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W. Gregory Shriver

Peter D. Vickery

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AERIAL ASSESSMENT OF POTENTIAL FLORIDA GRASSHOPPER SPARROW HABITAT: CONSERVATION IN A FRAGMENTED LANDSCAPE

W. GREGORY SHRIVER^{1,3} AND PETER D. VICKERY^{1,2}

¹*Department of Fisheries and Wildlife Conservation, Holdsworth
Natural Resource Center, University of Massachusetts
Amherst, Massachusetts 01003*

²*Center for Biological Conservation, Massachusetts Audubon Society,
208 South Great Road, Lincoln, Massachusetts 01773*

ABSTRACT.—The Florida Grasshopper Sparrow (*Ammodramus savannarum florida-nus*) is endemic to dry prairie habitat of central Florida. This year-round resident is dependent on dry prairie habitat for all stages of its life history and is considered endangered because of habitat loss and consequent population decline (Federal Register 1986). Dry prairie habitat once occupied an estimated 0.83 million ha throughout central Florida (Davis 1967), but its current status is unclear. Because only four populations of Florida Grasshopper Sparrow are currently protected, it is important to identify any remaining fragments of dry prairie habitat that might aid in the conservation of this endangered taxon. In 1995, six aerial surveys were flown in the former range of the Florida Grasshopper Sparrow to identify and rank potential dry prairie areas for breeding grasshopper sparrows. Of 138,000 ha surveyed, we found 64,000 ha in high quality habitat, 40,000 ha in marginal habitat, and 34,000 ha unsuitable for breeding grasshopper sparrows. Including already protected sparrow populations, we estimate that 156,000 ha of dry prairie habitat existed in 1995 (approximately 19% of the original area). In our aerial surveys we found five large areas that retain the native vegetation needed by breeding grasshopper sparrows. Thus, the U.S. Fish and Wildlife Service's 1988 recovery plan goal of 10 populations with at least 50 breeding pairs remains a major conservation challenge that is unlikely to be achieved without intensive habitat conservation initiatives, including acquisition, and habitat restoration.

Dry prairie and pine flatwoods of Florida once constituted the most extensive terrestrial ecosystems in central Florida (Abrahamson and

³*Present Address: State University of New York College of Environmental Science
and Forestry, 1 Forestry Drive, Syracuse, New York 13210*

Hartnett 1990). Characterized by low, flat topography, these ecosystems grade into each other in response to precipitation, drainage, soil types, and fire, creating a mosaic of prairie-flatwood associations (Abrahamson and Hartnett 1990). Dry prairies are treeless expanses of bunch grasses, low shrubs, and herbaceous plants. Flatwoods have a similar understory, but with a pine (*Pinus elliottii*, and *P. palustris*) overstory. The conditions that create treeless dry prairies instead of flatwoods have not been clearly identified, but the frequency and intensity of fire are probably primary influences (Abrahamson and Hartnett 1990). Pine trees readily colonize dry prairies that have not been burned for more than five years or that were burned under low intensity fire (W. G. Shriver pers. obs.).

The Florida Grasshopper Sparrow, (*Ammodramus savannarum floridanus*), a dry prairie endemic, was listed as federally endangered in 1986 (Federal Register 1986) primarily because of habitat loss and population decline. The recovery plan adopted by the US Fish and Wildlife Service (USFWS 1988) recommended conserving sufficient habitat to protect 10 populations of at least 50 breeding pairs in each population. In 1985, nine sites, with a total of 182 singing male grasshopper sparrows, were identified in central Florida (Delany et al. 1985, Delany and Cox 1986). At the time of this study (1995), three sites, Three Lakes Wildlife Management Area (Three Lakes), Avon Park Air Force Range (Avon Park), and The National Audubon Society's Ordway-Whittell Kissimmee Prairie Sanctuary (Ordway-Whittell), were protected (7,400 ha dry prairie total). In 1996, a fourth site, Kissimmee Prairie State Preserve, which occupies >12,000 ha of dry prairie habitat, was purchased by the State of Florida as part of the State Conservation and Recreation Lands (CARL) program. The numbers of singing males estimated for these sites ranged from 1 (Ordway-Whittell) to 116 (Three Lakes) (Table 1). Avon Park supported two separate populations: Delta/OQ Range with 40, (Vickery and Perkins 1997) and Echo Range with 72 singing males (Vickery and Shriver 1994). The number of territories at Ordway-Whittell declined over a three-year study from 1993 to 1995 (Shriver 1996), and only one male was counted in 1998 (D. Perkins pers. comm.). These estimates and information from Florida's Breeding Bird Atlas (Kale et al. 1992) suggest that currently protected dry prairie habitat will not adequately provide for the long-term survival of this endangered sparrow (Cox et al. 1994).

