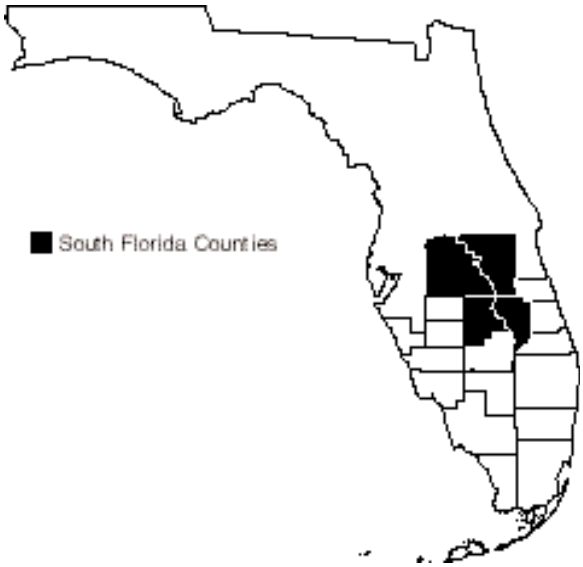
Florida Grasshopper Sparrow

Ammodramus savannarum floridanus

Federal Status:	**Endangered (July 31, 1986)**
Critical Habitat:	**None Designated**
Florida Status:	**Endangered**
Recovery Plan Status:	**Revision (May 18, 1999)**
Geographic Coverage:	**Rangewide**

Figure 1. County distribution of the Florida



The Florida grasshopper sparrow is a subspecies of grasshopper sparrow that is endemic to the dry prairie of central and southern Florida. This subspecies is extremely habitat specific and relies on fire every two to three years to maintain its habitat. Because of declines in the sparrow's suitable habitat and population size, the National Audubon Society placed the Florida grasshopper sparrow on its blue list in 1974. This species was listed as endangered by the State of Florida in 1977. The FWS listed the Florida grasshopper sparrow as endangered in 1986 because of habitat loss and degradation resulting from conversion of native vegetation to improved pasture and agriculture.

This account represents a revision of the existing recovery plan for the Florida grasshopper sparrow (FWS 1988).

Description

The Florida grasshopper sparrow (*Ammodramus savannarum floridanus*) is a small, short-tailed, flat-headed sparrow averaging 13 cm in total length (M. Delany, GFC, personal communication 1996; Vickery 1996a). The top of its head is mostly blackish with a light median stripe. The remainder of its dorsum is mainly black, edged with gray, and streaked with brown on the nape and upper back. The sparrows are whitish underneath, unstreaked, with buff throat and breast; juveniles have streaked breasts. The grasshopper sparrow's ventral color pattern resembles that of the Bachman's sparrow (*Aimophila aestivalis*). The retrices of the grasshopper sparrow are pointed, its lores are light gray to ochraceous, and the bend of the wing is yellow. Its bill is thick at the base, and its feet are flesh-colored.

This subspecies is marked with a longer bill and longer tarsi than the northern subspecies (*A. s. pratensis*); it also has a darker dorsum. The Florida grasshopper sparrow also lacks the reddish streaks on its nape that are found in the northern subspecies. Adult Henslow's sparrows (*A. henslowii*) and Le Conte's sparrows (*A. leconteii*) are

similar to grasshopper sparrows in size and shape; however, unlike adult grasshopper sparrows, adults of these species have ventral streaking (Stevenson and Anderson 1994). Although the juveniles of these species would be difficult to distinguish visually, only the Florida grasshopper sparrow breeds in Florida, so juveniles of these species do not overlap.

During the breeding season, the male and female grasshopper sparrows can be distinguished in the hand by the presence of a cloacal protuberance in the male or brood patch in the female. Gender may also be determined during the breeding season by wing chord length and body weight. Female grasshopper sparrows are smaller and heavier (Delany *et al.* 1994). However, this technique may not work outside of the breeding season (Delany *et al.* 1994, T. Dean, University of Massachusetts, personal communication 1996a).

The song of the Florida grasshopper sparrow is among the weakest of any North American bird (Stevenson 1978). Nicholson (1936) described it as being indistinct and as having a definite insect-like quality, which gave rise to the bird's common name (Sprunt 1954). The song starts as three low pitched notes followed by a longer, higher pitched "buzz" (Delany 1996a). Grasshopper sparrows sing while perched upon dead palmetto leaves, dead oak twigs, staggerbush (*Lyonia* spp.), and tarflower between 15 and 90 cm in height (Nicholson 1936, Delany *et al.* 1995). They may also sing from the ground, particularly after a summer burn event (P. Vickery, University of Massachusetts, personal communication 1998). Male Florida grasshopper sparrows sing throughout the day, although they sing more frequently from sunrise to 9:00 a.m. and at 15 minutes before sunset (Delany 1996a). When they are establishing breeding territories, they only sing the short primary song (Smith 1959). Male grasshopper sparrows begin singing mid- to late March, and their singing usually diminishes by late June. After late summer burns (June and early July) male grasshopper sparrows may extend singing through August (Vickery 1996).

Taxonomy

Grasshopper sparrows (*A. savannarum*) are in the order Passeriformes, family Emberizidae, subfamily Emberizinae (AOU 1983). Twelve subspecies of grasshopper sparrows have been described, including *A. s. floridanus* (Paynter and Storer 1970, Wetmore *et al*. 1984). The Florida grasshopper sparrow was first described by Mearns (1902) as *Coturniculus savannarum floridanus* on the basis of one male and two females that were collected in 1901 in a portion of the Kissimmee Prairie in southern Osceola County, Florida. By 1931, this subspecies had been incorporated into the genus *Ammodramus* (AOU 1931). *Ammodramus savannarum floridanus* has been accepted as a valid subspecies since it was described but has not been examined genetically (AOU 1910, Paynter and Storer 1970, P. Vickery, University of Massachusettes, personal communication 1998).

Florida grasshopper sparrow. *Original photograph by Betty Wargo.*

Distribution

Grasshopper sparrows are found from North to South America, Ecuador, and in the West Indies (Vickery 1996, AOU 1957). They are common breeders throughout much of the continental United States, ranging from southern Canada south to Florida, Texas, and California. Additional populations are locally distributed from Mexico to Colombia and in the West Indies (Delany *et al*. 1985, Delany 1996a, Vickery 1996).

