

Distribution, Habitat Use, and Nesting Success of Henslow's Sparrow in Oklahoma

DAN L. REINKING, DAVID A. WIEDENFELD, DONALD H. WOLFE,
and RONALD W. ROHRBAUGH, Jr.¹

George M. Sutton Avian Research Center
P.O. Box 2007
Bartlesville, OK 74005-2007

ABSTRACT -- Henslow's sparrow (*Ammodramus henslowii*) nests and forages in native grasslands, pastures, and oldfields in the midwestern and eastern United States and Canada as well as eastern portions of the Great Plains, and has steadily declined in abundance and distribution during the past 25 years. Before 1990 there were relatively few records of this species from Oklahoma. From 1992 to 1996 we documented a breeding population of hundreds to thousands of the Henslow's sparrow on The Nature Conservancy's Tallgrass Prairie Preserve in northeastern Oklahoma. We conducted systematic surveys of eight counties in northeastern Oklahoma and showed a broader distribution for this species than on the preserve alone. Vegetation height and density differed between recently burned and unburned areas, as did the presence of Henslow's sparrow. Greater than two growing seasons were required to produce nesting habitat occupied by the Henslow's sparrow after an area was burned. Results of five years of nest monitoring are described from 24 nests found; ten nests were successful and one was parasitized by a brown-headed cowbird (*Molothrus ater*). Prospects for creating and maintaining nesting habitat for the Henslow's sparrow in Oklahoma are good, given this species' ability to swiftly colonize areas of habitat newly created through management.

Key words: *Ammodramus henslowii*, fire, grazing, Henslow's sparrow, nest success, tallgrass prairie.

The Henslow's sparrow (*Ammodramus henslowii*) nests and forages in grassy fields, meadows, and tallgrass prairie in the midwestern and eastern United States and

¹Current address: Cornell Laboratory of Ornithology, 159 Sapsucker Woods Road, Ithaca, NY 14850-1923.

Canada, as well as eastern portions of the Great Plains (American Ornithologists' Union 1998). As evidenced by the United States Geological Survey Biological Resources Division North American Breeding Bird Survey (BBS) data (Sauer et al. 1997) and other studies (Illinois Natural History Survey 1983, Herkert 1997), Henslow's sparrow has steadily declined in abundance and undergone changes in distribution during the past 25 years. Population declines and concurrent range contractions in the north-central and northeastern United States prompted the United States Fish and Wildlife Service (USFWS) to consider this species as a candidate for listing as threatened or endangered (see Pruitt 1996), but it has ultimately retained status as a "Species of Concern" rather than being upgraded to threatened or endangered. Although BBS data suggest an 8.8% annual decline of Henslow's sparrow rangewide from 1966 to 1996, uncertainties remain about its precise rate of decline because its inconspicuous plumage and vocalization, localized populations, specific habitat requirements, and the dynamic nature of its habitat make population monitoring difficult. In addition, several large populations appear to be doing well in Indiana, Kansas, Missouri, and Oklahoma (USFWS 1998).

From the first alleged Oklahoma observation of Henslow's sparrow in 1923 (Nice 1931) to the first confirmed nesting of this species in Oklahoma in 1987 (Verser 1990), fewer than 12 reports of occurrence existed for the state (Reinking and Hendricks 1993). Baumgartner and Baumgartner (1992) treated Henslow's sparrow as a "straggler" in Oklahoma. In 1992, we initiated a five-year study designed to evaluate the effects of various land-use practices on breeding prairie bird species in Oklahoma. During our first field season we documented a substantial population of Henslow's sparrow on The Nature Conservancy's Tallgrass Prairie Preserve in Osage County, northeastern Oklahoma (Reinking and Hendricks 1993). Using density estimates from fixed-radius point counts along with the estimated areal extent of supposed useable habitat on the preserve (George M. Sutton Avian Research Center, unpubl. data), we estimated the size of this population to be roughly 3,000 singing males, although not all areas of useable habitat may have been occupied. Although this northeastern Oklahoma area falls outside of the widely published breeding range of Henslow's sparrow (see Rising 1996 and American Ornithologists' Union 1998 for more complete range descriptions) this may represent one of the largest single-location populations in North America.

