Wilson Bull., 114(2), 2002, pp. 221–226

WINTER ABUNDANCE OF AND HABITAT USE BY HENSLOW'S SPARROWS IN LOUISIANA

N. ROSS CARRIE,[1,3,5] ROBERT O. WAGNER,[2] KENNETH R. MOORE,[1] JEFFREY C. SPARKS,[1,4] ERIC L. KEITH,[1,3] AND CHRISTOPHER A. MELDER[1]

ABSTRACT.—Population trend data indicates the Henslow's Sparrow (*Ammodramus henslowii*) is declining. Little information is available on the status, distribution, and habitat requirements of this species during winter. We obtained winter density estimates of Henslow's Sparrows and quantified and compared habitat structure along transects occupied and unoccupied by birds in longleaf pine (*Pinus palustris*) forests in westcentral Louisiana. We flushed Henslow's Sparrows from 14 transects during four surveys of 48 20- × 100-m transects from January to February 1996, and 20 transects during four surveys of 46 of the same transects from December 1996 to February 1997. The range of Henslow's Sparrow densities for both survey periods combined was 0.0–13.8 birds/ha (median = 0.0, 75th percentile = 1.3, 95th percentile = 5.0). We used logistic regression to evaluate the association of vegetative structure with Henslow's Sparrow habitat use. The most parsimonious model included litter depth and herbaceous cover as habitat variables predictive of Henslow's Sparrow occurrence. The model correctly classified the occupancy status of 79% (52 of 66) of observed transects. The number of Henslow's Sparrows observed in transect surveys declined with increased number of growing seasons since the last burn, suggesting fire may influence habitat quality. *Received 17 July 2000, accepted 15 May 2002.*

The Henslow's Sparrow (*Ammodramus henslowii*) is a grassland species that breeds in the northeastern and northcentral United States and southern Canada, and winters in the southeastern United States (Hands et al. 1989, Butcher and Lowe 1990). Breeding Bird Survey (BBS) data show a significant decline between 1966 and 1994 (Peterjohn et al. 1994). Several researchers have expressed concern regarding recent declines on its breeding ground (Hands et al. 1989, Herkert 1994, Tate 1986, Pruitt 1996). The Henslow's Sparrow is listed as endangered in Canada and as either endangered, threatened, or a species of concern in 16 states in the U.S. (Pruitt 1996).

Few reliable estimates of winter abundance are available for Henslow's Sparrows. Currently, data from Christmas Bird Counts (CBC) provide the only winter population data for Henslow's Sparrows. The relatively secretive behavior of Henslow's Sparrows during winter reduces the likelihood of detection by observers during CBCs. In addition, statistical methods for rigorous analysis of CBC data are not yet available. Consequently, CBC data probably are not reliable for assessing winter Henslow's Sparrow population numbers (Butcher and Lowe 1990).

There is little information on the winter habitat of Henslow's Sparrows. Winter habitats have been described generally as open pine forests with a grass understory and wet meadows of the southeastern coastal plain (Hunter 1990, Hamel 1992). Most of the longleaf pine (*Pinus palustris*) forests of the southeastern coastal plain of the U.S. have been harvested and replanted with other pine species (Frost et al. 1986). Fire suppression in many of the remaining longleaf pine forests has resulted in the reduction or elimination of the herbaceous understory of this fire climax community (Frost et al. 1986, Bridges and Orzell 1989). The impact of these habitat alterations on the Henslow's Sparrows and the relative importance of this habitat for wintering populations of this species are unknown.

The purpose of our study was to provide density estimates of Henslow's Sparrows in longleaf pine forests during winter and to quantify the habitat structure of occupied sites. We predicted that within the longleaf pine landscape, occupied habitat would differ structurally from unoccupied habitat at a local scale.

[1] Director of Public Works, Environmental and Natural Resources Management Div., 1919 23rd St., Fort Polk, LA 71459, USA.

[2] Quantitative Ecological Services, Inc., P.O. Box 990, Rosepine, LA 70659, USA.

[3] Current address: Raven Environmental Services, P.O. Box 6482, Huntsville, TX 77342, USA.

[4] Current address: Texas Parks and Wildlife Dept., 11942 F.M. 848, Tyler, TX 75707, USA.