Unlike the migratory, northeastern grasshopper sparrow (*A. s. pratensis*) that overwinters in Florida, the Florida grasshopper sparrow is non-migratory, and is limited to the prairie region of south-central Florida. The Florida subspecies is isolated from *A. s. pratensis* by at least 500 km during the breeding season (AOU 1983). The historic distribution of the Florida grasshopper sparrow is not known with certainty, but there are records from Collier, Miami-Dade, DeSoto, Glades, Hendry, Highlands, Polk**,** Okeechobee, and Osceola counties (Delany and Cox 1985, Stevenson 1978). An observation of an adult grasshopper sparrow in Manatee County, Florida, recorded by Howell (1932) may have been *A. s. floridanus* (Stevenson and Anderson 1994). This supposition is questionable since *A. s. floridanus* has not been found north of Kenansville in Osceola county (Delany and Cox 1985). Another *A. s. floridanus* was found by J. C. Ogden on the Anhinga Trail, Miami-Dade County, in 1968 (Stevenson and Anderson 1994). The Florida grasshopper sparrow has been extirpated as a breeding bird in Collier, Miami-Dade, and Hendry counties. Recent surveys of known locations have not detected its presence in DeSoto and Glades counties; however other populations may exist in Glades County (Delany and Linda 1994). In 1977, a previously unknown population of 43 Florida grasshopper sparrows was found on Bravo Range at Avon Park AFR (M. Delaney, GFC, personal communication 1998). This species is now known only from Highlands, Okeechobee, Osceola, and Polk counties (Robertson and Woolfenden 1992, Delany 1996a).

Habitat

Florida grasshopper sparrow habitat consists of large (greater than 50 ha), treeless, relatively poorly-drained grasslands that have a history of frequent fires (FWS 1988, Delany 1996a). *A. s. floridanus* occurs in prairies dominated by saw palmetto (*Serenoa repens*) and dwarf oaks (*Quercus minima*) ranging from 30 to 70 cm in height. Bluestem grasses (*Andropogon* spp.), St. John's wort (*Hypericum* spp.), and wiregrasses (*Aristida* spp.) are also components of grasshopper sparrow habitat (Delany *et al.* 1985, FWS 1988).

These dry prairies are relatively flat and are moderately to poorly drained. The soils typically consist of 0.3 to 1.0 m of acidic, nutrient-poor quartz sands overlying a high clay subsoil or organic hardpan (spodic horizon) (FNAI and FDNR 1990, Abrahamson and Hartnett 1990). Both the heavy subsoil and hardpan reduce the movement of water below and above their surfaces (FNAI and FDNR 1990). Thus, dry prairies may become flooded for short periods during the rainy season, but remain dry for the remainder of the year. The water table in these prairies is normally found between several centimeters and a meter below the soil surface.

The main difference between dry prairies and pine flatwoods is that pines and palms are absent or at a density below one tree per acre. Grasshopper sparrows, however, cannot tolerate tree densities as high as one tree per acre. Some dry prairies may be artifacts of clearcutting, unnaturally frequent burning, livestock grazing, and alteration of hydrology (Abrahamson and Hartnett 1990). Prairie habitat may also have disappeared due to infrequent burn regimes from fire prevention, and from planting of slash pine.

When compared with habitat of other grasshopper sparrows, habitat used by *A. s. floridanus* and *A. s. pratensis* is characterized by a larger percentage of shrub and bare ground, a smaller percentage of tall vegetation, and less litter (Delany *et al*. 1985). Because the sparrows are ground-dwelling birds, they usually require at least 20 percent bare ground for unrestricted movement and foraging, but need enough vegetation to provide nesting cover (Whitmore 1979, Vickery 1996). Large areas of prairie habitat between 240-1,348 ha are needed to maintain populations of 50 breeding pairs (Delany *et al.*1995).

The range of the Florida grasshopper sparrow occurs within the area with the greatest number of thunderstorm-days in the continental United States (Chen and Gerber 1990), and the high frequency of lightning generated by these storms historically resulted in fire every few years on the dry prairie ecosystem (FNAI and FDNR 1990). As a result of these frequent fires, the density of trees and other tall vegetation is low and the percentage of bare ground higher.

Little is known about the Florida grasshopper sparrow's post-breeding activities and habitat preferences; however, ongoing radio telemetry research should yield valuable information on this aspect of the sparrow's life history and habitat associations.

Florida grasshopper sparrows are also documented to be reproductively successful in pastures that are overgrown or ungrazed (Vickery *et al*., University of Massachusetts, personal communication 1998). As pastures become heavily grazed, however, sparrow populations have been documented to decrease or disappear (Delany and Linda 1994).

Behavior

Reproduction and Demography

A. s. floridanus is the only subspecies of grasshopper sparrow that breeds in the State of Florida (Stevenson and Anderson 1994). This subspecies usually nests between early April and late June and may produce two broods in a single season (Stevenson and Anderson 1994, Nicholson 1936). Bimodal breeding seasons for *A. s. floridanus* occurred at the Ordway-Whittell Kissimmee Prairie Sanctuary after summer fires set early in the breeding season (late May to late June); the first peak in nesting ranged from March to late June, with the second peak between July and September (Vickery and Shriver 1995, 1996). Bimodal breeding seasons have also occurred at Three Lakes WMA in every year there was an adequate summer burn (Shriver 1996, Vickery *et al*., University of Massachussets, personal communication 1998).

Little information is available on the courtship activities of this secretive bird. Nicholson wrote that "the male Florida grasshopper sparrow has a fluttering mating flight similar to that of the seaside sparrow except that it is low, 3 to 5 feet above the ground for 50 to 100 feet; upon alighting on a twig or saw palmetto it bursts into song." Female grasshopper sparrows "may answer the song with a trill of her own. Then the male responds by singing the sustained song or by flying to her. Even at times, the male pursues the female and sings the sustained song as he gives chase" (Smith 1968).