In order to meet the USFWS recovery plan goal of 10 breeding sparrow populations, it is necessary to identify the location, size, and quality of the remaining grasshopper sparrow habitat. An earlier attempt to use satellite imagery to locate and quantify remaining dry prairie habitats important to Florida Grasshopper Sparrow populations did not accurately delineate sparrow habitat (Cox et al. 1994).

Table 1. Number of singing male Florida Grasshopper Sparrows at four protected sites in central Florida.

SITE	GRASSHOPPER SPARROWS (singing males)	PRAIRIE (ha)	REFERENCE
Avon Park AF Range Delta/OQ	40	700	Vickery and Perkins 1997
Echo	72	887	Vickery and Shriver 1994
Three Lakes WMA	116	4,000	Walsh et al. 1995
National Audubon Society Ordway-Whittell Kissimmee Prairie Sanctuary	1	1,000	D. Perkins pers. comm. 1998
Kissimmee Prairie State Preserve	> 100	12,000	D. Perkins pers. comm. 1998

Satellite information did not discriminate dry prairie from areas with scattered pine trees and fallow pastures, neither of which are often occupied by breeding grasshopper sparrows (Cox et al. 1994). To better determine the location and extent of remaining dry prairie, we conducted aerial surveys within eight central Florida counties, identified dry prairie habitat remnants, and ranked the quality of these areas for potential grasshopper sparrow breeding habitat.

METHODS

The Florida Natural Areas Inventory (FNAI) provided a database of potential natural areas (PNAs) of dry prairies (Steve Orzel pers. comm.) that we used for our survey. FNAI personnel used black and white aerial photographs (1:24,000) taken in 1992-1993 to identify PNAs that had native vegetation cover, which were then transcribed on Department of Transportation county maps and digitized. We queried the FNAI database in the 12-county area of the former range of the Florida Grasshopper Sparrow (Figure 1) to locate dry prairie PNAs. These areas were then identified on a Florida Atlas and Gazetteer for reference during aerial surveys (DeLorme Mapping 1989). Four of the 12 counties (Collier, Lee, Charlotte, and Sarasota) did not have dry prairie PNAs and were not surveyed from the plane. All 17 PNA's observed from the air in this study were in private ownership. Six aerial surveys were flown between 1 May and 31 July 1995. Each flight was longer than four hours, and flight altitude was decreased to an elevation of 300 m to view a dry prairie PNA. Although we searched the landscape for suitable Florida Grasshopper Sparrow habitat in addition to the FNAI PNAs, we did not find any. We classified dry prairie PNAs into the three categories (high, marginal, and poor quality) defined below based on the presence of native vegetation, recent fire history, fragment size, and contiguity.

High Quality Sites = vegetation dominated by native grasses, recent fire, greater than 100 ha in size, and contiguous with another dry prairie site.

