Studies in Avian Biology No. 19:160–164, 1999.

HENSLOW'S SPARROW RESPONSE TO PRESCRIBED FIRE IN AN ILLINOIS PRAIRIE REMNANT

JAMES R. HERKERT AND WILLIAM D. GLASS

Abstract. We studied the effects of prescribed fire on Henslow's Sparrows (*Ammodramus henslowii*) breeding in a native prairie remnant in northeastern Illinois in 1991–1996. Portions of this prairie were burned in four of the six years of our study. Henslow's Sparrow distributions were influenced by time since the last fire and location in the prairie (census-point effect). Sparrows usually did not occur in burned areas during the first growing season postfire and colonized adjacent unburned sections of the prairie as other sections were burned. Henslow's Sparrows were rarely recorded at some census points regardless of their burn history. The birds appeared to exhibit a hierarchical pattern of habitat occupancy, with use of secondary portions of the prairie being greatest in years of high overall abundance or when burning made primary areas unsuitable. Sparrow abundance tended to increase in years when spring precipitation in the current year exceeded that of the preceding year and to decline in years when spring precipitation declined. Although Henslow's Sparrows were sensitive to fire, our data suggest that numbers can be maintained, and even increased, on large prairies actively managed with prescribed fire.

LA RESPUESTA DEL GORRIÓN DE HENSLOW A INCENDIOS PROGRAMADOS EN UN REMANENTE DE LLANURA EN ILLINOIS

Sinopsis. Estudiamos los efectos de incendios programados para el Gorrión de Henslow (*Ammodramus henslowii*) en reproducción en un remanente de llanura nativa en el noreste de Illinois entre 1991 y 1996. Se quemaron porciones de esta llanura en cuatro de los seis años de nuestro estudio. El tiempo desde el último incendio y la ubicación en la llanura (efecto del punto de censo) influyeron en las distribuciones del Gorrión de Henslow. Normalmente no había gorriones en áreas quemadas durante la primera estación de cultivo después del incendio, por lo que colonizaron secciones contiguas no quemadas en la llanura cuando se incendiaron otras secciones. Raramente se registraron Gorriones de Henslow en algunos puntos de censo, a pesar de su experiencia de quema. Parecía que las aves exhibieron un sistema jerárquico de ocupación de hábitat, con un uso mayor de porciones secundarias de la llanura durante los años de alta abundancia general o cuando las quemas convirtieron las áreas primarias en zonas inadecuadas. Cuando la precipitación en la primavera del año en curso sobrepasó la del año anterior la abundancia de gorriones tendía a aumentar; por el contrario, cuando la precipitación en la primavera disminuyó, la abundancia de gorriones tendía a disminuir. Aunque los Gorriones de Henslow fueron sensibles al fuego, nuestros datos sugirieron que se puede mantener las cifras de gorriones, e incluso aumentarlas, en llanuras grandes controladas activamente con incendios programados.

Key Words: *Ammodramus henslowii*; habitat selection; Henslow's Sparrow; Illinois; prescribed fire.

Henslow's Sparrows (*Ammodramus henslowii*) breed in the northeastern and eastcentral United States and southern Canada (Hands et al. 1989). Populations are scattered and local in distribution, however, throughout the breeding range (Pruitt 1996). Since the late 1960s, populations have declined (Sauer et al. 1996, Herkert 1997, Peterjohn and Sauer 1999) and the breeding range of this species is currently contracting, particularly in the northeast and eastern portions of the range (Pruitt 1996). Loss and degradation of grassland habitats are thought to be major factors contributing to these declines (Pruitt 1996). Because of this species' overall rarity and declining populations, its rangewide population status is uncertain (U.S. Fish and Wildlife Service 1995, Pruitt 1996). As a result, it is important to understand more fully this species' breeding ecology.