Florida grasshopper sparrows begin nest-building activities approximately 4 weeks after the onset of territorial singing (Vickery 1996). Nests are located on the ground in shallow (<3.2 cm) excavations in the sand substrate (Delany and Linda 1998a, 1998b). The nest rims are level or slightly above the ground. The nests are dome-shaped, and constructed of narrow-leaved grasses and grass-like monocots, such as wiregrass (*Aristida beyrichina)*, bluestems (*Andropogon* sp.), and yellow-eyed grass (*Xyris* spp.). Delany and Linda (1998a) describe the nest characteristics. The nest outer diameter averages 10.3 cm, the inside diameter averages 6.9 cm, and the height averages 7.7 cm. The mean orifice width is 5.1 cm. These authors also found that nest opening directions are randomly oriented. Nests are typically shielded by dwarf shrubs, (*i.e.* saw palmetto (*Serenoa repens*) and dwarf live oak (*Quercus minima*), rather than grass clumps as reported for other subspecies.

As stated previously, the Florida grasshopper sparrow has been documented to be reproductively successful in pastures that are overgrown and ungrazed (Vickery *et al*., University of Massachusetts, personal communication, 1998). Once a pasture becomes heavily grazed, sparrow populations greatly decrease or disappear (Delany and Linda 1994). Low stocking rates and short duration grazing may be compatible with sparrow nesting requirements; however measures of reproductive success are needed to assess habitat quality (Delany and Linda 1998b).

Female grasshopper sparrows have been observed to leave their nests by running a distance away from the nest and then taking flight (Smith 1963). When the female returns, she does not directly approach the nest, but lands away from the nest and runs along paths back to it (Smith 1963).

Egg-laying may begin as early as late March and breeding activities may extend into September (McNair 1986, Vickery and Shriver 1995). Most nests contain three to five eggs with a mean of 3.71 (Delany 1996a, McNair 1986, Smith 1968). Perkins *et al.* (1998) found mean clutch sizes of 3.29 (n=7) at Avon Park AFR and 3.00 (n=2) at Three Lakes WMA. The eggs are white, smooth, slightly glossy, and lightly speckled and spotted with reddish-brown markings, and measure 1.8 to 1.4 cm (Sprunt 1954). These markings are generally sharp and well-defined, either scattered over the entire egg or concentrated toward the large end. The eggs of grasshopper sparrows are more delicate than those of savannah sparrows (*Passerculus sandwichensis*) or song sparrows *(Melospiza melodia*) (Smith 1968).

Female grasshopper sparrows incubate their eggs for 11 to 12 days (Nicholson 1936). Perkins *et al.*(1998) reported it takes an average of 13.5 days between the fledging of a successful nest and the first egg of a new attempt. T. Dean (University of Massachusetts, personal communication 1997a) found that if a nest is destroyed, the female may make a new one within 10 to 12 days. The chicks are altricial and are brooded by the female for 6 to 8 days (Delany 1996a), up to 9 days (Vickery 1996, Perkins *et al*. 1998). When young hatch, both male and female become more defensive to human and other intrusions (Smith 1963). In Florida, fledglings are known to aggregate in loose flocks with no parental care 3 to 4 weeks post fledging (Vickery 1996). Nonparental attendants have been reported for *A. s. pratensis* (Kaspari and O'Leary 1988); but complete information on their function or the extent of cooperative breeding is not available.

Results of a 3 year banding study indicate an annual survival rate of 0.598 and mean life expectancy of 1.95 years for male birds equal to or greater than 1 year old (n= 48) (Delany *et al.* 1993). There is no information on the survival and life expectancy of females and juvenile birds. Unfortunately this species has low nesting success rates. Perkins *et al*. (1998) found that the overall success rate for the 1996 breeding season was 0.11 at Avon Park AFR and 0.33 at Three Lakes WMA. Annual productivity ranged between 1.38 and 1.73 at Avon Park AFR and between 4.34 and 5.43 at Three Lakes WMA (Perkins *et al.* 1998). The major factor in this low success rate is loss of eggs or nestling from predation, primarily attributable to snakes and mammals (Vickery 1996; Perkins *et al*. 1998).

Territoriality

Average territory sizes are larger for *A. s. floridanus* than those of *A. s. pratensis*, and are well-defined (Kendeigh 1941, Smith 1963, Wiens 1973, Whitmore 1979). Mean territory size for Florida grasshopper sparrows on Avon Park AFR is 1.8 ha with a maximum home range size of 4.82 ha (Delany *et al.* 1995). The territory size of unmated and mated males is not significantly different. As the interval between fire events increases, sparrow home ranges become larger (Delany *et al*. 1992).

Males vigorously defend the boundaries of their territories from the time territories are established through incubation (Delany *et al*. 1995). After the young hatch, territory defense is less rigorous (Smith 1968).

Foraging

Florida grasshopper sparrows forage on the ground or just above it. An examination of the contents of 10 stomachs of Florida grasshopper sparrows from the Kissimmee Prairie found 69 percent "animal matter" (insects and spiders) and 31 percent vegetation (Howell 1932). Insects identified included grasshoppers, crickets, beetles, weevils, moths and their larvae, with a few flies and bugs. Sedge seeds, as well as some star grass (*Hypoxis* spp.) seeds composed most of the vegetation found in the diet (FWS 1988). Grasshopper sparrows may switch to a seed-dominated diet during the non-nesting season (T. Dean, University of Massachusetts, personal communication 1997b).

Movements

Although the Florida grasshopper sparrow is non-migratory, little is known about its localized movements. Movements among populations have not been documented, and the degree of connectivity between them is unknown. Male grasshopper sparrows have been recaptured outside of the breeding season near their breeding season territories (Delany *et al*. 1995, Delany 1996a). On Avon Park AFR, 21 of the 25 resighted males were located on the same territories in consecutive years. Three observed movements were 183m, 336m, and 570 m (Delany *et al.* 1995). The longest movement observed in that study was a 2.0 km movement by a male from his natal territory to a breeding territory. In a more recent study on post-breeding movements and winter ecology using radio-telemetry, T. Dean, (University of Massachusetts, personal communication 1996b) documented several long distance movements (greater than 3 km), though these movements varied on a individual basis. Vickery *et al*., did not observe any movements between any of the six known sites for this species, with over 300 birds banded between 1995 and 1998. A study by Geisel and colleagues in 1998 examined the genetic variability of Florida grasshopper sparrows from blood tissue sampled from the six known populations. Genetic distances were minimal, suggesting that these populations are closely related and either have not been separated for long or are connected by gene flow (M. Delaney, GFC, personal communication 1998).

