

The time devoted to singing by the three males was highly variable during July and August (223 to 4962 songs per day). This variation appears to be related to the stage of the nesting cycle. For example, on 17 July male S established himself on portions of three existing territories in an area occupied by five singing males. He was included in the song count on 18 July. In his apparent attempt to establish a territory, male S sang more than twice as many songs as I had previously recorded (4962), and sang during all hours from 03:00 to 21:00. Nest building was in progress in the territory of male J,

who sang about as many songs (2099) as other males at the same stage earlier in the year. Male S was not observed after 20 July.

During the nestling period daytime singing was limited to intervals of only two or three minutes. These sessions immediately followed about half of the feedings of nestlings made by the males. In the early morning and evening the males also sang for periods of one to ten minutes which were not associated with feeding the nestlings.

TERRITORIES AND POPULATION SIZE

Over the course of the breeding season, shifting of territories, disappearance of singing males, and establishment of males new to the area were common occurrences. Ten males had only one territory which appeared to remain stable during their stay on the area, two males had two successive territories, two males had three territories, and four males had four territories. The greatest shift of territories on the study area was made by male E. After setting up his first territory he moved 625 feet south. Later, he moved 65 feet further south, and finally northeast 605 feet. These territories lasted for 28–30 days, 32–34 days, 22–23 days, and 34–35 days respectively. Young were fledged in the second and fourth territories.

For the most part, territories were distinct units separated from others on all sides by buffer zones where neither male sang. Over the summer the average distance between adjacent territories was inversely related to the number of territories present, ranging from 47 feet in July when the population was the highest, to 431 feet in September when the population was the lowest (Table 2). Territory size for all territories through the year averaged 0.8 acres ($N = 36$). On the northern half of the area where the vegetation was the tallest and most dense, territory size averaged 0.7 acres whereas on the southern half the average was 1.1 acres. The average size of a territory was smallest at the beginning of the year and gradually increased through the summer (Table 2). This pattern, however, was not true of all individuals.

Only six territories were defended on the area during the first half of May. This number gradually increased to a maximum of 15 territories during the first half of July and then gradually decreased to three territories in the first half of September (Table 2). Thereafter no territories were defended by song, but Henslow's Sparrows were present in the area until 16 October. During the first half of July when the population was the most dense, the number of breeding birds per 100 acres was 59.3 on the north half and 42.9 on the south half of the study area. The mean number of breeding birds per 100 acres from records in the literature was 23 (Robins, 1967). The majority of the 27 studies reported figures below the mean. If buffer zones

TABLE 2
HENSLow'S SPARROW TERRITORIES ON 30 ACRES OF SUITABLE HAYFIELD
HABITAT AT KALAMAZOO, MICHIGAN
Each territory was present eight or more days during the half-month intervals.

Period	Number of territories	Males per 100 acres	Mean territory size in acres	Mean distance between adjacent territories (feet)
May 1-15	6	20.0	0.7	221
May 16-30	9	30.0	0.9	69
June 1-16	10	33.3	0.9	83
June 17-30	12	40.0	0.9	77
July 1-16	15	50.0	0.8	47
July 17-30	13	43.3	0.9	55
Aug. 1-15	10	33.3	1.0	75
Aug. 16-30	8	26.7	1.1	82
Sept. 1-17	3	10.0	1.6	431

between territories are not essential, the area could support a population more than double that observed in 1966.

RELATIONS WITH OTHER ANIMALS

Avian breeding associates.—The grassland portion of the study area had an estimated 37.4 breeding males of all bird species in 1966 (R. Brewer, pers. comm.). The seven species present and the number of males were: Henslow's Sparrow, 15; Red-winged Blackbird (*Agelaius phoeniceus*), 7.2; Short-billed Marsh Wren (*Cistothorus platensis*), 6; Eastern Meadowlark (*Sturnella magna*), 4.5; Bobolink (*Dolichonyx oryzivorus*), 4.0; Savannah Sparrow, (*Passerculus sandwichensis*), 0.5; and Grasshopper Sparrow (*Ammodramus savannarum*), 0.2. Henslow's Sparrows comprised 40 per cent of the total number of males present. Inasmuch as the Red-winged Blackbird, Eastern Meadowlark, and Bobolink are polygynous they would have, in comparison with Henslow's Sparrows, larger populations and more nests than are indicated by the number of males.