Henslow's Sparrows prefer tall, dense grasslands with well-developed litter and standing dead residual vegetation (Wiens 1969, Robins 1971, Skinner et al. 1984, Zimmerman 1988, Sample 1989, Herkert 1994, Mazur 1996). Several commonly employed grassland-management activities, such as prescribed fire, grazing, and mowing, generally remove or reduce tall, dense vegetation and/or litter and frequently lead to short-term reductions in Henslow's Sparrows (e.g., Skinner et al. 1984, Zimmerman 1988, Sample 1989, Herkert 1994, Swengel 1996). In some situations, prescribed fire may even extirpate populations from small sites (e.g., Minney 1994). Although fire is known to reduce Henslow's Sparrow numbers at the local level (i.e., within particular transects; Zimmerman 1988, Herkert 1994, Swengel 1996), little is known about how this species responds to fire at broader scales.

To effectively design and implement conser-

vation strategies to benefit Henslow's Sparrows, a more thorough understanding of this species' broad-scale response to prescribed fire and other common grassland-management practices is needed. Our study examined the site-level response of Henslow's Sparrows to prescribed burning on a large native-prairie remnant in Illinois.

METHODS

We studied the effects of prescribed fire on Henslow's Sparrows between 1991 and 1996 at Goose Lake Prairie State Natural Area, a 650-plus-ha tallgrass-prairie remnant in Grundy County, northeastern Illinois. The study area was divided into three burn units, and portions of it were burned in 4 of the 6 yr of our study. The northwest (NW) burn unit was approximately 300 ha and was burned twice during the study; the entire unit was burned in 1992, and 240 ha were burned in 1996. The southern (S) burn unit was approximately 125 ha and was burned once, in 1993. The northeast (NE) burn unit was approximately 250 ha and was burned once, in 1994.

We surveyed Henslow's Sparrows using 10-min point counts. We conducted 11 point counts two to three times each year between 23 May and 12 July at permanently marked locations evenly distributed at approximately 0.8-km intervals. At each point we recorded all singing males detected. Because Henslow's Sparrows are rarely detected beyond 150 m of census points (J. R. Herkert and S. K. Robinson, unpubl. data), we could not have detected males at more than one census point.

We used one-way analysis of variance (ANOVA) to test the effect of prescribed fire on relative abundance of Henslow's Sparrows. Each census point was classified into one of five burn categories based on the time since last burning. Burn 1 sites had been burned the previous April (1–2 mo before censusing); Burn 2 sites were entering their second growing season postfire (13–14 mo postfire at the time of censusing); Burn 3 sites were entering their third growing season postfire (25–26 mo); Burn 4 sites were entering their fourth growing season postfire (37–38 mo); and Burn 5 sites had not been burned in more than 4 yr. Because Henslow's Sparrows were not uniformly distributed in the study area and their numbers varied from year to year, census points and years were used as blocking variables in the ANOVA model.

In 1995 and 1996 we sampled vegetation at all census points and recorded vegetation height-density, litter depth, and shrub/tree density. Height-density was measured at 10 randomly located sites at each census point using a Robel pole (Robel et al. 1970). At each sample location we recorded the height at which 90% of the pole (approximately 2.5 cm wide, 1.5 m high, and marked in 10-cm intervals) became obscured by vegetation from a viewing distance of 4 m in each of the four cardinal directions. Litter depth was measured (in centimeters) as the distance between the ground and the top of the horizontal litter layer at 40 randomly located points at each census point. Shrub/tree density was measured by counting all shrubs or trees taller than 2 m and within 100 m of the census point. We used a t-test to compare vegetation features at census points where Henslow's Sparrows were recorded with points where the species was not recorded and to compare vegetation features between burned (Burn 1) and unburned (Burns 2–5) areas.

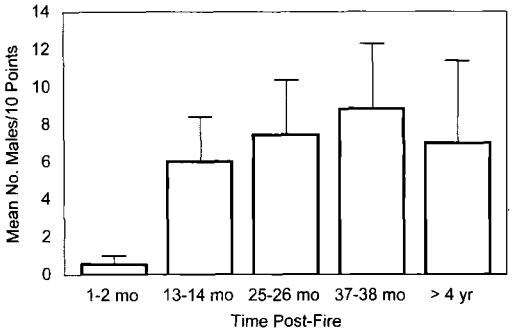

FIGURE 1. Mean number (± SE) of Henslow's Sparrow males recorded at census points in different years postfire. Burn 1 = 1–2 mo postfire, Burn 2 = 13–14 mo postfire, Burn 3 = 25–26 mo postfire, Burn 4 = 37–38 mo postfire, and Burn 5 = > 4 yr postfire.