Relationship to Other Species

Many other sparrow and non-sparrow species are present in dry prairies in the winter, including Bachman's sparrows, Henslow's sparrows, and savannah sparrows (*Passerculus sandwichensis*). However, no information is available on habitat partitioning or competition between these species and the Florida grasshopper sparrow, although grasshopper sparrows in other areas have been displaced from singing posts by meadowlarks (*Sturnella magna*) and bobolinks (*Dolichonyx orizivorus*) (Dean and Vickery 1996, Vickery 1996).

Predator interactions are important to most passerine species, and the Florida grasshopper sparrow is no exception. Although predators of Florida grasshopper sparrows have not been studied in detail, they have been observed for other subspecies. Predators known to take eggs or nestlings include the striped skunk (*Mephitis mephitis*), spotted skunk (*Spilogale putorius*), raccoon (*Procyon lotor*), longtailed weasel (*Mustela frenata*), foxes, cats (*Felis* spp.),

feral hogs (*Sus scrofa*), snakes, and possibly armadillos (*Dasypus novemcinctus*) (Vickery 1996). Predators of adult birds include various hawk species as well as loggerhead shrikes (*Lanius ludovicianus*). Since grasshopper sparrows spend the majority of their time on the ground, adults and young birds are, most likely, captured on the ground (Vickery 1996). Studies on Avon Park AFR and Three Lakes WMA have recorded several predation events for radio-instrumented adult grasshopper sparrows. Although not identified to species level, the predators have been identified as mammals, snakes, and birds (Perkins *et al.* 1998, T. Dean, University of Massachusetts, personal communication 1996c, 1997c). As with many other federally-listed endangered species in Florida, the relationship between the Florida grasshopper sparrow and man has been significant. Changes in land use will continue to be a significant factor in the survival and recovery of this species. Conversion of native prairies to row crops and citrus, removal of the subshrub components of the communities, replacement of native bunch grasses with exotic sod-forming grasses, and suppression of a natural fire regime have made much of the historically available habitat unsuitable for *A. s. floridanus*.

Status and Trends

Early records on Florida grasshopper sparrow abundance and distribution are scarce; however, it is believed that the sparrow was more numerous and widespread than it is today (Delany 1996b). Howell's (1932) observations of *A. s. floridanus* suggest that sparrow population numbers were greater during the early 1930s. Colony size at that time appears to have ranged between 3 to 19 pairs although precise survey data for the early 20th century are not available (Howell 1932, Smith 1968, McNair 1986). Apparently, sparrow numbers were never constant or predictable. Nicholson (1936) noted that "grasshopper sparrows do not occupy all apparently suitable habitats, and the species fluctuates considerably in abundance from year to year."

Between 1927 and 1945, many sightings of grasshopper sparrows were recorded for Kenansville in Osceola County, Basinger and a location south of Fort Drum in Okeechobee County, and a site south of Lake Hicpochee and an area southeast of Immokalee in Hendry County. There appears to be a gap in Florida grasshopper sparrow records between 1945 and the early 1960s. Records for the 1960s include a site north of Okeechobee in Okeechobee County, and a site south of Brighton in Glades County. In the early 1970s, records note a site west of Lake Okeechobee with no county specified and a site southwest of Kenansville (FWS 1988).

Before the GFC began conducting surveys for the Florida grasshopper sparrow in the 1980s, the historic sightings identified above gave little insight to the degree of abundance of the species (Delany and Cox 1985, Stevenson and Anderson 1994). The GFC surveys of the early and mid-1980s focused on historically occupied as well as potential breeding sites. The surveys located 182 individuals on nine sites in Glades, Highlands, Okeechobee, Osceola, and Polk counties (Delany *et al*. 1985, Delany and Cox 1985). Cattle grazing on improved pastures (one animal per eight ha) occurred on almost all grasshopper sparrow sites (Delany and Cox 1985). Abandonment on some

pasture sites is probably a response to changes in land management toward improved pastures (Delany and Linda 1994).

The results of GFC's surveys led to the Federal listing of the sparrow as endangered on July 31, 1986. The reason for listing was identified as population decline resulting from habitat degradation and loss from pasture improvement (51 FR 27495).

Singing male surveys performed between 1989 and 1993 resulted in a minimum population estimate of 424 adults at seven breeding sites (Delany 1996b). Sparrows were found at three former locations, but were not located at six locations from the previous survey (Delany and Linda 1994). All six abandoned sites were pasture that had been improved for cattle grazing or sod production. The three occupied sites, some of which had been managed to support cattle grazing, had been burned at 2 to 3 year intervals; the fires may have preserved the suitability of these habitats.

The most recent estimates of Florida grasshopper sparrow numbers indicate that there are fewer than 800 individuals as of the 1997 breeding season; approximately 200 at Avon Park AFR, 150 to 200 at Three Lakes WMA, and at least 200 on Kissimmee Prairie State Preserve (Vickery *et al.* University of Massachusetts, personal communication, 1998).

The Florida grasshopper sparrow is currently protected on four large tracts of land; three are publicly owned, and one is privately owned. Much of the additional suitable habitat for this subspecies is found on a few large, private ranches. The protected sites include: Avon Park AFR (Highlands and Polk counties), Three Lakes WMA (Osceola County), Kissimmee Prairie State Preserve (Okeechobee County), and the National Audubon Society's Ordway-Whittell Kissimmee Prairie Sanctuary (Figure 2). These four sites contain the largest and best-known subpopulations of this bird.

As a general matter, endemic habitat specialists with restricted, limited ranges are sensitive to many environmental factors, including hydrological changes and degradation or loss of habitat. The Florida grasshopper sparrow is one of these habitat specialists, and is threatened by many of these environmental factors. Changes in hydrological management regimes that render nesting areas too wet during the nesting season may affect this species' ability to reproduce. Overgrazing may eliminate plant species necessary for foraging and reproduction as well as limit the amount of available cover to conceal nests. Inappropriate fire management practices can lead to overgrown breeding areas or sites with woody plant invasion.