[5] Corresponding author;
E-mail: carrie@ravenenvironmental.com

METHODS

Study site.—We surveyed for Henslow's Sparrows on the 13,335-ha Peason Ridge training area of Fort Polk (31° 21′ N, 93° 14′ W) and the 16,188-ha Vernon Ranger District (31° 01′ N, 93° 13′ W) of the Kisatchie National Forest, Louisiana. The area is characterized by flat to gently rolling plains with moderate slopes (1–3%) and well-drained fine sandy loam soils (Daigle et al. 1989). Vegetation consisted of a longleaf pine overstory and a grass understory comprised mostly of *Schizachrium* spp., *Andropogon* spp., *Panicum* spp., and *Dicanthelium* spp. Both areas were managed for timber production on a 120-year rotation and were prescribed burned at 3-year intervals.

Surveys.—We established 48 20- × 100-m transects spaced approximately 0.5 km apart in mature longleaf pine habitat. Transects at 0.5-km intervals that would have fallen in habitats other than mature longleaf pine forest were relocated to the nearest adjacent area of this habitat type. We surveyed each transect four times from January to February 1996 (first survey period) and 46 of 48 transects four times from December 1996 to February 1997 (second survey period). We conducted surveys from 08:00–12:00 on days when wind speeds were <2 m/s, skies were clear to partly cloudy, and daytime temperatures were >10° C. Survey crews included two individuals spaced approximately 12 m apart, each using two 4-m bamboo cane poles to beat the vegetation to flush birds. An observer centered between the two pole operators recorded birds as they flushed in front of the 20-m wide survey line. After flushing, birds were monitored until they landed to ensure that they were not counted more than once. Nearly all birds that we flushed flew beyond the transect, but not to an adjacent transect.

To estimate bird density for each transect, we divided the mean number of birds counted on the four surveys by the area of the transect (0.2 ha). We used these density estimates for the 48 transects to calculate the overall median, 75th, and 95th percentiles, and range for each annual survey period and for both periods combined.

Habitat measurements.—We sampled vegetation on occupied transects using 0.04-ha circular plots centered on the point where a bird was flushed. We measured vegetation during March or April following both survey periods to minimize disturbance of birds occupying the transects. We measured overstory density with a spherical densiometer (Nuttle 1997) and tree basal area with a 1-factor metric prism. We recorded the number of trees <25 cm dbh and >2 m tall (midstory layer) and the number of trees >25 cm dbh (overstory layer). Woody stems <1 cm dbh and <2 m tall were considered shrubs. We measured standing herbaceous vegetation using a 1-m rod held perpendicular to the ground to count the number of grass blades and forbs contacting the rod at a height of 0–100 cm. Ten separate counts of herbaceous vegetation were made approximately every 2 m with the rod along a line transect centered across the plot and oriented toward the north. We measured litter depth, defined as the vertical distance between the soil and the top surface of the accumulated leaf litter and matted dead grass, at the same points herbaceous cover was measured. We collected the same vegetative measurements at randomly selected points within transects where birds were not detected during the survey period to represent available unoccupied habitat.

Statistical analysis.—We calculated mean vegetation measurements by averaging data collected from all sampled points within each transect-survey period. We transformed litter depth measurements to a standard normal distribution to remove the effect of a systematic difference in its measurement between survey periods. We categorized transects as used if at least one bird was flushed during the survey period. We determined correlation coefficients among vegetation measurements.

We used model selection to analyze habitat use. Based on prior field observations, at the start of this study we selected habitat variables to measure in the field that we believed would be important correlates of habitat use. Using univariate logistic regression (Hosmer and Lemeshow 1989), we analyzed the importance of each independent variable (vegetative measurements and survey period) with respect to transect use. We ranked the relative weight of each independent variable using the small sample correction of Akaike information criterion (AIC_c; Burnham and Anderson 1998). We then constructed a global multivariate logistic regression model that included all variables except those that were highly correlated ($r > 0.7$) and explained a similar biological phenomenon, selecting the variable with the lowest AIC_c from the correlated set for inclusion in the model. We tested the fit of the global model based on deviance and a significance level of 0.40, and a visual examination of observed and fitted values and residuals (Agresti 1996, Venables and Ripley 1999). We used stepwise selection (stepAIC; Venables and Ripley 1999) to select the most parsimonious model based on minimizing AIC (Burnham and Anderson 1998). We calculated model uncertainty in terms of Akaike weights, which indicate the likelihood of the model for a given set of data (Burnham and Anderson 1998). We developed correct classification and sensitivity scores for the AIC_c-selected model to assess model performance. Correct classification is the percent of all observations that were correctly classified; sensitivity is the ability to correctly predict use only (Fielding and Bell 1997).