We examined the potential effect of precipitation on Henslow's Sparrow abundance by comparing sparrow abundance at the site with three measures of precipitation: annual (1 June previous year to 31 May current year), January–April (1 January–31 April), and April–May (1 April–31 May). Precipitation data were collected at the Channahon Recording Station, approximately 10 km east of the study area.

RESULTS

Henslow's Sparrow distributions were significantly influenced by burning ($F = 3.49$; df = 1, 49; $P = 0.0010$) and location in the prairie (census-point effect; $F = 4.44$; df = 10, 49; $P < 0.0002$). Preliminary analyses indicated that abundance among Burn 2, Burn 3, Burn 4, and Burn 5 areas did not differ ($P > 0.20$), so these categories were combined for analyses (Burn 2^+, including results reported above). Henslow's Sparrows were generally absent from recently burned areas (Burn 1; Fig. 1). Their relative abundance in Burn 2 areas (second season postfire) was approximately 10 times greater than it was in Burn 1 areas but approximately 20% lower than it was in Burn 3 areas (third season postfire; Fig. 1). Henslow's Sparrow numbers at the study site increased between 1991 and 1996, with peak numbers recorded in 1995 (Fig. 2).

Henslow's Sparrows were not uniformly distributed among census points, and they were rarely recorded at some census points regardless of their burn history. For example, census points in the NW burn unit consistently had higher sparrow numbers than did census points in other burn units, except in years when the NW unit was burned (Fig. 3).

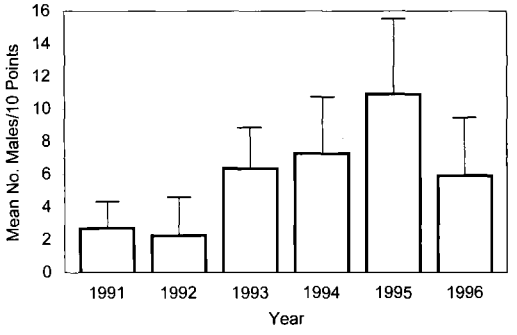

FIGURE 2. Mean number (± SE) of Henslow's Sparrow males recorded at census points at Goose Lake Prairie, Illinois, 1991–1996.

Our comparison of vegetation features in 1995–1996 found little difference in vegetation height-density or litter depth between occupied and unoccupied census points during these 2 yr (Table 1). Density of tall (≥ 2 m) shrubs and/or trees was more than 70% greater at unoccupied sites than it was at occupied sites (Table 1). Burning reduced vegetation height-density and litter depth (Table 2).

Variation in annual abundance of Henslow's Sparrows in the three burn units suggests that this species colonized adjacent unburned sections of prairie when other sections were burned (Fig. 3). Sparrow densities in the NE burn unit showed three increases of more than 50% (1992, 1995, 1996; Fig. 3). Two of these years (1992, 1996) were years in which the adjacent NW burn unit was burned. The third year, 1995, was the year the NE burn unit changed from Burn 1 to Burn 2 and was also the year of highest overall sparrow abundance (Fig. 2). The only increase of more than 50% in the NW burn unit was in 1993, following the 1992 burn of the NW unit and coincident with the 1993 burn of the S burn unit. A smaller increase (approximately 40%) was observed in the NW burn unit in 1994, the year the adjacent NE unit was burned. No apparent shifts in sparrow numbers in the S burn unit were evident in relation to burning in