The greatest threat to the Florida grasshopper sparrow is habitat loss and degradation associated with the conversion of prairies to improved pasture and agriculture (Delany and Cox 1985, Delany and Linda 1994). An examination of Florida wildlife habitat trends from 1936 to 1987 documented this loss. In 1936, 17 percent of the land area in Florida was identified as agricultural and rangelands (nearly 2.5 million ha); by 1987 agriculture and rangelands had grown to represent 30 percent of the land area in Florida (over 4 million ha). Rangeland alone accounted for 2.57 million ha (63 percent) of the identified agricultural land in 1987 (Kautz 1993). Shriver (1996) provides a detailed account of remaining Florida grasshopper sparrow habitat.

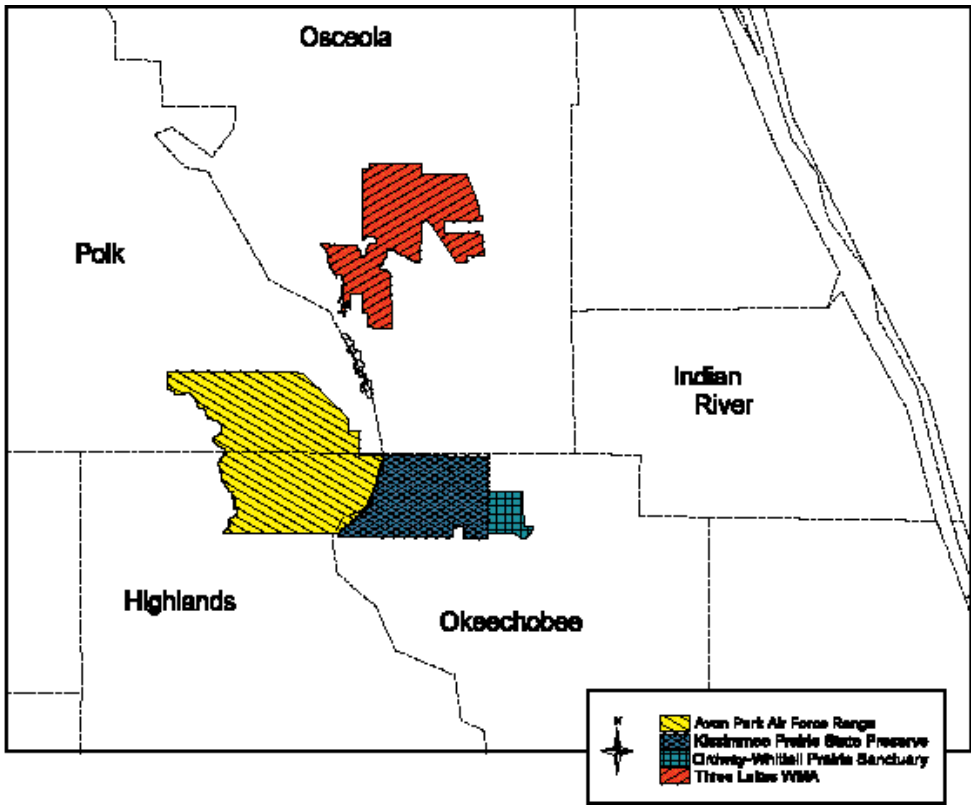


Figure 2. Protected sites for Florida grasshopper sparrows.

Some alterations in the vegetative structure and composition within occupied habitat may be tolerated by this species, particularly when the management allows native vegetation to persist (Delany and Cox 1985). However, when agricultural management becomes intensive, the sparrow's ability to survive and reproduce is compromised as a result of the loss of plant species necessary for successful foraging and nesting (Nicholson 1936, Delany *et al.* 1985, Delany 1996b).

In addition, overgrazing may destroy suitable habitat. Grazing at levels at or below one animal per eight ha has not been documented as detrimental to the grasshopper sparrow (Delany and Cox 1985, Delany 1996b), but more research is needed on the potential effects of grazing on sparrow fitness. If fire management programs mimic natural fire frequencies, grazing is not necessary to maintain vegetation in a suitable state for grasshopper sparrow use.

Unfavorable hydrological conditions may also threaten this species. Too much water in prairie areas may prevent nesting and, if improper hydrological conditions continue for extended periods, alter the vegetative composition of the site. During several breeding seasons in the early to mid-1990s, the Ordway-Whittell Kissimmee Prairie Sanctuary and Three Lakes WMA were too wet throughout the nesting season to allow successful reproduction. Improper hydrological management on adjacent properties was identified as the cause of the inundation. The high water levels not only resulted in reproductive failure, but also may have resulted in a severe population decline from a range of 11 to 16 territories in 1993 to 1996, to 7 in 1997, to 2 in 1998.

At least one nest has been documented to have failed due to flood in 1997 at Avon Park AFR (Vickery *et al*. University of Massachusetts, personal communication 1998). In addition to the detrimental effects of long-term inundation on reproductive efforts and vegetative composition, seasonal flooding during the breeding season may be another source of nest failure (Vickery 1996).

Other threats to grasshopper sparrows include predation on nests, young, and adults, and possibly nest parasitism by the brown-headed cowbird (*Molothrus ater*). This species parasitizes grasshopper sparrow nests where the two species are sympatric, though parasitism rates are relatively low (Smith 1968). Although the brown-headed cowbird does not breed within the Florida grasshopper sparrow's range, the shiny cowbird (*M. bonariensis*) has colonized this area since 1990 (Vickery 1996). The extent to which this nest parasite will threaten the Florida grasshopper sparrow has not been determined.

Management

Frequent fire is necessary to maintain an open vegetative community and to prohibit the invasion of pines and hardwoods into dry prairie habitat. Florida grasshopper sparrow densities decline two or more years following a burn event (Delany and Cox 1986, Vickery and Shriver 1995). Prior to European settlement, dry prairies were maintained by lightning-induced fires. These fires occurred primarily during the summer growing season between June and August. Since European settlement, however, the primary fire regime in dry prairies has been human-induced winter fires used by ranchers to improve pasture lands (Vickery and Shriver 1995).