After examining habitat use, we suspected that there was a relationship between time since a transect was burned and the density of Henslow's Sparrows. To investigate this relationship, we obtained the fire history for each transect from fire management records maintained by the Fort Polk environmental division and the U.S. Forest Service. These records enabled us to categorize 66 of the 96 transects into one of three categories: transects with one growing season, transects with 2 growing seasons, and transects with >2 growing seasons since last burned. We tested the association

TABLE 1. Density (birds/ha) of Henslow's Sparrows (*Ammodramus henslowii*) from transect surveys in longleaf pine forests in westcentral Louisiana.

Period	Number of transects with ≥1 bird flushed[a]	Number of birds flushed[b]	Density[c]			
			Median	75th percentile	95th percentile	Range
Jan. 1996 to Feb. 1996	14 (48)	35	0.0	1.3	5.0	0.0–13.8
Dec. 1996 to Feb. 1997	20 (46)	33	0.0	1.3	2.5	0.0–8.8
Total	34 (94)	68	0.0	1.3	5.0	0.0–13.8

[a] Number of transects surveyed in parentheses.
[b] Total number of birds flushed during four surveys per survey period.
[c] Number of birds per hectare calculated from the mean number of birds per hectare for each of the 48 transects.

between the three growing season categories and the number of birds per transect with Pearson's chi-square tests. All analyses were conducted using S-Plus 2000 (MathSoft 1999).

RESULTS

We detected Henslow's Sparrows on 58% (28 of 48) of transects over the two survey periods (Table 1). Two transects that burned in August 1996 had no herbaceous cover that could support birds during the second survey period and consequently were not surveyed. Forty-three percent (6 of 14) of transects occupied by birds the first survey period were occupied the second survey period. No birds were detected on 71% (34 of 48) of transects during the first survey period and 57% (26 of 46) of transects during the second survey period.

Habitat characteristics were measured in 13 occupied and 17 unoccupied transects the first survey period and 19 occupied and 17 unoccupied transects the second survey period. Transformed litter depth, basal area, and herbaceous cover were the most important variables in determining transect use (Table 2). Basal area, overstory density, and trees >25 cm dbh were highly correlated and explain the same biological phenomenon. Since basal area had the lowest AIC_c value, it was entered into the global model. The other variables appeared to have little association with habitat use. The global model exhibited no evidence of lack-of-fit. The best model for discriminating between used and unused transects included litter depth (parameter estimate $\beta = 0.56$, SE = 0.19) and herbaceous cover (parameter estimate $\beta = -2.01$, SE = 0.53; Table 3). This model received >50% of the Akaike weight and was more than twice as likely to be the best model. This model correctly classified the occupancy status of 79% (52 of 66) of observed transects, with a 78% sensitivity rate (correctly classifying 25 of 32 used transects). The model indicates that the probability of use

TABLE 2. Mean values for vegetative measurements collected in 0.04-ha plots within transects that were used and unused by Henslow's Sparrows (*Ammodramus henslowii*) in longleaf pine forests in westcentral Louisiana, January to February 1996 and December 1996 to February 1997. Parameter estimates, *P* values for *t*-statistics, and bias-corrected Akaike Information Criterion (AIC_c) are presented from the global logistic regression model.

Variable	Occupied		Unoccupied		Parameter estimate	SE	*P*	AIC_c
	$\bar{x}$	SE	$\bar{x}$	SE				
Litter depth (cm)[a]	−0.41	0.11	0.49	0.17	−2.03	0.57	<0.001	77.30
Basal area (m^2/ha)	7.58	0.89	10.90	0.89	−0.06	0.07	0.222	88.69
Herbaceous cover (contacts/m)	4.97	0.40	3.89	0.27	0.53	0.23	0.012	90.13
Shrub density (stems/m^2)	114.81	23.37	77.46	13.49	0.00	0.00	0.493	93.61
Survey period	—	—	—	—	−0.01	0.35	0.488	95.04
Trees <25 cm dbh (stems/ha)	4.95	1.18	5.00	1.28	0.05	0.06	0.192	95.62
Overstory density (%)[b]	47.31	5.24	61.81	2.68	—	—	—	89.51
Tree >25 cm dbh (stems/ha)[b]	2.69	0.50	4.19	0.41	—	—	—	90.11

[a] Transformed to a standard normal distribution.
[b] Variables not included in the logistic regression model to avoid collinearity with basal area.