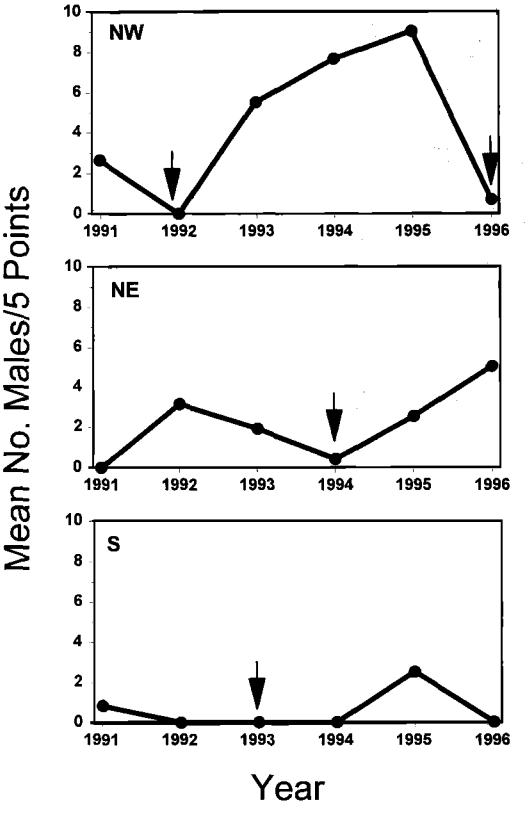

FIGURE 3. Mean number of Henslow's Sparrow males in three burn units at Goose Lake Prairie, Illinois, 1991–1996. The NW burn unit was approximately 300 ha and contained five census points; the NE burn unit was approximately 250 ha and contained four census points; and the S burn unit was approximately 125 ha and contained two census points. The NW burn unit was burned in 1992 and 1996, the NE unit in 1994, and the S unit in 1993.

adjacent blocks, although use of this unit also was highest in 1995, the year of highest overall abundance (Fig. 3).

Annual Henslow's Sparrow abundance was most strongly associated with total January–April precipitation ($r = 0.51$, $P = 0.296$, $N = 6$

TABLE 1. COMPARISON OF HABITAT FEATURES BETWEEN OCCUPIED AND UNOCCUPIED CENSUS POINTS AT GOOSE LAKE PRAIRIE, ILLINOIS, 1995–1996

	Occupied (N = 10)		Unoccupied (N = 10)			
	Mean	(SE)	Mean	(SE)	t	P
Height-density (VOR[a])	3.4	(0.2)	3.6	(0.3)	0.37	0.72
Litter depth (cm)	3.5	(0.7)	3.5	(0.8)	0.01	0.99
Shrub density (no./3.1 ha)	3.6	(1.9)	6.2	(2.0)	0.92	0.37

Note: Figures are vegetative means and standard errors (SE) for measurements taken at census points where Henslow's Sparrows were either present or absent. Comparisons between means were conducted with a t-test.

[a] VOR = Visual Obstruction Reading.

TABLE 2. COMPARISON OF HABITAT FEATURES BETWEEN BURNED AND UNBURNED CENSUS POINTS AT GOOSE LAKE PRAIRIE, ILLINOIS, 1995–1996

	Burned (N = 4)		Unburned (N = 16)			
	Mean	(SE)	Mean	(SE)	t	P
Height-density (VOR[a])	2.7	(0.1)	3.7	(0.2)	3.7	0.002
Litter depth (cm)	2.1	(0.7)	4.2	(0.6)	2.0	0.062

Note: Figures are vegetative means and standard errors (SE) for measurements taken at census points where Henslow's Sparrows were either present or absent and for measurements taken in burned (Burn 1) and unburned (Burn 2–5) areas. Comparisons between means were conducted with a t-test. Shrub density was not compared between burned and unburned points since burning did not have an immediate effect on shrubs or trees taller than 2 m.

[a] VOR = Visual Obstruction Reading.

yr). Sparrow abundance generally increased in years when spring precipitation in the current year exceeded that of the preceding year and declined when there was less spring precipitation (Fig. 4). Precipitation also may have influenced sparrow abundance following burning; abundance in Burn 1 areas was highest in the wettest burn year (1996) and lowest in the driest burn year (1992; Fig. 5).

DISCUSSION

Henslow's Sparrows shifted their distributions in response to prescribed burning, colonizing adjacent unburned areas as portions of the prairie were burned. Their use of management units peaked when adjacent burn units were burned; abundances in both the NE and NW burn units were generally high in years when an adjacent burn unit had been burned (Fig. 3).