All the protected sites have had similar land use in the past 20 years. Avon Park AFR, Ordway-Whittell Kissimmee Prairie Sanctuary, and Three Lakes WMA have been used for cattle grazing and managed using frequent prescribed winter burns (Vickery and Shriver 1993). The Kissimmee Prairie State Preserve has undergone similar management practices as those employed at the other three sites. Of the four sites, only Avon Park AFR and the Kissimmee Prairie State Preserve continue to have cattle grazing. Avon Park AFR, Kissimmee Prairie Sanctuary, Kissimmee Prairie State Preserve, and Three Lakes WMA have been incorporating summer burns into their grasshopper sparrow management program. Summer burns, as opposed to winter burns, may benefit the sparrow by increasing the length of the breeding season, (Vickery and Shriver 1995) and increasing sparrow breeding densities and possibly reproductive success (Shriver *et al.* 1996). There are also vegetative changes associated with summer fires versus winter fires. The major change is that wiregrass only flowers in the summer after a summer fire, which in turn may allow greater winter forage (Vickery *et al*., University of Massachusetts, personal communication 1998).

At Ordway-Whittell Kissimmee Prairie Sanctuary, experiments with summer burns (late June to early July) on a 3 year cycle are being conducted. There are plans to continue burning on this schedule for 3 more years. Increases in the breeding season length and sparrow breeding densities were observed when summer burns were employed. Sparrows re-established

territories within one week of a summer burn at these sites and they continued breeding activities into September (Shriver *et al.* 1996). In unburned areas, however, breeding activity stopped by late July. It is unknown, at this time, whether reproductive success differs between summer-burned and winter-burned areas.

The 42,943 ha Avon Park AFR contains approximately 3,035 ha of suitable Florida grasshopper sparrow habitat distributed in two main areas. Management in the past and present has focused on accommodating low density grazing leases. Staff at Avon Park AFR are currently investigating different management strategies designed to benefit grasshopper sparrows. The first summer burn of the area was completed in 1996 and additional summer burns are planned. Research at the AFR has been directed towards testing summer burns, investigating the sparrow's winter ecology through radio telemetry, and analyzing the genetic structure of this isolated subspecies.

Three Lakes WMA encompasses 24,282 ha, 2,347 ha of which are suitable for the Florida grasshopper sparrow. Another 1,600 ha may be suitable for grasshopper sparrows, but is not currently occupied. Historically, small units were burned in the winter. Since the early 1990s, larger units have been burned in the fall and winter. Summer burns were initiated in 1995; area managers are developing a fire management regime that will call for prescribed fire on a 2 to 3 year rotation (T. Dean, University of Massachusetts, personal communication 1997a).

The Kissimmee Prairie State Preserve is an important parcel of Florida grasshopper sparrow habitat in that it is the largest block of dry prairie (~9,289 ha) in public ownership, and it provides a corridor between other protected sites. Initial surveys indicate that there are at least 100 territories based on 136 point counts (Vickery *et al*., University of Massachusetts, personal communication 1998). These point counts only occupy one-half to two-thirds of the available prairie there, so it is likely there are approximately 200 territories at this site alone, but more work is needed to determine population size at this time. The site has been, and will continue to be, managed for grazing until DEP develops a fire management plan.

In addition to fire, roller chopping may be used to alter the vegetative composition and structure within prairie habitats. Rollerchopping in winter may initially produce the fastest reduction of shrub cover and increased herbaceous growth (Fitzgerald *et al.* 1995). However, the remaining biomass is greater after rollerchopping than after a burn. It is important to note that rollerchopping cannot fully replace the function of fire since wiregrass is dependant on summer fires to complete its reproductive cycle. Allowing wiregrass to bloom results in greater seed production, which may increase winter forage for the Florida grasshopper sparrow. In addition, rollerchopping disturbs the soil which enhances conditions for exotic invasion.

Hydrological management is also important to maintain productive Florida grasshopper sparrow habitat. The Florida grasshopper sparrow cannot successfully nest if water levels are too high. Two of the three protected grasshopper sparrow sites have hydrological issues that have precluded or reduced reproductive efforts and success. Water levels at Ordway-Whittell

Kissimmee Prairie Sanctuary and Three Lakes WMA have been too high since 1995. These hydrological management problems have resulted in flooded nesting areas during the breeding season; as a result, there was essentially no reproduction at Ordway-Whittell Kissimmee Prairie Sanctuary during the 1995, 1996 and 1997 breeding seasons. A hydrological study has been initiated to determine the management regime necessary to restore natural hydrology to this area. Hydrological restoration should alleviate one of the threats to the grasshopper sparrow at this site.

Similar hydrological problems are present at Three Lakes WMA. To address these issues, the COE has developed a settlement agreement with the adjacent landowners. This settlement agreement is a first attempt to ensure that grasshopper sparrow breeding areas are dry enough to allow successful reproduction in the nesting season. Should the first actions taken to alleviate the high-water problem prove inadequate, the COE will look at other mechanisms to rectify the situation.

Although the protected sites discussed above are attempting to optimize management of the prairies under their control, much native prairie habitat still remains on private lands. The cooperation of private landowners in maintaining these native vegetative communities will be an important component in the recovery of this subspecies. Private landowners have an opportunity to improve their pasture land management, while also benefitting the sparrow. Opportunities exist through exotic plant removal, more natural burn regimes, and the maintenance of native plant species necessary for nesting. The development of an incentives program for ranchers who use land management practices that maintain a portion of their properties in functional grasshopper sparrow habitat would constitute an additional recovery opportunity, and should be initiated.

The use of grazing to enhance prairie habitat needs more investigation, particularly where there may be plans to initiate a landowner incentive program for cattle grazing on native range. It is evident from the literature that sparrow populations greatly decrease or disappear when a pasture is heavily grazed (Delany and Linda 1994). Likewise, successful grasshopper sparrow reproduction has been documented in pastures that are overgrown and ungrazed, as in pasture habitat at Kissimmee Prairie State Preserve (Vickery *et al*. 1998).

In order to effect recovery, habitat suitable for grasshopper sparrows on private land should be delineated and prioritized for acquisition or easement. The most appropriate fire and hydrological regimes need to be developed and implemented on public lands with suitable grasshopper sparrow habitat, and incentives for private landowners to restore or maintain prairie habitat need to be developed. A combination of land acquisition, private landowner incentives, and restoration appears to be the means available and necessary for Florida grasshopper sparrow recovery.

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Recovery for the Florida Grasshopper Sparrow

Ammodramus savannarum floridanus

Recovery Objective: RECLASSIFY to threatened.

