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BREEDING SEASON HABITAT SELECTION BY THE HENSLOW'S SPARROW (*AMMODRAMUS HENSLOWII*) IN KANSAS

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ABSTRACT.—Spring burning preempts settling by Henslow's Sparrows (*Ammodramus henslowii*) on tallgrass prairie in the Flint Hills Upland of Kansas. Territories were mapped on four unburned watersheds totaling 211 ha on the Konza Prairie Research Natural Area during the breeding seasons of 1985 and 1986. Vegetation was compared for areas sequestered within territories and those excluded from territories. Males establish territories in patches with greater coverage by standing dead vegetation, lesser coverage by woody vegetation, and taller live grasses. It is hypothesized that the primary ultimate cause for this proximate selection is the depressing effect of standing dead vegetation on aboveground grass productivity which results in a more open substrate for this ground-dwelling species.
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The status of the Henslow's Sparrow (*Ammodramus henslowii*) in North America has recently been summarized by Knapton (1984:73), "The whys and wherefores of population fluctuations, or perhaps more accurately the long term gradual but consistent population decline in the Henslow's Sparrow throughout its range, are very poorly understood, and the species remains somewhat of an enigma." This comment reflects the impressions of ornithologists throughout the species' range, and certainly describes the basis for the species' evaluation in Kansas and other states as threatened or at least a species in need of conservation. The purpose of this study was to describe the habitat variables that are associated with its presence during the breeding season so that better decisions regarding its management might be made.

The Henslow's Sparrow arrives in Kansas in mid-April and departs to its wintering grounds along the coast of the Gulf of Mexico in October (Johnston 1965). In Kansas, breeding season records are distributed from along the western edge of the tallgrass prairie in the Flint Hills Uplands eastward through the forest-prairie mosaic (Marvin Schwilling, pers. comm.) into Missouri west and north of the Ozark Plateau (Clawson 1982). It maintains a monogamous mating system (Wiens 1969) with well-defined territories that are relatively stable throughout the nesting season (Wiens 1969, Robins 1971), but not necessarily contiguous with adjacent males even at high densities (Robins 1971). Loose colonies are

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formed (Graber 1968, Wiens 1969), but isolated pairs also occur (Sutton 1959).

The Henslow's Sparrow breeds on the Konza Prairie Research Natural Area in Riley and Geary counties, Kansas, where it is an uncommon summer resident from mid-April until early September (Zimmerman 1985). Transect counts made during June on selected watershed-sized study sites from 1981 through 1986 (Table 1) reveal that it does not occur in grassland habitats burned in April, just prior to the birds' arrival, but maintains a regular, low-density population in watersheds that have not been burned that year. These observations are in agreement with studies in Missouri (Skinner et al. 1984) where it occurs only on idle or lightly grazed, unburned prairie. During June and July of 1983 and 1984 an attempt was made to locate all singing males on Konza Prairie, mapping their presence on a 6.25 ha grid system established across the site. The plots of the 89 males in 1983 and 105 males in 1984 are mutually exclusive of the distribution of burned treatments in both years. Male Henslow's Sparrows do not establish territories in burned prairie, although they occasionally invade prairie sites in late summer that had been burned that spring (Elmer Finck, pers. comm.; Skinner et al. 1984).

The most obvious difference between burned and unburned prairie is the almost complete absence of litter and standing dead vegetation in burned prairie, while these components can be substantial in unburned prairie, depending upon its previous fire history. Wiens (1969) demonstrated in Wisconsin that litter was significantly deeper and of greater coverage in Henslow's Sparrow territories compared to other grassland birds and that the coverage by standing dead forbs was also greater. He made no mention of standing dead grasses. The study by Skinner et al. (1984) on the prairies of southwestern Missouri also made no mention of standing dead grasses, and unlike Wiens, they could find no significant relationship between the amounts of litter and the presence of Henslow's Sparrows. Both Wiens (1969) and Skinner et al. (1984), however, demonstrated the species' preference for tall and dense grass coverage. This measure may have included standing dead vegetation along with green grasses, but certainly also denotes selection for live grass.