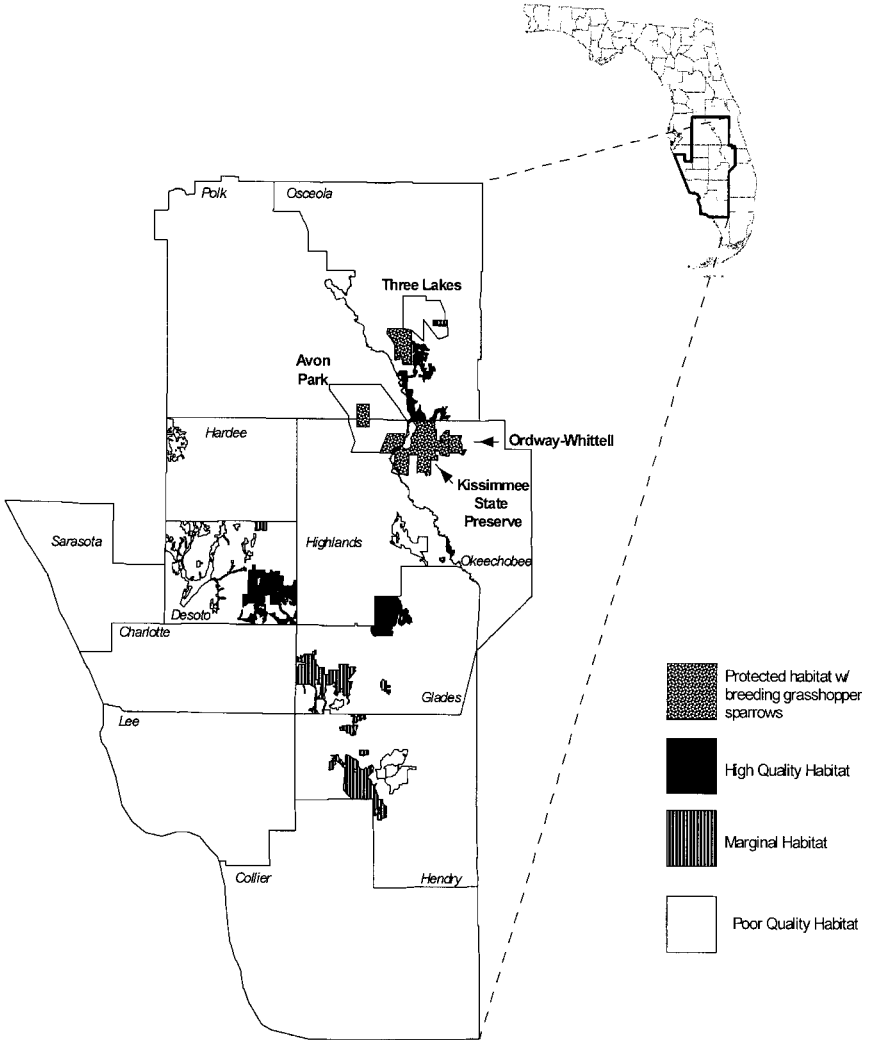


Figure 1. Map of the remaining Florida Grasshopper Sparrow habitat based on six aerial surveys flown in 1995. Currently protected sites (with breeding sparrows) and habitat quality estimates of the remaining breeding sparrow habitat are shown.

Marginal Sites = native vegetation, recent fire, and less than 100 ha but greater than 25 ha.

Poor Quality Sites = invasive exotic vegetation, no fire (shrub dominated cover), isolated. Not potential sparrow habitat.

RESULTS AND DISCUSSION

We surveyed 138,000 ha of potential dry prairie habitat on 17 privately owned PNAs in eight central Florida counties (Figure 1). Of the privately owned PNAs, 64,000 ha (46%) were high-quality grasshopper sparrow breeding habitat, 40,000 ha (29%) were marginal, and 34,000 ha (25%) were either poor quality or converted to agriculture (Figure 1). With the addition of protected sites in public ownership that have suitable sparrow breeding habitat, we estimate that 156,000 ha of dry prairie habitat remained in Florida in 1995.

Estimating the extent of pre-colonial habitat to determine the amount of dry prairie habitat lost is difficult. However, two estimates of the historic extent of dry prairie exist. Davis (1967) estimated that 0.83 million ha of dry prairie habitat existed in pre-settlement Florida (Kautz et al. 1993) while Crumpacker et al. (1988) estimated that 1.1 million ha of palmetto prairie habitat historically existed in the United States. This figure may be an overestimate of the amount of dry prairie habitat because it includes the entire state Florida and potentially other regions where palmetto prairie exists. Since the Davis (1967) estimate is clearly within the state of Florida and restricted to the former range of dry prairie, we use this estimate to attempt to determine the amount of dry lost prairie from presettlement to 1995. Kautz et al. (1993) used Landsat Thematic Mapper satellite imagery (1985-1989) to determine the percent cover of 22 land cover types in Florida. They estimated that 561,000 ha of dry prairie remained, representing a loss of 269,000 ha (33%) of the original area. Our 1995 estimate of 156,000 ha of dry prairie represents an additional loss of 405,000 ha and indicates that only 19% of historical dry prairie remained in 1995.

Effective management for the long-term persistence of an endangered species relies not only on knowledge of a species' biology, but also on the identification and prioritization of potential sites for conservation action. Presently, four protected populations of Florida Grasshopper Sparrows exist with three PNAs ranked as high quality sparrow habitat. Thus, the 1988 USFWS goal of 10 populations with at least 50 breeding pairs is still a major conservation challenge unlikely to be achieved without concerted prairie habitat conservation initiatives, including habitat acquisition, and habitat restoration. Delany (1993) estimated that Three Lakes and Avon Park were the only two sites that supported more than 50 breeding pairs. Ordway-Whittell was also listed as a potential site with habitat to support a large population of breeding sparrows (Cox et al. 1994). By 1997 however, the grasshopper sparrow population at this site had declined from 11 singing males 1993 (Shriver 1996) to 1 singing male in 1998 (D. Perkins, unpubl. data). This decline was primarily the result of an artificial dike that in-

undated sparrow habitat with unnaturally high water levels (Paul Grey pers. comm.). Until this site is restored to a more natural hydrologic condition, its potential to support a large breeding population of sparrows will be limited.