Recovery Criteria

This objective will be achieved when any further loss, fragmentation, and degradation of habitat within the Kissimmee River basin has been prevented; when at least 10 protected and managed sites contain stable, self-sustaining populations of 50 to 100 breeding pairs of Florida grasshopper sparrows within the historic range of the species; and when Florida grasshopper sparrows on each of these sites exhibit a rate of increase (r) equal-to or greater than 0.0, sustained as a 2-year running average over at least 6 years.

This recovery objective is an interim goal because of the limited data on the biology, ecology, and management needs of this species. It may be possible to reclassify the Florida grasshopper sparrow if there is sufficient, restorable habitat that can be recolonized by additional populations; however, the feasibility of such restoration and recolonization is still uncertain. This recovery objective will be reassessed annually based on new research, management, and monitoring information. These criteria will be refined if new information identifies new ways of re-establishing populations of this species or expanding its current range.

Species-level Recovery Actions

S1. Determine the distribution and abundance of the Florida grasshopper sparrow. Additional surveys should be undertaken to more accurately determine current distribution and abundance of the Florida grasshopper sparrow. The locations of remaining dry prairie habitat at Avon Park AFR, Three Lakes WMA, and the Ordway-Whittell Kissimmee Prairie Sanctuary are provided in Shriver (1996). In addition to these maps, LANDSAT data could be used to locate potential habitat on private lands which may contain grasshopper sparrows.

S2. Protect and enhance existing populations of Florida grasshopper sparrows.

S2.1. Encourage natural colonization of restored habitats by Florida grasshopper sparrows. Many areas within the historic range of the Florida grasshopper sparrow are being restored as part of the COE and SFWMD Kissimmee River restoration. Other areas are being restored because of a change in land use in the Kissimmee River valley (such as the expansion of the Three Lakes WMA). There are also efforts underway to connect the Ordway-Whittell Kissimmee Prairie Sanctuary with Kissimmee Prairie SP. Dispersal of the Florida grasshopper sparrow into restored areas from occupied sites should be encouraged by establishing corridors. Corridors may be established by selectively removing pines or other tree species and applying

prescribed fire, The removal of pine plantations at Avon Park AFR should be completed to increase prairie size and connectivity between the disjunct populations there.

S2.2. Develop and implement a plan to re-introduce Florida grasshopper sparrows into suitable habitats in the Kissimmee River Valley. Many areas once supported grasshopper sparrows in the past, but are not currently occupied. Some of these areas still have suitable habitat for the sparrows, while others will need restoration. The survival and recovery of the Florida grasshopper sparrow will depend on re-establishing Florida grasshopper sparrow populations in these areas. The second recovery priority is establishing a specific plan to re-introduce and re-establish Florida grasshopper sparrows into areas that currently support suitable habitat. This plan must identify the specific areas that are suitable for such re-introductions, protocols for determining when habitat is suitable for a reintroduction, the size of a reintroduced population, monitoring protocols for re-introduced populations, and land management prescriptions for re-introduction areas.

S2.3. Develop a captive propagation plan for the Florida grasshopper sparrow following DOI guidelines, and implement as warranted. An estimated 600 adult Florida grasshopper sparrows (1996 census) exist in the wild. In the event of further declines in the size or distribution of the Florida grasshopper sparrow, a captive population may provide the difference between survival and extinction for this species. The captive propagation plan should identify specific demographic thresholds that would trigger the establishment of captive populations, facilities that could support a captive propagation program, protocols for selecting and capturing individuals for a captive population, reintroduction protocols, and criteria that clearly state when the captive propagation program could be ended.

S3. Conduct research to determine the basic biological needs of The Florida grasshopper sparrow. Although considerable research has been done on the biology and ecology of the Florida grasshopper sparrow, more information is necessary before the Florida grasshopper sparrow can be properly managed and effects of habitat management actions assessed.

S3.1. Develop information on the Florida grasshopper sparrow's basic biology, including genetic and ecological studies. Biological studies should be continued to expand scientific knowledge of the demographics of Florida grasshopper sparrow populations (survivorship, fecundity, mortality, dispersal) and the relationship of these demographic variables to habitat availability and quality under various management regimes. Continue studies to assess effects of grazing on reproductive success.

S3.2 Continue winter ecology studies. The winter ecology and life history needs of the Florida grasshopper sparrow may be a limiting factor to the recovery of the species. Winter ecology investigations should continue in order to determine if management actions need to be revised in order to maximize survival of wintering birds.

S3.3. Develop a reserve design for Florida grasshopper sparrows using landscape maps, GIS, and spatially-explicit population models. Population viability analyses can be determined from existing demographic data, and can be combined with landscape-coverage GIS data to develop spatially-explicit models. Using these tools, the reserve design will identify large, contiguous areas of prairie habitat necessary for the survival and recovery of Florida grasshopper sparrows in South Florida.

S4. Continue efforts to monitor the status and trends of Florida grasshopper sparrow populations.

S4.1. Develop consistent survey/census protocols and assure continuation and consistency of ongoing monitoring protocols. Evaluate existing monitoring techniques to determine which are best able to identify small changes in Florida grasshopper sparrow populations. Surveys for Florida grasshopper sparrows should be consistent on all sites. At a minimum, population surveys should provide a minimum population estimate plus a relative measure of abundance.

S4.2. Monitor Florida grasshopper sparrow populations on public lands to evaluate management actions. Establish monitoring programs for the Florida grasshopper sparrow on the Avon Park AFR, Kissimmee Prairie SP, and Three Lakes WMA to determine if fire management, water management, and other management actions are consistent with the recovery needs of the sparrow.

S4.3. Monitor the success of reintroduced Florida grasshopper sparrow populations. To determine whether recovery efforts are proving successful, it will be necessary to conduct periodic censuses and surveys of all introduced populations.

S5. Increase public awareness of the biology, ecology, status and trends of the Florida grasshopper sparrow. The public must be made more aware of the status and trends of the Florida grasshopper sparrow, its recovery needs, and opportunities for the public to participate in the sparrow's recovery. This public awareness program must include an effort to contact owners of lands that support populations of Florida grasshopper sparrows; it must also include development and distribution of educational materials developed specifically to inform the public about the Florida grasshopper sparrow.

S6. Assess reclassification criteria based on the results of research projects; revise as necessary.

