NOTES

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CHARACTERISTICS OF OCCUPIED AND ABANDONED FLORIDA GRASSHOPPER SPARROW TERRITORIES

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The Florida Grasshopper Sparrow (*Ammodramus savannarum floridanus*) is a nonmigratory subspecies endemic to the prairie region of southcentral Florida (Stevenson 1978). Because of its restricted distribution, loss of habitat, and population decline, *A. s. floridanus* was classified as endangered in 1986 (Fed. Reg. 1986). Much of Florida's dry prairie has been converted to improved pasture (Davis 1980) for cattle grazing which may have caused the extirpation of the sparrow from some of its former range. We monitored Florida Grasshopper Sparrow populations and measured features of the vegetation at occupied and abandoned territories to assess the effects of range management.

Florida Grasshopper Sparrow populations identified by Delany and Cox (1986) were visited during the breeding season (March-June) 1989-1992 and searched using their methods. Florida Grasshopper Sparrows were found at three former sites (3, 7, and 8; Delany and Cox 1986), and previously unknown sites in Highlands (T33S, R31E, Sec. 26) (D. R. Progulske, Jr., pers. commun.) and Desoto (T38S, R33E, Sec. 9) counties. Occupied sites had been burned at 2-3 year intervals. Cattle grazed four occupied sites at one animal per 8.7-28.3 ha. Surveys of six previously occupied sites (1, 2, 4, 5, 6, and 9; Delany and Cox 1986) failed to reveal Grasshopper Sparrows. All abandoned sites had been plowed and planted with bahia grass (*Paspalum* sp.), pangola grass (*Digitaria* sp.), and American joint vetch (*Aeshynomene americanus*) to improve cattle grazing or were plowed and planted with bahia grass for sod production.

Centers of Florida Grasshopper Sparrow territories were determined according to the methods of Wiens (1969) and served as starting points for two 25-m, randomly oriented transects. Measurements at abandoned sites were made within the approximate area of former territories (M. F. Delany, field notes 1981-1984). Measurements were made at point subsamples (10/territory) at 5 m intervals along each transect. Point subsample measurements included: 1) vertical density—the total number of vegetation contacts with a 7-mm diameter metal rod placed vertically into the vegetation; 2) height—the highest contact recorded; and 3) percentage cover—the total cover by each of grasses, forbs, shrubs, litter, and bare ground as determined by counting the number of cm of each component at a 1-m subsection of transect adjacent to point samples. Methods and calculations are according to Whitmore (1981) and Delany et al. (1985). One territory was sampled at each of five occupied sites and three abandoned sites. Two territories sampled at a fourth abandoned site were separated by >1 km and located on different ranches. Therefore, the experimental unit was considered to be the territory. The vegetational component proportions (i.e., grass, shrub, forb, litter, and bare ground proportions), and number of contacts or density (DENS) and height of contact (HT) measurements, were averaged for each territory.

A multivariate analysis of variance (MANOVA) was performed to test for differences in vegetation parameters between occupied and abandoned territories. The vegetation component proportions were transformed using generalized logits, with the transformed value for component i, t_i, computed as $t_i = \ln(p_i/p_{grass})$, where p_i = the pro-

portion of component i, i = shrub, forb, litter, bare ground, and p_{grass} = grass proportion (Aitchison 1986). The Box-Cox variance stabilizing transformation for DENS and HT were log (DENS) and $HT^{-1.5}$, respectively. Thus the response vector in the MANOVA was comprised of the shrub, forb, litter, and bare ground logits, log(DENS), and $HT^{-1.5}$. If the MANOVA was significant, then a t-test of a difference between occupied and abandoned territories was performed for each of the untransformed vegetation parameters as follows. A folded F-test of the hypothesis that the variances were equal was performed. If the hypothesis of equal variances was not rejected, then the usual t-test was performed. If the hypothesis of equal variances was rejected, then an approximate t-test using non-pooled variance and Satterthwaite's approximation for degrees of freedom was performed. All computations were performed using the SAS System (SAS Institute Inc., 1989).

Features of the vegetational structure at occupied and abandoned territories were strikingly different (Fig. 1, Table 1). The MANOVA test rejected the null hypothesis of H_o: no vegetation difference between occupied and abandoned territories, with Wilks' $\lambda = 0.0420$, $F = 11.4059$, numerator degrees of freedom = 6, denominator degrees of freedom = 3, $P = 0.0358$. The hypothesis of equal variances was rejected for untransformed grass, litter, and bare ground percent cover and vegetation height ($P < 0.03$ for each).

Grasshopper Sparrows require open areas (22-36% bare ground; Whitmore 1981, Delany et al. 1985) for foraging but enough vegetation for nesting cover (Whitmore 1979). Nests of *A. s. floridanus* are usually shielded by a shrubby growth of saw palmetto (*Serenoa repens*) (Nicholson 1936), dwarf oak (*Quercus minima*), dwarf huckleberry (*Gaylussacia dumosa*), or St. John's wort (*Hypericum brachyphyllum*) (pers observ.). Characteristics of used and abandoned habitat provide an index of suitability for the Florida subspecies. Results are consistent with the hypothesis that Florida Grasshopper Sparrows cannot adapt to conditions that remove foraging areas and potential nest sites (Delany et al. 1985).