The current distribution and nesting ecology of Henslow's sparrow in Oklahoma is poorly understood. In addition to the large population recorded on the Tallgrass Prairie Preserve, scattered smaller sub-populations and individuals have been reported recently during the breeding season in other parts of Osage County and in at least four other counties in northeastern Oklahoma (Verser 1990, Reinking and Hendricks 1993, Seibert and Loyd 1993, D. L. Reinking, pers. obser.). Concern over Henslow's sparrow populations throughout its range makes a thorough understanding of the habitat requirements of this species in Oklahoma desirable. This information, together with

demographic data from nest monitoring, will be useful in determining specific land management practices, which can maintain or increase populations of Henslow's sparrow both in Oklahoma and elsewhere in native tallgrass prairie areas and possibly in structurally similar habitats.

Several previous Henslow's sparrow studies (such as Robins 1971, Zimmerman 1988, 1993, Smith 1992, Herkert 1994a, 1994b, 1998, Winter 1999, Winter and Faaborg 1999, Winter et al. 2000) indicated that major characteristics of Henslow's sparrow nesting habitat include tall, dense, grass-dominated vegetation, a large amount of standing, dead vegetation, little woody vegetation, and that relatively large tracts of suitable habitat were required to support a persistent population, compared to some other grassland passerines. These habitat characteristics can be provided in tallgrass prairie areas through some combination of fire, mowing, and/or grazing. The timing and intensity of these disturbances to a large extent determines the vegetative composition and structure of a prairie area, and thus can influence whether or not an area can be occupied by the Henslow's sparrow.

Our objectives were to: 1) measure vegetation height and density at occupied and unoccupied sites within a native tallgrass prairie landscape at the Tallgrass Prairie Preserve, 2) evaluate the effects of fire frequency on the distribution and abundance of Henslow's sparrow at the Tallgrass Prairie Preserve, 3) locate and monitor nests of Henslow's sparrow to determine rates of nesting success, and 4) determine presence at previously occupied sites and at other sites thought to have useable habitat in northeastern Oklahoma.

STUDY AREA and METHODS

The largest and most stable known population of Henslow's sparrow in Oklahoma is located on The Nature Conservancy's Tallgrass Prairie Preserve, about 8 km north of Pawhuska, Osage County, northeastern Oklahoma (Fig. 1). This 15,000 ha area of native tallgrass prairie was established as a preserve in 1989 and is being managed at the landscape level by using historic patterns of fire and grazing by bison (*Bos bison*), as best these patterns are understood, to restore the functional integrity of the tallgrass prairie ecosystem. The site provides an ideal setting for evaluating the habitat requirements of Henslow's sparrow due to the variety of fire and grazing histories of management units within the preserve. The preserve forms the southern terminus of the Flint Hills region, most of which lies in east-central Kansas, along a 70 km wide and 322 km long, north-south band extending from northern Oklahoma to southern Nebraska. The Flint Hills are characterized by large amounts of surface limestone, which renders cultivation largely impossible or impractical. As a result, much of the Flint Hills region, including the Tallgrass Prairie Preserve, is native tallgrass prairie, which has been used for cattle (*Bos taurus*) grazing but remains unplowed. Dominant

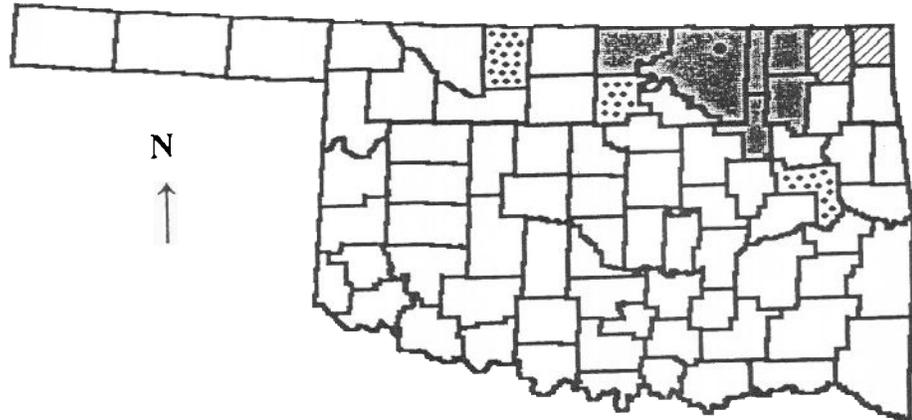


Figure 1. Current known range and areas surveyed for Henslow's sparrow in Oklahoma. Darkly shaded counties were surveyed in 1996 and contained Henslow's sparrow. Additional breeding season reports from Noble County (southwestern-most dotted county) in 1997 and 1998 and a spring report from Alfalfa County (western-most dotted county) in 1998 are illustrated along with a June 1998 sighting from Muskogee County (southern-most dotted county). The two barred northeastern counties were surveyed for sparrows in 1996 but none were found. The single dot represents the location of the Tallgrass Prairie Preserve in Osage County.