Male Bobolinks and Red-winged Blackbirds occasionally chased singing Henslow's Sparrows, and adults flying to and from the nest during the nestling stage. Such incidents appeared to occur only when a blackbird or Bobolink by chance happened to fly over a singing male or cross the path of a flying Henslow's Sparrow. Attacks were limited to dips in flight to within a few feet of the grass into which the Henslow's Sparrows immediately disappeared. On several occasions when Short-billed Marsh Wrens began singing, a neighboring Henslow's Sparrow male flew near the wren and began singing. One morning a pair of Henslow's Sparrows attacked a Short-

billed Marsh Wren. Several times a male Henslow's Sparrow pursued a Grasshopper Sparrow flying across his territory. The reverse was observed on several occasions in an abandoned field near Augusta, Michigan.

Enemies.—One nest discovered near Augusta, Michigan contained two Brown-headed Cowbird (*Molothrus ater*) eggs and two Henslow's Sparrow eggs. All hatched, but on the sixth day of the nestling period the two sparrow nestlings were found dead two and three feet from the nest. Both appeared to have died shortly before discovery. The two sparrows weighed 5.3 and 6.5 grams and were much smaller than individuals of the same age weighed by Hyde (9 gm; 1939).

Because of the continuous cover of the vegetation and secretive habits of Henslow's Sparrow, I feel the most important enemies were probably mammals or snakes living wholly or partially within the concealing grasses. The only species actually observed preying upon a Henslow's Sparrow was the thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*). While observing the young leave nest 7 on 25 July I saw a ground squirrel pick up one young bird still in the nest and carry it off through the grass. The victim's three nestmates had departed only a few minutes before. Because they are diurnal ground squirrels may be important predators of ground-nesting birds.

THE NEST

The open, cup-shaped nests were constructed of the common grasses on the area. Large, broad brome grass (*Bromus inermis*) leaves comprised an outer layer of the nest; the interior was lined with small, fine bluegrass (*Poa compressa* and *P. pratensis*) stems. No green vegetation was present in the nests. The grasses comprising the nests were loosely woven together and as the nestlings grew, the nest expanded. A new nest was constructed for each nesting attempt.

Although the study area appeared to have a continuous cover, clumps of grasses were discernible upon parting the vegetation. All of the nests found were at the base of these clumps resting upon the litter. They were about one inch above ground and not fastened to the standing vegetation, but merely placed among the stems. Only one of the 10 nests discovered was similar to the roofed nests described as typical by Hyde (1939).

EGG LAYING AND NESTING SUCCESS

The most common clutch sizes of Henslow's Sparrow are four or five eggs. At Kalamazoo six nests contained five eggs, three contained four eggs or young, and one nest contained only two young birds. One nest found near Augusta, Michigan, contained two sparrow eggs and two cowbird eggs. When found, the 11 nests contained 40 eggs and six young. One or more

young were fledged from six nests and 17 young fledged from all nests. Only at nest 3 did all young fledge. Oddly enough, this was the only nest at which the male did not participate in the care of the young.

The laying season appears to extend from late May to late August. Assuming the incubation period to be 11 days, as Hyde (1939) suggested, the date of completion of 3 nests was calculated as being between 25 and 27 May, or about one month after the first birds arrived. On 25 August a recently fledged bird (six fecal sacs were found next to it) was discovered and banded. Two young about three or four days old disappeared from another nest (nest 10) on 19 August.

Several males defended territories for more than two months. From these observations and the length of time eggs or young were in the nest, it would seem that some birds may raise more than two broods in one season. Two, however, may be the most common number.

INCUBATION AND BROODING BEHAVIOR

During 59 hours of observation at two nests in the second half of the incubation period only females were seen to incubate. Males were not observed near the nests at this time. Incubation attentiveness was about 70 per cent prior to hatching of the first egg. Fifty-two attentive periods had a mean length of about 44 minutes ($SD = 16.7$), and 55 inattentive periods had a mean length of 19 minutes ($SD = 9.5$). Attentiveness was also recorded during 4.2 hours between hatching of the first and last (fifth) egg. The percentage time the eggs were covered during the hatching period declined only slightly from pre-hatching levels, but there was a considerable, and statistically significant (t test, $p < 0.001$), decline in the length of both attentive (43.8 versus 11.7) and inattentive (13.8 versus 7.1) periods.

During almost 130 hours of observation of individually marked birds at six nests only the females brooded. Frequently, however, the males remained standing on the rim of the nest or close by for several minutes after feeding the young. Brooding attendance generally decreased as the nestlings aged, but the number of days of the nestling period on which the young were brooded varied from nest to nest. Daytime brooding was terminated by the third day at nest 6, by the fifth day at nest 3 and by the fourth or fifth day at nest 5. At nests 8 and 9 daytime brooding was observed through the second half of the nestling period, even on the day when the young fledged. Only at nests 8 and 9 were eggs present during the whole nestling period.

NEST SANITATION

No eggshells were found in or near the nests. Six young in three nests hatched in my presence and all of the six eggshells were eaten by the females. Unhatched eggs were left in two nests. Both parents disposed of fecal sacs.