Patterns of habitat use for other subspecies of Grasshopper Sparrow have been associated with changes in vegetation structure induced by land management (Smith 1963, Bock and Webb 1984, Frawley and Best 1991). Although responses of grassland passerines to habitat perturbations are often delayed and unpredictable (Wiens and Rotenberry 1985), clear patterns of habitat occupancy may be detected if ecological systems are relatively closed (Wiens et al. 1987). Because Florida Grasshopper Sparrows are sedentary (Delany, unpubl. banding data), the abandonment of sites was probably a

Table 1. Comparison of structural characteristics of occupied ($N = 5$) and abandoned ($N = 5$) Florida Grasshopper Sparrow territories, 4 May - 8 June, 1989-93.

	Occupied		Abandoned	
Habitat variable	$\bar{x}$	SE	$\bar{x}$	SE
Grass cover (%)	36.7	9.0	83.1	1.8*
Shrub cover (%)	19.9	3.3	1.6	1.6*
Forb cover (%)	7.7	2.1	2.0	1.3
Litter cover (%)	10.2	2.3	12.7	0.6
Bare ground (%)	25.6	6.9	0.5	0.2*
Density: contacts/point	4.8	1.1	3.9	0.5
Vegetation height (cm)	21.4	2.2	11.0	0.5*

*Significant difference (t-test, $P < 0.05$)

response to changes in land management. Land use trends indicate continued habitat loss for the sparrow since its listing (Fed. Reg. 1986).

The objective of the recovery plan for the Florida Grasshopper Sparrow is to maintain extant populations and increase distribution and abundance (USFWS 1988). The largest known populations are on public lands which provide the best opportunity for

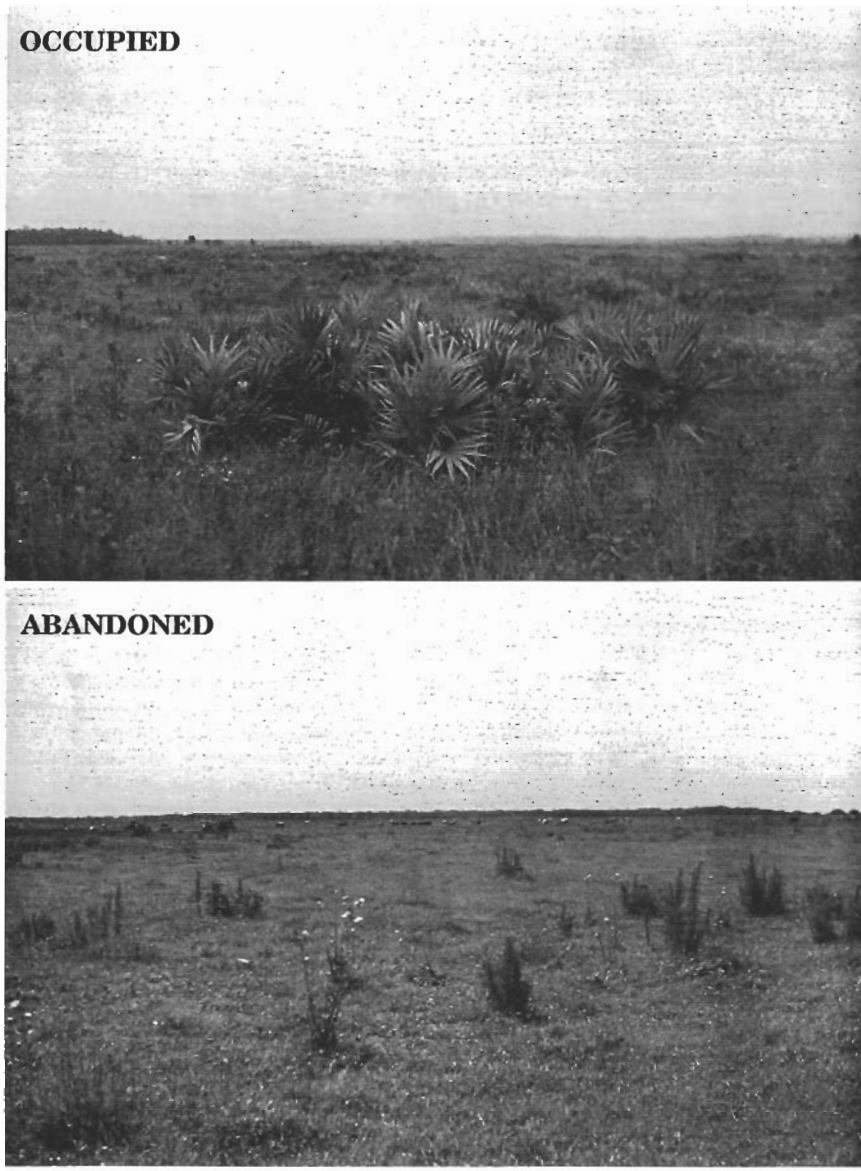

Figure 1. Habitat occupied (above) (site #7, Delany and Cox 1986) and abandoned (below) (site #9) by Florida Grasshopper Sparrows, 1994.

effective management. Most prairie habitat, however, is on private lands and vulnerable to conversion. The initial alteration of prairie rangeland for more intensive cattle grazing, as described above, is expensive ($205 - $321 per ha, USDA, Soil Conserv. Serv., unpubl. data), and annual pasture maintenance is usually ≥$70 per ha. The cooperation of ranchers is essential to recovery of the subspecies, and some may be amenable to economic incentives to maintain prairie habitat while also allowing some grazing.

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