vegetation on non-wooded portions of the preserve being used by the Henslow's sparrow includes native warm-season grasses such as big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), Indian grass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum*). Other common vegetation includes broomweed (*Gutierrezia dracunculoides*), Indian hemp dogbane (*Apocynum cannabinum*), western ironweed (*Vernonia baldwinii*), aster (*Aster spp.*), goldenrod (*Solidago spp.*), lespedeza (*Lespedeza spp.*), buckbrush (*Symphoricarpos orbiculatus*), common buttonbush (*Cephalanthus occidentalis*), and blackberry (*Rubus spp.*).

Transect surveys

We systematically surveyed management units on the preserve for the presence of the Henslow's sparrow during the 1996 breeding season. Two 400 m long transects were established in each of five management units representing five treatment types: 1) zero years post fire (burned just prior to the breeding season), 2) one year post fire,

3) two years post fire, 4) three years post fire, and 5) greater than three years post fire, for a total of ten transects. All units except the greater than three years post burn unit were grazed (about 1.2 ha per head of yearling cattle) for about 100 days between April and July during our study. The greater than three years post fire area had not been burned or grazed for at least six years, but land management information was not available for years prior to ownership by The Nature Conservancy. Each treatment type was contained in a single management unit, making the two transects in each unit pseudo-replicates. However, management units were large ($n = 5$, ranging in size from 121 ha to 914 ha with a mean of 451 ha, Table 1) so that transects could be established relatively far apart within a management unit. Management units, while not contiguous, were bordered by contiguous tallgrass prairie. The maximum distance between management units was 8 km. Transect surveys were conducted by using a fixed-width (100 m) single count technique (Bibby et al. 1992). Each transect was surveyed once during the third week of the month in each of May, June, and July. Two observers alternated transects from month to month to minimize any observer-related bias. Presence and number of bird detections of Henslow's sparrow were determined for each transect and treatment type.

Table 1. Henslow's sparrow detections by month on ten 400 m transects with fixed width of 100 m in five management units in tallgrass prairie of northeastern Oklahoma, 1996.

| Management Unit and Size | May | June | July |
|---------------------------------|-----|------|------|
| 0 years post fire (479 ha) | 0 | 0 | 0 |
| 1 year post fire (615 ha) | 0 | 0 | 0 |
| 2 years post fire (914 ha) | 2 | 3 | 6 |
| 3 years post fire (121 ha) | 1 | 6 | 7 |
| > 3 years post fire (129 ha) | 1 | 4 | 8 |

Vegetation sampling

We measured vegetation height and density by recording the number of vegetative contacts within three height strata (less than 10 cm, 10 to 50 cm, and greater than 50 cm) on a 0.635 cm diameter rod held vertically (Wiens 1969) 1 m north, south, east, and west of 20 sampling points evenly spaced along each transect center line. The number of vegetative contacts within each stratum was used as an index of vegetation density. The maximum vegetation height within a 1 m radius of each of the 20 sampling points also was recorded. Given the dynamic nature of tallgrass prairie vegetation, this sampling was conducted three times, once each at the end of May, June, and July to coincide with the Henslow's sparrow nesting season.

Nest monitoring

Data on Henslow's sparrow nests were collected between 1992 and 1996. Nests were found incidentally as part of a larger study on nesting in other species of grassland birds. In the larger study, three crews of three people each monitored a total of 18 plots (each 16.2 ha in area) of tallgrass prairie located on the preserve and on private ranches in Osage and Washington counties for nests of grassland birds. The work was carried out for each of the five years from mid April through July. Behavioral observations and random flushes of incubating birds were used to find nests. Nests were checked every two to four days until fledging or failure (Ralph et al. 1993). Nest success was calculated according to the method described by Mayfield (1961, 1975).