TABLE 3

INITIATION AND ENDING OF REGULAR SONG FOR MALE HENSLAW'S SPARROWS
Individuals are the same as in Table 1, except that occasional outbursts of isolated songs during the night were ignored.

	10 May	26 May	18 July	15 August
Morning				
Initiation of song (minutes before sunrise)	42	39	54	28
Temperature (°C)	-9	18	19	19
Cloud cover (per cent)	0	85	10	90
Evening				
Ending of song (minutes after sunset)	26	25	13	25
Temperature (°C)	1	10	20	17
Cloud cover (per cent)	75	20	100	0

A high percentage of fecal sacs was eaten during the first days of the nestling period. Thereafter, the percentage of those carried away gradually increased. Production of fecal sacs by the young was maintained for over 2.5 hours after fledging at nest 7. Near nest 11 a recently fledged bird was discovered crouching near six fecal sacs. At nest 7 the adults carried fecal sacs away whenever they were produced, even when the young were outside of the nest.

BEHAVIOR OF PARENTS AFTER LOSS OF YOUNG

On the evening of the third day of the nestling period the female at nest 6 began overnight "brooding" at 14 minutes past sunset. Four young were present. Observations were discontinued 11 minutes later with the female still on the nest. The next morning I entered the blind at 04:30, 43 minutes before sunrise. The female stood on the rim of the nest at 04:53 and probed into the nest for about 30 seconds. All of the nestlings were gone. Then the male arrived with food and the female flew off. The male remained at the nest for three minutes apparently searching for the young which had disappeared overnight. At 04:58 the female returned with food but soon ate it and began "brooding." After four minutes of sitting she stood on the rim of the nest and began probing in the bottom of the nest. Between 05:00 and 06:00 the female alternately "brooded" and probed into the nest five times and she made two foraging trips. The male brought food to the nest only once during that hour.

At 06:18 a Short-billed Marsh Wren flew to a point about five yards

TABLE 4
ENDING AND BEGINNING OF OVERNIGHT ROOSTING ON THE NEST BY NINE FEMALES

	Days when roosting ended before sunrise	Days when roosting ended after sunrise	Days when roosting began before sunset	Days when roosting began after sunset
Number of observations	15	7	4	22
Mean per cent cloud cover	28	61	80	29
Mean temperature (Centigrade)	12	15	18	16

northwest of the nest. Immediately, the sparrows from nest 6 chased it. In the next six minutes the marsh wren flew up from the grass three times and on each occasion both sparrows chased it. One of the sparrows made physical contact with the wren on two of these occasions before the wren retreated into the vegetation.

DAILY CYCLE

The daily duration of song of the males was calculated for four days through the breeding season beginning with their first regular singing in the morning and ending with their last regular singing in the evening. Duration of song was directly related to total day length, lasting approximately one hour longer than the period from sunrise to sunset. The time of initiation of song was latest on those days with the highest percentage of cloud cover (Table 3). The time of ending of song was fairly constant in relation to sunset. The earliest ending of song occurred on 18 July when there was a continuous cloud cover.

The average time of initiation of overnight roosting on the nest by females was 12 minutes past sunset and the average departure time in the morning was 5 minutes past sunrise. Late morning and early evening roosting by females was directly related to higher temperatures and high cloud cover percentages (Table 4). The small difference in temperature and the large difference in cloud cover suggests that cloud cover was more important in regulating the beginning and ending of a female's day as appeared to be the case for singing by males.

SUMMARY

In Michigan Henslow's Sparrow breeds in areas characterized by (1) herbaceous cover (usually grasses or sedges), (2) the presence of litter, (3) an intermediate range of moisture, and possibly (4) the presence of singing perches in the spring.

Territories appeared to be established and maintained exclusively by song. Many

territories (any area defended by song) were surrounded by areas where no males sang. During the height of the breeding season 58 per cent of the suitable habitat remained unoccupied. The average size of all singing territories was 0.8 acres. Territory size and density of the vegetation were inversely related. The maximum population was 50 singing males per 100 acres during the first half of July.

Nests were built of dead grasses, and were placed in the center of clumps of vegetation. Thirty-seven per cent of the eggs and young discovered fledged. Incubation and brooding were performed entirely by the female. Incubation attentiveness was 70 per cent. Attentiveness decreased during the nestling period; brooding behavior was maintained after the fifth day only in those nests that contained unhatched eggs.

Daily duration of song by the males was directly related to, but one hour longer than, the period from sunrise to sunset. In general, incubating and brooding females first left the nest before sunrise and began overnight roosting on the nest after sunset. Cloud cover appeared to be important in influencing the beginning and ending of the active day for both males and females.

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