Henslow's Sparrows appeared to exhibit a hierarchical pattern of habitat occupancy (see O'Connor 1981). Use of secondary portions of the study site (NE and S burn units) was greatest in years of high overall sparrow abundance (e.g., 1995) or in years when burning made the principal area (NW burn unit, based on abundance) unsuitable. In both years when the NW burn unit was burned, Henslow's Sparrow numbers on the adjacent NE burn unit increased by more than 50%. Although these data suggest a shifting population, a study of a marked population of birds at this site would be necessary to establish this pattern conclusively.

The avoidance of recently burned sections of prairie exhibited by Henslow's Sparrows in our study is consistent with previous work (Zimmerman 1988, 1992; Herkert 1994). Recolonization of this species following burning (Fig. 1) was more rapid in our study, however, than was previously reported for this site (e.g., Herkert 1994). Herkert (1994) previously reported that Henslow's Sparrow densities in prairie areas in their second season postfire were less than half that of areas in their third or greater growing season postfire. In this study, Henslow's Sparrow numbers were only 20% lower in prairie areas in their second season postfire than they were in areas in their third season postfire, and 32% lower than they were in areas in their fourth season postfire (Fig. 1).

Local features also played a role in determining distribution patterns. Some census points rarely had sparrows, regardless of the management history of the surrounding area. Local fea-

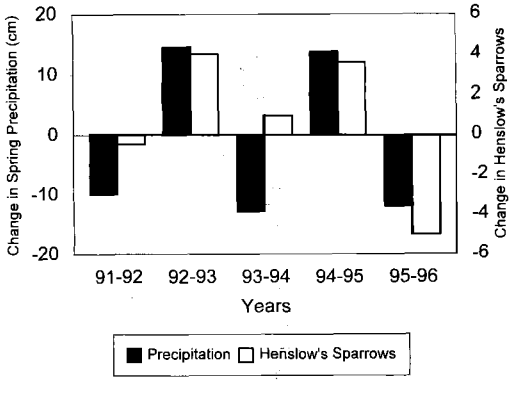

FIGURE 4. Relationship between changes in Henslow's Sparrow abundance and January–April precipitation. Numbers represent changes in precipitation (centimeters) and in Henslow's Sparrows (mean total abundance) between successive years.

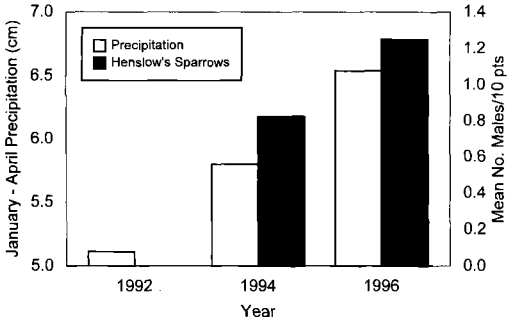

FIGURE 5. Henslow's Sparrow abundance in burn-year (Burn 1) areas in relation to January–April precipitation (centimeters).

tures that make some portions of this prairie more attractive than others for this species are not well understood. Sparrows at this site appeared to favor the NW management unit; at least estimated densities in this area were higher than they were in other sections. Our analyses of vegetation features among occupied and unoccupied areas in 1995–1996 suggest that differences in vegetation height-density or litter depth, two factors reported to strongly influence Henslow's Sparrow abundance (Zimmerman 1988, Herkert 1994), were probably not responsible for differences in abundance among particular census points, since there was little difference in these variables between occupied and unoccupied areas (Table 1). These data suggest that there may be structurally suitable habitat at this site that is unoccupied in some years.

Even though large portions (up to 300 ha) of this prairie were burned in 4 of 6 yr, the overall Henslow's Sparrow population at this site increased during our study (Fig. 2). This trend suggests that burning did not have an adverse effect on sparrows at this site when assessed at a broad scale, and that although this species was sensitive to burning, numbers can be maintained and even increased on large prairies actively managed with prescribed fire. Maintaining Henslow's Sparrow numbers on a site may be accomplished by using a rotational burning system in which small portions (usually no more than 20–30%) of a given site are burned in any particular year. Burn units should also be designed to ensure that areas known to be suitable for Henslow's Sparrows are available (in the appropriate burn status) in all burn-rotation situations. Managers interested in Henslow's Sparrow management should avoid burning all portions of an area known to be used by this species in the same year.