Roadside surveys for sparrow distribution

We conducted surveys in 1996 to determine Henslow's sparrow distribution in eight northeastern Oklahoma counties. Requests for information on Henslow's sparrow were sent to 14 groups or individuals thought to have sight records of Henslow's sparrow in Oklahoma. This information, combined with information already available on past sightings of Henslow's sparrow in the state, was used to evaluate the distribution of this species in Oklahoma in 1996. All sites for which we had prior documentation were visited once during each of the months of May, June, and July to check for the presence of Henslow's sparrow. Because land access was limited, and because prior sightings from these areas were made from the road, surveys for this study also were conducted from the road. Presence was determined by using one 10-minute unlimited distance point count for each 0.32 km of linear roadside access along potential areas of occurrence. Because visual clues were needed to identify potential Henslow's sparrow habitat, and because of our desire to cover as much area as possible looking for potential habitat, point counts were conducted during daytime hours. Opportunistic examination of potential habitat during travel to and from study sites, as well as systematic travel of as many county roads in eight counties as time permitted, contributed additional study areas. We estimated that at least 80% of all rural, public roads were surveyed in Osage, Washington, Nowata, and Craig counties, and

approximately 50% of rural roads were surveyed in Kay, Ottawa, Rogers, and Tulsa counties. These survey methods ("look-see counting") were outlined in Bibby et al. (1992). We combined the results of these surveys with documented anecdotal reports of occurrence as well as reports generated by the Oklahoma Breeding Bird Atlas Project (which began in 1997) from additional counties since the 1996 surveys took place.

Statistical analyses

Comparisons of Henslow's sparrow relative abundance were made among treatment groups and months based on the results of surveys conducted along two 400 m transects per treatment group per month. Relative abundance as used here was calculated as the total (transect 1 + transect 2) number of Henslow's sparrow detected per treatment per month within the sampled area, i.e., the number of Henslow's sparrow detected within the 800 m by 100 m area sampled within each treatment.

There were few non-zero values for the vegetation density index in the greater than 50 cm height stratum, so these data were not statistically analyzed. Because assumptions of normality were met in the other vegetation samples, vegetation density and mean maximum vegetation height measurements from transects were compared among treatment groups by using univariate analysis-of-variance (ANOVA), blocked by month.

Nests were categorized as early (initiated in May or June) or late (initiated in July or August), and nest outcome (fledged or failed) was analyzed by using the chi-square statistic. All statistical tests were conducted by using Complete Statistical System (StatSoft 1989).

RESULTS and DISCUSSION

Transect surveys

The Henslow's sparrow was detected on six of the ten Tallgrass Prairie Preserve survey transects (Table 1) and in three of the five management units. No Henslow's sparrow was detected along transects in management areas burned more recently than two years prior to the surveys, while it was detected in all other treatment areas (two, three, and greater than three years post fire) in all three months.

Although the size of the management units varied considerably (Table 1), two of the three units which contained Henslow's sparrow were among the smallest in size. The smallest unit, at 121 ha, is still much larger than the minimum size of 30 ha suggested by Zimmerman (1988) and Herkert (1994b), so area sensitivity was probably not a factor in the distribution of the Henslow's sparrow in our study areas.

Although the number of detections was very low, it increased from May to June to July within each of the three management units containing Henslow's sparrow

(Table 1). The Henslow's sparrow generally begins arriving in Oklahoma in early to mid April. The May surveys were probably conducted prior to the complete arrival of the population and territory establishment, and the July surveys probably included fledged juvenile birds or post-breeding females that were undetected earlier in the season. Most detections on transects were of singing males, and the few detections ($n = 3$), which were not singing males, occurred during the July surveys.

Vegetation sampling

Because no Henslow's sparrows were recorded on any transect in the zero and one-year post fire plots, for vegetation comparison we combined those two treatments and compared them with the combined two, three, and greater than three year post fire treatments by using ANOVA. All ANOVAs showed significant differences between these two groups of treatments (all with 1, 24 degrees of freedom): vegetation density index less than 10 cm ($F = 59.62$, $P < 0.01$); vegetation density index 10 to 50 cm ($F = 87.98$, $P < 0.01$); and vegetation maximum height ($F = 150.56$, $P < 0.01$). Vegetation height and density were both greater on two, three, and greater than three year post fire plots than on zero and one year post fire plots (Table 2).