TABLE 3. Habitat models used to explain differences between transects occupied and unoccupied by Henslow's Sparrows (*Ammodramus henslowii*) in longleaf pine forests in westcentral Louisiana, January to February 1996 and December 1996 to February 1997. The bias-corrected Akaike Information Criteria (AIC_c), the difference in AIC_c values between the *i*th model and the lowest AIC_c value (Δ_i), and Akaike weights (w_i) are presented for the set of models considered in the stepwise model selection process.

Variable	Deviance	AIC_c	Δ_i	w_i
Herbaceous cover, litter depth[a]	61.721	68.11	0	0.56
Herbaceous cover, trees <25 cm dbh, litter depth	60.912	69.57	1.46	0.27
Herbaceous cover, trees <25 cm dbh, basal area, litter depth	60.193	71.19	3.08	0.12
Year, herbaceous cover, trees <25 cm dbh, basal area, litter depth	60.192	73.62	5.51	0.04
Year, herbaceous cover, trees <25 cm dbh, shrub density, basal area, litter depth	60.192	76.12	8.01	0.01

[a] Transformed to a standard normal distribution.

increased as litter depth decreased and herbaceous cover increased.

We found a marginally significant negative association between the number of Henslow's Sparrows observed on transects and the number of growing seasons since last burned (Fig. 1).

DISCUSSION

Henslow's Sparrows on our study area used sites with little or no litter and large amounts of herbaceous cover. In our study area, such habitat conditions occurred in open pine savannahs and openings in extensive forest. Large expanses of sparsely forested grassland were common on Fort Polk as a result of previous military use, frequent wildfires, and prescribed burns. Forest openings occupied by sparrows often were the result of trees that had been killed by insect infestations or wind. Fewer trees prevent rapid accumulations of litter and allow greater light penetration in the herbaceous understory, maintaining the habitat structure used by Henslow's Sparrows.

Wintering Henslow's Sparrows used sites in our study area without the deep accumulations of surface litter typical of sites used during the breeding season. On the breeding grounds, this species generally is found on sites with a well-developed litter layer that they use for

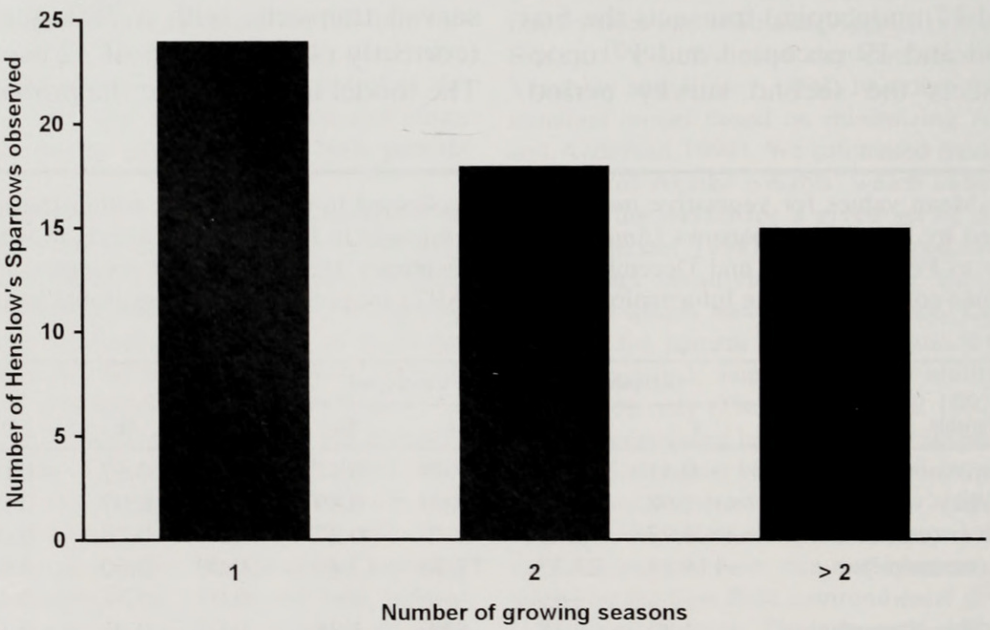

FIG. 1. The number of Henslow's Sparrows observed in longleaf pine forests was negatively related to the number of seasons since last burned (χ^2 = 5.23, 2 = df, P = 0.073). Data are from four surveys of 48 20- × 100-m transects from January to February 1996, and four surveys of 46 of those transects from December 1996 to February 1997, westcentral Louisiana.

nesting, escaping from predators, and foraging (Wiens 1969, Robins 1971, Kahl et al. 1985, Zimmerman 1988, Hanson 1994, Herkert 1994). Anecdotal accounts suggest that during the winter, Henslow's Sparrows feed mostly on seeds picked from the ground (Oberholser 1974). Foraging may be most efficient for birds that use areas with little or no litter where seeds on the ground are easily accessible. In addition, the accumulation of dead vegetation and litter after each growing season may depress herbaceous growth during following years (NRC pers. obs.). Birds typically run across the ground rather than fly when pursued (NRC pers. obs.). The lack of surface litter may provide a more open substrate for the birds as they move across the ground.