When designing a system of reserves to protect the habitat and populations of an endangered species, it is critical to consider essential biological requisites of rare species (Shafer 1990), in this case area requirements and dispersal abilities. Generally, grasshopper sparrows occupy large tracts of open grasslands and avoid narrow fragmented patches (Peterjohn and Rice 1991). Research in Illinois (Herkert 1994) and Maine (Vickery et al. 1994) has documented that Grasshopper Sparrows do not occupy small grasslands. In Florida, Delany et al. (1985) suggested that 240 to 1,348 ha of contiguous dry prairie habitat was needed to support a breeding population of Florida Grasshopper Sparrows. Based on territory size estimates, at least 600 ha was needed to support 50 breeding pairs (Delany 1993). The apparent sensitivity of this species to habitat area makes conservation of large prairie remnants paramount for increasing the long-term viability of this sparrow.

The notably sedentary nature of this bird reduces the probability that unoccupied prairie habitats will be readily colonized (Vickery and Dean 1997). This conclusion is further supported by DNA analysis that found genetic differences between two sparrow populations (Echo Range and Delta/OQ Range) within Avon Park, sites that are no more than 12 km apart (Vallianatos 1997). This is the shortest distance between any of the existing breeding populations, indicating that connectivity sufficient to facilitate gene flow between breeding sites is very limited or does not exist.

This survey has demonstrated that large prairie remnants with native vegetation only occur on three remaining unprotected sites (1 high quality site in each of the following counties; Osceola, Desoto, and Glades, Figure 1). Therefore, active conservation initiatives and acquisition of all remaining dry prairie habitat should be a major conservation priority. This study supports Cox et al.'s (1994) assertion that conservation of dry prairie habitat should be a top priority in this region. In addition, this study makes it clear that protection of existing native prairie is unlikely to be adequate for achieving the goals of the USFWS recovery plan. Including the three high quality sites and the four presently protected sites, it appears that three additional sites will have to be restored before the USFWS recovery goal of 10 breeding populations can be achieved.

Recent dry prairie initiatives.—In 1996, a landmark dry prairie and central Florida conservation plan was completed. In a cooperative initiative between the National Audubon Society, The Nature Conser-

vancy, and the State of Florida Conservation and Recreation Lands (CARL) program, a 21,000 ha ranch was acquired by the State of Florida, the Kissimmee Prairie State Preserve. This state preserve protects the area between Avon Park and Ordway-Whittell (Figure 1). This acquisition has created a protected wilderness area in central Florida and may link two known breeding grasshopper sparrow populations. The State CARL plan has also secured a conservation easement on the Brichtour Ranch (only high quality habitat in DeSoto County, Figure 1) and added another site (Bombing Range Ridge and Flatwoods) adjacent to Avon Park Air Force Range and Kicco Wildlife Management Area, where Florida Grasshopper Sparrows have been identified. These initiatives have substantially increased the area and distribution of dry prairie habitat under protection, and secured the fourth site known to support Florida Grasshopper Sparrows.

Conservation considerations.—Because restoration of “improved” pastures and other degraded sites will evidently be necessary to achieve the goals of the USFWS recovery plan, it will be critical to consider the landscape context of these sites. The spatial configuration of all sites needs to be carefully considered, including providing for adequate connectivity between existing sites, two of which are very isolated. Although sparrows are known to move widely within prairie fragments in the nonbreeding season, evidence to date suggests that this taxon does not readily move beyond these fragments (Vickery and Dean 1997). Given these very limited dispersal tendencies, it is unclear what will constitute an adequate corridor for this endangered taxon. This is a topic that has not been studied, but requires attention. We suggest that future restoration sites should be sited within the present matrix of remaining dry prairie habitat, and sites in Okeechobee, Highlands, se. Polk, and s. Osceola counties appear to provide the best potential for sparrow habitat restoration. The two major breeding sites at Avon Park (Echo and Delta/OQ ranges) appear to function as two separate populations, thus it would be particularly advantageous to restore additional prairie sites at Avon Park. In the 1960s, nearly 9,000 ha at Avon park were planted with an introduced form of North Florida Slash Pine (*Pinus elliottii*) for commercial forestry purposes, supplanting much of the native prairie at this site (Avon Park 1994). Restoration of these plantations to dry prairie habitat provides an obvious opportunity to both increase the number of sparrow breeding sites and to improve connectivity between existing sites that are currently separated by 12 km.

Given the loss of approximately 81% of native dry prairie in Florida, it seems clear that, in addition to site-specific management, landscape-level planning and implementation throughout interior central Florida will be essential if endangered Florida Grasshopper Sparrows

and the biologically diverse ecosystem that they inhabit are going to persist. We hope these results will encourage conservation planners and dry prairie land managers in Florida to take a broader, landscape-level perspective of the conservation issues surrounding Florida Grasshopper Sparrows. Although site specific management is very important, it has received considerable attention and study, and site management has been generally effective in maintaining high quality sparrow habitat. But it now seems clear that these efforts will be insufficient without a broader, more regional approach to this critical conservation issue.

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