If the distribution of males located during the preliminary studies of 1983 and 1984 is analyzed by geologic formation (Table 2), it is clear that males are significantly more abundant in unburned prairie on the Barneston (Florence limestone member) and Matfield formations (see Jewett 1941 for characterizations) than would be expected from the proportionate distribution of the different formations on Konza Prairie ($\chi^2 = 83.6$, df = 3, $P < 0.05$). The Matfield shale is overlain by a relatively deep, silty clay loam that has been shown to support a greater aboveground biomass of

TABLE 1
HENSLOW'S SPARROWS ON JUNE TRANSECTS AT KONZA PRAIRIE[a]

	1981	1982	1983	1984	1985	1986
Watersheds not burned that spring						
Total km	6.175	7.292	6.763	7.322	7.665	7.292
Total birds	16	18	22	33	25	45
Birds/km	2.6	2.5	3.2	4.5	3.3	6.2
Watersheds burned that spring						
Total km	1.580	1.953	2.482	1.923	1.580	1.953
Total birds	0	0	0	0	0	0

[a] From Konza Prairie LTER data set CBP01.

grasses than the shallower soils of other formations (Abrams et al. 1986). The amount of woody vegetation decreases as elevation increases from the Eskridge to the Barneston formation, with most of the woody vegetation present on limestone outcrops below the base of the Matfield. The distribution of males suggests a preference for denser grass and an avoidance of woody vegetation.

I hypothesized that in unburned watersheds, the habitat included within the territories would contain a greater height and coverage of standing dead vegetation compared to sites within unburned watersheds but outside the boundaries of the territories. Furthermore, I hypothesized that the coverage and height of live grasses would be greater within territories than outside of territories in these unburned watersheds and that coverage by woody vegetation would be less within territories than outside of territories.

METHODS

Prior to the arrival of the birds in the spring of 1985, transects for the sampling of the vegetation were established in three unburned watersheds of 36.1 ha, 39.0 ha, and 85.5 ha at the Konza Prairie Research Natural Area, southwest of Manhattan, Kansas. The beginning point on the perimeter of the watershed for each of four transects and its azimuth were chosen randomly. Sampling stations were then marked at random intervals along this transect in sequence until the boundary of the watershed was reached. In this way, about 150 sampling points used in both 1985 and 1986 were located.

After the birds arrived, the territories of individual males settling on these watersheds were mapped each year by plotting the positions of observations on large scale maps. The use of taped songs was very helpful in locating males, as the species is not a persistent singer and I have found that it often sings from perches within the canopy. The previously determined vegetation sampling points were then categorized as being within these territories or outside of these terrritories. As would be expected, few of these predetermined sampling points fell within Henslow's Sparrow territories. To increase the sample size for the within-territory treatment, a randomly determined number of vegetation sampling points were

TABLE 2

DISTRIBUTION OF MALES ACCORDING TO GEOLOGIC FORMATION

Formation[a]	% Surface exposure	% Total males
Barneston (ca 425 m)	14	27
Matfield	25	55
Wreford to Blue Rapids	28	17
Crouse to Beattie	21	0
Eskridge (ca 350 m)	12	1

[a] See Jewett 1941.

located at random intervals on a transect oriented on the longest dimension of each Henslow's Sparrow territory in these watersheds. In 1985, territories were also mapped and vegetation analyzed in an adjacent watershed of 50.1 ha that was on an every two years burning schedule.

At each vegetation sampling point, those previously established as well as those positioned within known territories, ten subsamples were taken at randomly determined points around the sampling point. The presence or absence of contacts by standing dead vegetation at 5 cm intervals along a 1 mm in diameter vertical rod was recorded and the proportion of hits at each 5 cm interval for the ten subsamples gave the percentage of standing dead cover at each height interval. For each of the ten subsamples the life form of the tallest live plant (grass, forb, woody) and its height or absence of vegetation at that point were recorded. These data generated percentage cover and heights of live vegetation for each of the sampling points.

RESULTS

The vertical coverage of standing dead vegetation within territories compared to that outside of territories is presented in Fig. 1. Percentage data were converted by an arc-sine transformation for parametric statistical analysis. There were no differences between geologic formations in the amount of standing dead vegetation, which corroborates clipping data analyzed by Abrams et al. (1986). On the other hand, there was a significant difference between years in these data, and the results from each year were analyzed separately. The difference between years in standing dead vegetation is a reflection of the difference in the amount of precipitation during the previous years' growing seasons (Abrams et al. 1986). For both years, these data support the hypothesis that the amount of standing dead vegetation within the territories of male Henslow's Sparrows is greater than that in areas excluded from territories. Whether the males use this variable as a proximate cue for territory selection is not known, but it is clear that the resultant territories do contain a greater amount of standing dead vegetation. This difference is considerably more subtle than the difference manifest between burned and unburned prairie.