Fire may influence habitat suitability for wintering Henslow's Sparrows by reducing litter and maintaining the herbaceous understory. Burning can increase the richness and coverage of herbaceous plants, depending upon the season and frequency an area is burned (White et al. 1991). Prescribed burns on Fort Polk and the Vernon Ranger District were conducted during fall and winter (September to March). White et al. (1991) found that herbaceous species richness was significantly higher for winter burn treatments than for nonburn treatments. Hodgkins (1958) also found that forb cover increased during the first growing season after a fire and decreased during subsequent years as grass and woody cover increased. The availability of forbs during winter may influence the suitability of habitat for Henslow's Sparrows. We detected more sparrows on transects located in areas that had undergone at least one growing season since the last burn, and the number of sparrows declined as the number of growing seasons increased. Plentovich et al. (1999) also found large numbers of Henslow's Sparrows in recently burned areas that had high densities of herbaceous vegetation. Reducing the frequency of fires may adversely impact Henslow's Sparrow winter habitat quality in longleaf pine communities by allowing dead vegetation and litter to accumulate in the herbaceous understory.

The presence or absence of low woody vegetation was not a significant predictor of occupancy in our study area, although encroachment by low woody vegetation can limit use by Henslow's Sparrows on their breeding grounds (Zimmerman 1988). Low (<1 m) shrub clumps were present in low numbers throughout the understory of both occupied and unoccupied sites in our study area. Birds often flew into shrubs after flushing during our surveys, suggesting that widely spaced shrubs may be important as cover. Transects had been routinely burned every 3 years, promoting growth of the herbaceous vegetation and limiting woody encroachment. Extensive shrub cover can reduce the amount of herbaceous cover (Frost et al. 1986, Bridges and Orzell 1989) and may ultimately reduce winter habitat quality for Henslow's Sparrows.

Sites where Henslow's Sparrows overwinter in our study area generally were drier than the winter habitat described by Plentovich et al. (1999). The herbaceous understory in transects in our study area occurred exclusively on dry, well-drained sandy loam soils. In contrast, Plentovich et al. (1999) found Henslow's Sparrows to occur in areas with moist soils either in pitcher plant (*Sarracenia* spp.) bogs or in transition areas between pitcher plant bogs and drier upland habitats. Large numbers of Henslow's Sparrows also have been found in moist grasslands and bogs in coastal Mississippi (M. S. Woodrey unpubl. data). Although the soil moisture level was substantially different in our study area compared to these other areas, all areas appeared to have the well-developed herbaceous understories that the species seems to prefer.

The importance of a well-developed herbaceous layer suggests that grassland habitats other than those associated with the longleaf pine community should be surveyed for Henslow's Sparrows. Abandoned agricultural fields, easements along powerlines and roads, and forest openings produced by both even-age (clearcuts, shelterwood cuts) and uneven-age (group selection cuts) management practices should be studied to determine whether such areas provide suitable winter habitat for Henslow's Sparrows.

ACKNOWLEDGMENTS

We thank D. C. Rudolph, R. N. Conner, D. McNair, D. K. Carrie, Kathleen Beal and three anonymous reviewers for constructive comments on an early draft of the manuscript. The Fort Polk Environmental and Natural Resources Management Division supported this research through appointments to the postgraduate environmental management participation program administered by the Oak Ridge Inst. for Science and Education. We thank C. Stagg and S. Parris of the Fort Polk Environmental and Natural Resources Management Div. for their support and advice during this project.

LITERATURE CITED

AGRESTI, A. 1996. An introduction to categorical data analysis. John Wiley and Sons, New York.

BRIDGES, E. L. AND S. L. ORZELL. 1989. Longleaf pine communities of the west Gulf Coastal Plain. Nat. Areas J. 9:246–253.

BURNHAM, K. P. AND D. R. ANDERSON. 1998. Model selection and inference: a practical information-theoretic approach. Springer-Verlag, New York.