Table 2. Vegetation density index within three height strata over three months, and maximum vegetation height over three months, in five treatment groups. Treatment areas zero and one year post burn did not have Henslow's sparrow (Table 1), while treatment areas two, three, and greater than three years post burn did contain Henslow's sparrow. The treatment group containing zero and one year post burn transects differed significantly from the treatment group containing the two, three, and greater than three years post burn transects in all three vegetation measures (see text). All but the greater than three years post burn plots were grazed (see text).

| Vegetation measure | Treatment (number of years post burn) | | | | |
|-------------------------------------|---------------------------------------|------|------|------|------|
| | 0 | 1 | 2 | 3 | >3 |
| Vegetation density index (< 10 cm) | 14.1 | 22.5 | 30.7 | 28.3 | 35.4 |
| Vegetation density index (10-50 cm) | 4.5 | 7.5 | 34.7 | 27.0 | 46.4 |
| Vegetation maximum height (cm) | 37.3 | 45.0 | 78.5 | 71.3 | 88.3 |

The Henslow's sparrow at the Tallgrass Prairie Preserve was found in areas which had not been burned for greater than two growing seasons (Table 1), but once the

vegetation reached sufficient height and density, it showed little difference among groups. Our zero, one, two, and three year post fire management areas did receive cattle grazing during our study, about 1.2 ha per yearling (Robert Hamilton, Tallgrass Prairie Preserve, pers. comm.), but the maximum level of grazing that would be appropriate for maintaining this species on Oklahoma lands remains unknown. Possibly, Henslow's sparrow numbers would eventually decline in unburned areas due to woody encroachment if subjected to a long absence of fire (see Kahl et al. 1985, Herkert 1998, Zimmerman 1988), although such a trend was not evident in our results, even after at least six years without fire. The effects of grazing on vegetation structure and the rate of woody encroachment in a given area also will vary on broad and micro-geographic scales depending on edaphic factors and the amount of precipitation in a given growing season and in the year preceding it.

We have observed a tendency for the Henslow's sparrow (including singing males) to invade areas by late July, which did not contain Henslow's sparrow in May or June. This has also been observed elsewhere (see Zimmerman 1993) and suggests either that habitat requirements for post-breeding foraging activities are not as stringent as those for nesting habitat, or that vegetative growth during the growing season (even in recently burned areas) develops sufficient structure to meet the breeding season habitat requirements of the Henslow's sparrow. We do not know whether nesting attempts actually occur in these areas late in the nesting season.

Nest monitoring

With a small sample size of nests ($n = 24$) found over a period of five years, the conclusions we can draw regarding nest success are limited. All Henslow's sparrow nests were found on the nine plots located on the preserve, and at least three nests were located in each year from 1992 through 1996. All nests were located in areas which had not been burned for a minimum of three years. Seven nests were in areas accessible to bison, although grazing pressure near the nests was probably light given the preference of bison to graze recently burned areas over the unburned areas in which the nests were located (Coppedge 1996). Outcomes were determined for 22 of 24 monitored nests, with ten of these (about 45%) being successful. Two nests (8%) were parasitized by the brown-headed cowbird (*Molothrus ater*), one of which failed due to predation, while the other fledged both two host and one brown-headed cowbird young. The Mayfield seasonal success probability was 29%. Nests with both eggs and young were observed from May through August, a protracted breeding season which suggested the possibility of renesting and/or multiple broods, although we were not following marked individuals and could not confirm this. Figure 2 shows the temporal distribution of the 24 nests observed with eggs or young. Early nests, those initiated in May or June, tended to be more successful than late nests initiated in July and August (Fig. 3), but not significantly so ($\chi^2 = 2.12$, $df = 1$, $P = 0.15$). The number of young fledged per unparasitized, successful nest ($n = 9$) ranged from one to five, with a mean of 3.3 fledged young.

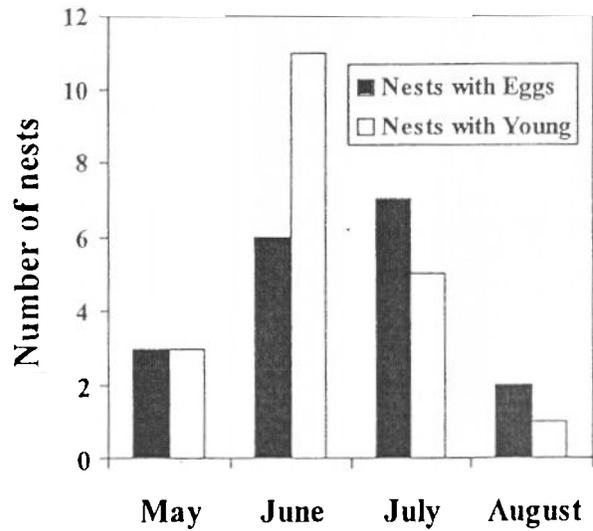


Figure 2. Temporal distribution of 24 Henslow's sparrow nests observed with eggs or young in northeastern Oklahoma found between 1992 and 1996. A single nest may be represented more than once if it was observed in both incubation and nestling stages, or if it was observed in more than one month.