The hypothesis that the coverage by live grass would be different within

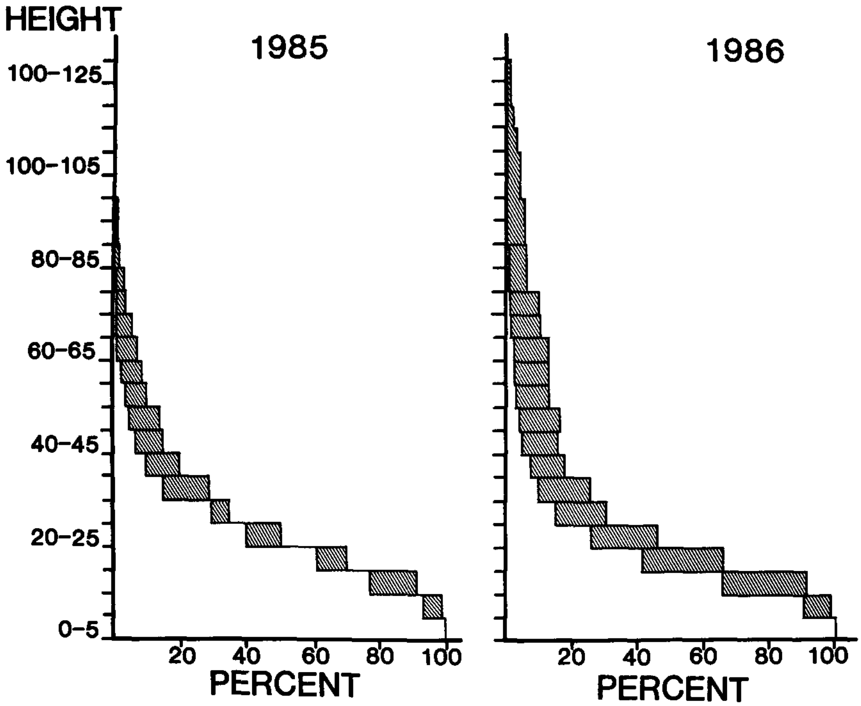

FIG. 1. Vertical distribution of percent coverage by standing dead vegetation at 5 cm height intervals. Data for points outside of territories (open bars) are superimposed on data for points within territories (shaded). The differences are significant ($P < 0.05$), except at the 0–5 cm interval for both years, above 90 cm in 1985, and above 115 cm in 1986.

the territories of Henslow's Sparrows compared to that outside of territories is not supported by the data, at least for one of the years (Table 3). The hypothesis that woody vegetation would be less within Henslow's Sparrow territories, however, is supported for both years. The other consistent pattern is the lack of difference between the coverage by forbs in habitat included within territories and that excluded from territories. Even though the aboveground biomass of forbs in unburned prairie is significantly greater than that in burned prairie (Abrams et al. 1986), Henslow's Sparrows apparently do not use coverage by forbs to discriminate during territory selection.

In the analysis of the heights of the live vegetation (Table 4), not only is there a difference between the two years, but there are differences between the geologic formations as well. The hypothesis that grass height would be greater within territories is supported in all comparisons within

TABLE 3

COMPARISON OF PERCENT COVERAGE OF LIVE VEGETATION BETWEEN POINTS WITHIN TERRITORIES AND POINTS OUTSIDE OF TERRITORIES[a]

	1985			1986		
	Within (N = 204)	Outside (N = 142)	*t*-value	Within (N = 113)	Outside (N = 149)	*t*-value
Grass	83.3	70.0	6.81	78.6	79.2	ns
Forb	14.4	15.0	ns	12.0	12.6	ns
Woody	0.7	1.8	2.53	0.8	2.7	2.43
Open	1.7	13.7	11.95	7.8	5.2	2.11

[a] Statistics are based on arc-sine transformed data with Student's $t = 1.97$ at $P = 0.05$.

the same formation except for the small sample sizes involved in the sub-Matfield strata measured in 1986. While forb height within territories is greater for the 1985 sampling period, this is not a valid conclusion for the 1986 data, and there are no significant patterns in the differences between the heights of the woody vegetation included or excluded from territories.