BUTCHER, G. S. AND J. D. LOWE. 1990. Population trends of twenty species of migratory birds as revealed by Christmas Bird Counts, 1963–1987. Final report, cooperative agreement no. 14-16-009-88-941. USFWS Office of Migratory Bird Management, Washington, D.C.

DAIGLE, J. J., B. MUSE, M. C. COOLEY, J. P. EDWARDS, G. J. TRAHAN, C. J. MYERS, AND E. WILLIAMS. 1989. Soil survey of Fort Polk and Peason Ridge military use area, Louisiana. U.S. Soil Conservation Service and Louisiana Dept of Agriculture, Baton Rouge, Louisiana.

FIELDING, A. H. AND J. F. BELL. 1997. A review of methods for the assessment of prediction errors in conservation presence/absence models. Environ. Conserv. 24:38–49.

FROST, C. C., J. WALKER, AND R. K. PEET. 1986. Fire dependent savannas and prairies of the Southeast: original extent, preservation status and management problems. Pp. 348–357 *in* Wilderness and natural areas in the eastern United States: a management challenge (D. L. Kulhavy and R. N. Conner, Eds.). Center for Applied Studies, School of Forestry, Stephen F. Austin State Univ., Nacogdoches, Texas.

HAMEL, P. B. 1992. Henslow's Sparrow (*Ammodramus henslowii*). P. 314 *in* Land manager's guide to birds of the South. The Nature Conservancy, Chapel Hill, North Carolina.

HANDS, H. M., R. D. DROBNEY, AND M. R. RYAN. 1989. Status of the Henslow's Sparrow in the northcentral United States. Missouri Coop. Fish and Wildlife Research Unit, Univ. of Missouri, Columbia.

HANSON, L. G. 1994. The Henslow's Sparrow (*Ammodramus henslowii*) of Minnesota: population status and breeding habitat analysis. M.Sc. thesis, Central Michigan Univ., Mount Pleasant.

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

HODGKINS, E. J. 1958. Effects of fire on undergrowth vegetation in upland southern pine forests. Ecology 39:36–46.

HOSMER, D. W. AND S. LEMESHOW. 1989. Applied logistic regression. John Wiley and Sons, New York.

HUNTER, W. C. 1990. Henslow's Sparrow (*Ammodramus henslowii*). Pp. 60–61 *in* Handbook for nongame bird management and monitoring in the southeast region. U.S. Fish and Wildlife Service, Atlanta, Georgia.

KAHL, R. B., T. S. BASKETT, J. A. ELLIS, AND J. N. BURROUGHS. 1985. Characteristics of summer habitats of selected nongame birds in Missouri. Res. Bull. 1056, Univ. of Missouri, Columbia.

MATHSOFT. 1999. S-Plus 2000 guide to statistics. MathSoft, Inc., Seattle, Washington.

NUTTLE, T. 1997. Densiometer bias? Are we measuring the forest or the trees? Wildl. Soc. Bull. 25:610–611.

OBERHOLSER, H. C. 1974. Western Henslow's Sparrow, *Nemospiza henslowii henslowii* (Audubon). P. 907 *in* The bird life of Texas. Univ. of Texas Press, Austin.

PETERJOHN, B. G., J. R. SAUER, AND W. A. LINK. 1994. The 1992 and 1993 summary of the North American Breeding Bird Survey. Bird Popul. 2:46–61.

PLENTOVICH, S., N. R. HOLLER, AND G. E. HILL. 1999. Habitat requirements of Henslow's Sparrows wintering in silvicultural lands of the Gulf Coastal Plain. Auk 116:109–115.

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

ROBINS, J. D. 1971. Differential niche utilization in a grassland sparrow. Ecology 52:1065–1070.

TATE, J., JR. 1986. The blue list for 1986. Am. Birds 40:227–236.

VENABLES, W. N. AND B. D. RIPLEY. 1999. Modern applied statistics with S-Plus. Springer-Verlag, New York.

WHITE, D. L., T. A. WALDROP, AND S. M. JONES. 1991. Forty years of prescribed burning on the Santee fire plots: effects on understory vegetation. Pp. 51–59 *in* Fire and the environment: ecological and cultural perspectives. Proceedings of an international symposium (S. C. Nodvin and T. A. Waldrop, Eds.). U.S. Forest Service General Technical Report SE-69, Asheville, North Carolina.

WIENS, J. A. 1969. An approach to the study of ecological relationships among grassland birds. Ornithol. Monogr. 8:1–40.

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