Additional research is needed to assess the response of Henslow's Sparrows to prescribed burns on smaller prairies. Until more is known about the broad-scale movements of this species in smaller prairies, caution should be applied when burning small sites known to support breeding Henslow's Sparrows.

ACKNOWLEDGMENTS

We thank the Illinois Department of Natural Resources and Illinois Nature Preserves Commission for allowing us to work at Goose Lake Prairie. We also thank the Illinois Water Survey for providing us with precipitation data. L. Igl, P. D. Vickery, and one anonymous reviewer provided many helpful comments on an earlier version of this manuscript.

LITERATURE CITED

HANDS, H. M., R. D. DROBNEY, AND M. R. RYAN. 1989. Status of the Henslow's Sparrow in the northcentral United States. U.S. Fish and Wildlife Service, Twin Cities, MN.

HERKERT, J. R. 1994. Status and habitat selection of the Henslow's Sparrow in Illinois. Wilson Bulletin 106:35–45.

HERKERT, J. R. 1997. Population trends of the Henslow's Sparrow in relation to the Conservation Reserve Program in Illinois, 1975–1995. Journal of Field Ornithology 68:235–244.

MAZUR, R. 1996. Implications of field management for Henslow's Sparrow habitat at Saratoga National Historic Park, New York. M.S. thesis. State University of New York, Syracuse, NY.

MINNEY, D. 1994. Breeding Bird Census: tallgrass prairie remnant. Journal of Field Ornithology 65 (supplement):123.

O'CONNOR, R. J. 1981. Habitat correlates of bird distribution in British census plots. Studies in Avian Biology 6:533–537.

PETERJOHN, B. G., AND J. R. SAUER. 1999. Population status of North American grassland birds from the North American Breeding Bird Survey, 1966–1996. Studies in Avian Biology 19:27–44.

PRUITT, L. 1996. Henslow's Sparrow status assessment. U. S. Fish and Wildlife Service, Bloomington Field Office, Bloomington, IN.

ROBEL, R. J., J. N. BRIGGS, A. D. DAYTON, AND L. C. HULBERT. 1970. Relationships between visual obstruction measurements and weight of grassland vegetation. Journal of Range Management 23:295–297.

ROBINS, J. D. 1971. A study of Henslow's Sparrow in Michigan. Wilson Bulletin. 83:39–48.

SAMPLE, D. W. 1989. Grassland birds in southern Wisconsin: habitat preference, population trends, and response to land use changes. M.S. thesis. University of Wisconsin, Madison, WI.

SAUER, J. R., S. SCHWARTZ, B. G. PETERJOHN, AND J. E. HINES. 1996. The North American Breeding Bird Survey home page. Ver. 94.3: www.mbr.nbs.gov/bbs/bbs96t3.htm. U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, MD.

SKINNER, R. M., T. S. BASKETT, AND M. D. BLENDEN. 1984. Bird habitat on Missouri prairies. Terrestrial series #14, Missouri Department of Conservation, Jefferson City, MO.

SWENGEL, S. R. 1996. Management response of three species of declining sparrows in tallgrass prairie. Bird Conservation International 6:241–253.

U.S. FISH AND WILDLIFE SERVICE. 1995. Migratory nongame birds of management concern in the United States: the 1995 list. U.S. Fish and Wildlife Service, Office of Migratory Bird Management, Washington, D.C.

WIENS, J. A. 1969. An approach to the study of ecological relationships among grassland birds. Ornithological Monographs no. 8.

ZIMMERMAN, J. L. 1988. Breeding season habitat selection by the Henslow's Sparrow (*Ammodramus henslowii*) in Kansas. Wilson Bulletin 100:17–24.

ZIMMERMAN, J. L. 1992. Density-independent factors affecting the avian diversity of the tallgrass prairie community. Wilson Bulletin 104:85–94.