DISCUSSION

These data demonstrate that Henslow's Sparrows establish their territories in habitat patches with significantly greater coverage of standing dead vegetation. I suggest that this association with higher densities of standing dead vegetation is related to the adverse effect of standing dead plant material and litter on the growth of new grass (Knapp and Seastedt 1986), thus providing a more open substrate for this largely ground-dwelling species. Although my data on coverage by live vegetation within and outside of territories on unburned watersheds do not reflect this difference, they were not collected at ground level. An alternate hypothesis would be that the increased cover afforded by standing dead vegetation and the significantly taller live grasses protect nests from more intense cowbird parasitism, predation, or microclimate extremes.

The implications of these conclusions for the management of the species are quite clear. Any practice that removes considerable standing dead vegetation will exclude the species. Obviously, spring burning preempts Henslow's Sparrows, but even without burning, moderate grazing during the previous growing season removes enough aboveground biomass so that there is insufficient standing dead vegetation the next year to meet the habitat requirements of this bird. The scarcity of sightings throughout the tallgrass prairie area of Kansas is perhaps related to the extensive use of fire in range management and stocking rates of at least moderate grazing intensities. But exemption from burning is also detrimental to the species'

TABLE 4

COMPARISONS OF HEIGHT (CM) OF LIVE VEGETATION BETWEEN POINTS WITHIN TERRITORIES AND POINTS OUTSIDE OF TERRITORIES[a]

	Within	Outside
Grass		
1985		
Florence	42.4 ± 0.9 (N = 61)[e]	32.5 ± 1.1 (N = 25)[c]
Break		28.8 ± 1.4 (N = 13)[c]
Matfield	47.0 ± 0.7 (N = 138)[d]	33.2 ± 1.0 (N = 84)[c]
Sub-Matfield		25.8 ± 0.7 (N = 20)[b]
1986		
Florence	46.6 ± 0.7 (N = 45)[e]	43.6 ± 1.2 (N = 28)[d]
Break		38.3 ± 1.8 (N = 13)[b]
Matfield	45.5 ± 1.0 (N = 64)[d,e]	36.0 ± 0.9 (N = 87)[b,c]
Sub-Matfield	31.8 ± 3.2 (N = 4)[b]	32.9 ± 1.5 (N = 21)[b]
Forb		
1985		
Florence	43.7 ± 1.3 (N = 40)[c]	34.1 ± 3.1 (N = 13)[b]
Break		27.5 ± 3.8 (N = 8)[b]
Matfield	46.4 ± 1.0 (N = 102)[c]	31.3 ± 1.0 (N = 58)[b]
Sub-Matfield		27.2 ± 3.0 (N = 15)[b]
1986		
Florence	39.6 ± 2.6 (N = 28)[c]	38.8 ± 1.8 (N = 20)[c]
Break		37.3 ± 6.1 (N = 9)[c]
Matfield	38.5 ± 2.4 (N = 40)[c]	31.2 ± 1.2 (N = 54)[b]
Sub-Matfield	23.7 ± 1.9 (N = 3)[b]	31.6 ± 2.2 (N = 12)[b,c]
Woody		
1985		
Florence		47.0 ± 9.0 (N = 2)[b]
Break		88.0 (N = 1)[b]
Matfield	55.7 ± 3.9 (N = 7)[b]	45.4 ± 3.2 (N = 9)[b]
Sub-Matfield		47.8 ± 5.6 (N = 4)[b]
1986		
Florence		46.0 (N = 1)[b]
Break		56.2 ± 9.0 (N = 5)[b,c]
Matfield	73.3 ± 13.8 (N = 4)[c]	50.7 ± 3.0 (N = 11)[b]
Sub-Matfield		52.7 ± 5.7 (N = 3)[b,c]

[a] Statistical comparisons are within each life form and within each year. Means (± SE) with the same superscript within each life form–year set are not significantly different ($P > 0.05$, using Student's t-test).

continued existence, as the species prefers sites with little woody vegetation. Perhaps more importantly, the stimulating effect of burning on aboveground productivity of grasses that then results in denser cover by standing dead vegetation in the subsequent year meets the species' needs.

The best management practice would be a rotational burning plan, perhaps on a three- or four-year cycle, involving three or four adjacent tracts of prairie. Incidental observations on the presence or absence of birds on unburned prairie suggest that each tract should be at least 30 ha in size. Under this protocol there would always be habitat with standing dead available, while at the same time periodic burning would remove woody vegetation and enhance aboveground biomass production for one year, augmenting the available standing dead vegetation the next year.

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