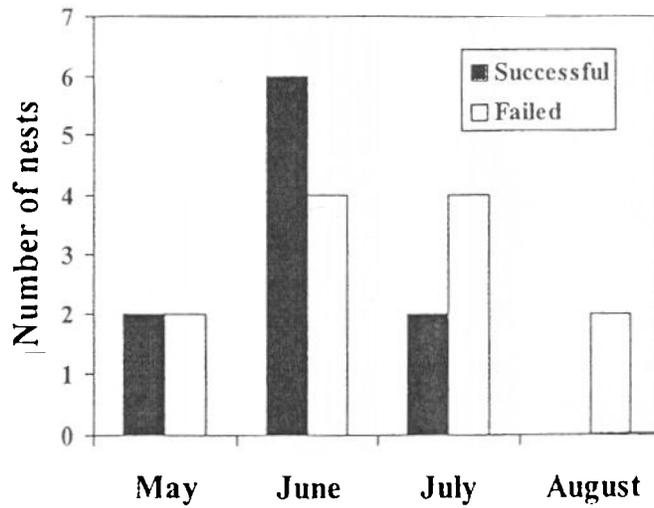


Figure 3. Outcomes of 22 Henslow's sparrow nests by month of nest initiation, found from 1992 to 1996 in tallgrass prairie of northeastern Oklahoma. Successful nests were those which fledged at least one host young.

Roadside surveys for sparrow distribution

We surveyed roadsides in eight northeastern Oklahoma counties for potential habitat and conducted roadside point counts at 93 historic and potential new sites in seven of these counties. The Henslow's sparrow was documented at 28 sites in six counties. The counties where the Henslow's sparrow was documented and the number of sites with documentation in each of these counties in 1996 were: Nowata (3), Tulsa (1), Rogers (1), Washington (4), Osage (17), and Kay (2). Since the 1996 surveys were conducted, the authors, Oklahoma birders, and Oklahoma Breeding Bird Atlas Project volunteers have documented the presence of the Henslow's sparrow in several additional locations in these and other counties, including Alfalfa, Noble, and Muskogee (Fig. 1). Early breeding season reports in 1998 (DI.R pers. obser. and J. Dole pers. comm.) included locations farther west and south than previous sightings, which suggests that either the breeding range of Henslow's sparrow is continuing to expand in Oklahoma (as it appears to have done over the past decade) or that increased observer attention to this somewhat inconspicuous species is resulting in a more complete picture of its distribution, or both.

The future of Henslow's sparrow in Oklahoma

The ability of the Henslow's sparrow to colonize formerly unused areas of land each year might have evolved due to its rather specific habitat requirements, in combination with the dynamic nature of tallgrass prairie habitat. The ever-changing landscape mosaic of grassland seral stages resulting from climate, periodic fires, and the grazing of large herbivores probably engendered this colonizing capacity of the Henslow's sparrow. The prospects for successful management of this species are enhanced by this capacity, provided that useable habitat can be provided through landowner cooperation and/or incentive programs. Current uniform and intensive use (ubiquitous grazing usually associated with frequent, usually annual, burning) of remaining native grasslands severely limits the amount of late seral stage grasslands available for the Henslow's sparrow, a habitat-specific species. However, some yet undetermined low to moderate level of grazing is nonetheless the most compatible income-generating land use for maintaining this species in Oklahoma besides outright, targeted conservation acquisitions. Occasional fire (with a minimum of a three year interval) used as a management tool will continue to be important in controlling woody vegetation. Development of land management recommendations, which provide areas of useable nesting habitat for the Henslow's sparrow, while still allowing profitable grazing, would offer hope for sustaining this species on private lands.

At present, numbers of Henslow's sparrow on the Tallgrass Prairie Preserve are probably somewhat lower than in 1992. A lack of fire and grazing between 1989 and 1992 had resulted in optimal habitat conditions for this species over much of the preserve. Since 1992, applications of fire and grazing to large portions of the preserve have probably reduced the amount of nesting habitat available to the Henslow's

sparrow. However, the current long-term management plan of the Tallgrass Prairie Preserve calls for a rotational burning program randomly affecting about one-fifth of the preserve in any given year, with free-ranging bison as resident large herbivores (Robert Hamilton, Tallgrass Prairie Preserve, pers. comm.). This plan should ensure that continued nesting habitat for sizeable numbers of the Henslow's sparrow will remain available at least in this area of Oklahoma.

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