Habitat-level Recovery Actions

H1. Protect and enhance currently occupied habitat. Alteration and habitat loss are primary threats to prairie species. As much of the remaining prairie habitat as possible must be secured. State and COE efforts to restore the Kissimmee River floodplain might provide useful habitat for prairie dependent species. Habitat must be maintained in an early stage of succession through selective thinning and prescribed burning.

H1.1. Protect and enhance Florida grasshopper sparrow habitat on public and private land. Florida grasshopper sparrows currently occur on the Avon Park AFR, Kissimmee Prairie SP, and Three Lakes WMA; additional populations occur on adjacent private lands. These populations are critical to the survival and recovery of the sparrow. These lands are being managed to support populations of the Florida grasshopper sparrow; these management efforts must continue.

H1.1.1. Maintain and enhance habitat on acquired lands or lands under conservation easements or agreements. Conduct prescribed burns, selective thinning, or mechanical manipulation at periodic intervals to maintain dry prairie and pasture habitat and prevent forest encroachment. Intensive rangeland improvements should be discouraged in prairie areas to maintain as many native plant species as possible.

H1.1.2. Encourage purchase. State, county, and local governments and private organizations can purchase lands. The FWS can consider purchase of land to protect endangered or threatened species through its Land Acquisition Planning System.

H1.1.3. Discourage changes in the present level of cattle grazing where conducive to grasshopper sparrows. On most private lands, cattle grazing is at the level of one animal per ha. This level of grazing does not seem to be detrimental to prairie species, but it should not be increased until further studies have been conducted. Current land management practices appear to, at a minimum, sustain grasshopper sparrows. Provide additional incentives for private landowners to enhance habitat for Florida grasshopper sparrows.

H1.2. Protect and enhance habitat on public lands. Prairie habitat present on public lands should be protected and enhanced for prairie dependent species. Sites that are occupied by these prairie species include Avon Park AFR in Polk and Highlands counties, the Florida Game and Fresh Water Fish Commission's Three Lakes WMA in Osceola County, the Kissimmee Prairie SP property in Okeechobee County, and the National Audubon Society's Kissimmee Prairie Sanctuary in Okeechobee County. Federal land management agencies should try to protect, maintain, and enhance prairie habitat on all lands they manage. Since caracara nesting is minimal on Avon Park AFR and this site is essential for the survival of the Florida grasshopper sparrow, grazing should not be increased in this area, and prairie management should focus on the grasshopper sparrow. Other public lands should use the recommendations obtained from habitat component research on the caracara to determine which management actions are compatible with the survival of both species.

H1.2.1. Continue prescribed burns at periodic intervals. Occupied areas should be burned in a mosaic fashion on a periodic rotational basis (generally every 1.5 to 3 years) to maintain early stages of succession. The burn interval may vary depending on site, vegetation, fuel loads, hydrology, *etc.* and may extend from 1 to 4 years at certain locations.

H1.2.2. Maintain pastures in native vegetation to the extent possible. Prairie species may be adversely affected if pasture lands are improved to the point where native vegetation is removed. Pastures will not be suitable for grasshopper sparrows if they are heavily grazed or managed heavily for grazing.

H1.2.3. Do not allow reforestation of prairies. Prairie species prefer areas devoid of trees. Grasshopper sparrows, especially, cannot breed in forested areas. However, scattered live-oak/ cabbage palm hammocks are valuable components of prairie systems. Although these hammocks are not used by grasshopper sparrows, they are compatible with sparrow management and should not be removed.

H1.2.4. Establish appropriate burn seasonality. Fire management should be performed in all seasons, although the majority of prescribed burns to benefit grasshopper sparrows should be done during the season of occurrence of most natural lightning fires: from late spring to early summer.

H1.2.5. Avoid construction of fences or other structures in grasshopper sparrow habitat. Fencing or other vertical structures may be used as perches by grasshopper sparrow predators and should be avoided in areas important to the sparrow.

H1.2.6. Avoid land management and maintenance activities during the nesting season. Management/maintenance activities such as mowing, rollerchopping, fertilizing, and use of heavy equipment that may affect grasshopper sparrows or native flora should be avoided during the nesting season (15 March to 15 September).

H1.3. Conduct section 7 consultations on all Federal activities that might affect grasshopper sparrows and their habitat. The Air Force and the Department of the Interior will consult with the FWS on any activities (authorized, funded, or carried out) that might adversely affect prairie species on land they control in Florida. Such activities include: pesticide use, road building, construction of new facilities, training exercises, clearing for new runways, *etc.*

H2. Create, restore, or expand habitat wherever possible. Habitat loss has occurred throughout the range of prairie species, and has been the primary factor threatening the survival of these animals.

H2.1. Continue to identify areas of suitable unoccupied habitat or potential habitat. Shriver (1996) provides maps of suitable dry prairie habitat on three of the sites where Florida grasshopper sparrows occur. Continue these efforts using LANDSAT imagery and GIS to locate areas of suitable or suboptimal habitat on private lands. Ground-truth these areas to determine suitablity for sparrows, and determine the feasibility of improving the selected sites for sparrow occupation.

H2.2. Improve selected areas as needed. Restore available sites to suitable conditions through fire management and removal of woody plants.

H2.3. Expand habitat in currently occupied areas, and restore habitat in currently unoccupied areas. Continue the removal of pine plantations at Avon Park AFR to increase prairie size and connectivity between the disjunct populations there. Continue efforts to connect Kissimmee Prairie SP with the Ordway-Whittell Kissimmee Prairie Sanctuary. Wherever possible, enhance prairie habitat in the vicinity of occupied habitat, through prescribed burning, chopping, and woody vegetation removal to enhance areas to attract grasshopper sparrows.

H3. Continue research on grasshopper sparrow/habitat interactions. Research should continue to determine how habitat correlates to grasshopper sparrow abundance, and how changes in habitat use relate to fire and plant succession. Information is especially needed on non-breeding ecology and habitat use, as well as on territory shifts as they relate to habitat quality. Information is also needed to determine whether grazing has an effect on sparrow fitness. These studies can be done on any of the protected populations where cattle grazing is occurring on sparrow habitat during any time of the year. Information obtained through these studies will indicate the best management practices for areas important to both breeding and post-breeding survival. This will relate directly to land management activities at occupied sites.