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Species Profile: Henslow's Sparrow (*Ammodramus henslowii*) on Military Installations in the Southeastern United States

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Improving Mission Readiness through
Environmental Research

Species Profile: Henslow's Sparrow¹

(*Ammodramus henslowii*)



Taxonomy

Class	Aves
Order	Passeriformes
Family	Emberizidae
Genus/species	<i>Ammodramus henslowii</i>
Other Common Names	None known

Description

The Henslow's sparrow has a short tail, large pale-gray bill, and flat olive-green head (Peterson 1980, National Geographic Society 1983, Stokes and Stokes 1996). The central crown stripe is yellowish and bordered by two black stripes. Other head markings include a broad, pale-olive eye stripe, black line behind the eye, and two black lines along the sides of the throat. The wings are reddish brown; the rump and uppertail

¹ This report was designed primarily for use on military installations in the southeastern United States. However, because most studies of the Henslow's sparrow have been conducted on the species breeding grounds in the northeastern and midwestern States, life history and habitat information are provided for these regions as well.

coverts are bright rust and streaked with black. The back feathers are black centrally with wide chestnut borders and narrow white margins, which produce a boldly streaked appearance (Roberts 1949). The upper breast has dark streaks that extend along the sides through the flanks.

The adult Henslow's sparrow is 12.1 to 13.3 cm (4.75 to 5.25 in.) in length, and the average weight is 13.0 g (0.5 oz) (Roberts 1949). The closed wing is 4.9 to 5.6 cm (1.9 to 2.2 in.) long, and the tail length is 4.8 to 5.2 cm (1.9 to 2.0 in.). The outer tail feathers on each side are nearly 1.2 cm (0.5 in.) shorter than the middle feathers.

The juvenile plumage is paler and yellower than the adult plumage, with less streaking below (National Geographic Society 1983). The head and back are streaked with black, and the feathers have rounded central spots; the chin and throat are buffy (Roberts 1949).

Shy and secretive, the Henslow's sparrow is often detected only by its song—a very short, hiccupping “tsi-lick” (Peterson 1980). It spends most of its time concealed in the grass and dense vegetation of its habitat (Graber 1968). This sparrow seldom flies when disturbed but rather skulks or runs through the undercover (Smith 1968). When flushed, it flies low and jerkily, with a twisting motion of its tail (Peterson 1980).

Similar Species

The adult Henslow's sparrow can be distinguished from other species of sparrows by the characteristic olive-colored head in conjunction with the reddish wings (Peterson 1980). However, the juveniles of the grasshopper (*Ammodramus savannarum*) and Henslow's sparrows may be difficult to identify, as each resembles the adult of the opposite species. Because it has almost no streaking on the breast, the juvenile Henslow's sparrow resembles the adult grasshopper sparrow. The juvenile grasshopper sparrow has breast streaks, thus resembling the adult Henslow's sparrow, but its wings lack the Henslow's olive and russet tones.

Status

Legal designation

Federal. The Henslow's sparrow was a candidate species (C2) for listing as either threatened or endangered by the U.S. Fish and Wildlife Service (USFWS). However, the USFWS discontinued the designation of C2 species as candidates for listing (50 CFR 17), published 28 February 1996. The Henslow's sparrow is considered to be a species of concern, but more biological research and field study are needed to resolve its conservation status.

State. The Henslow's sparrow is listed as endangered in Illinois, Iowa, Massachusetts, New Hampshire, New Jersey, and Vermont (USFWS 1996). It is listed as threatened in Indiana, Maryland, and Virginia and is considered of special concern in Michigan, Minnesota, Wisconsin, Kentucky, Pennsylvania, New York, and Connecticut (officially extirpated). Listings as endangered in Minnesota and as threatened in Wisconsin and New York were pending at the time of the publication. Henslow's sparrow has been accorded no status in other midwestern States nor in those within its wintering range.

Distribution and numbers

The Henslow's sparrow is endemic to the United States but has different breeding and wintering ranges (American Ornithologists' Union 1983). This species breeds locally in the eastern and midwestern United States and southern Canada and winters in the mid-Atlantic and Gulf Coast States (Peterson 1980, National Geographic Society 1983, Stokes and Stokes 1996, USFWS 1996) (Figure 1). Its breeding range extends from New England (where it is now extirpated in most areas) and southern Ontario westward through the Great Lakes region and north-central States to eastern South Dakota, Kansas,

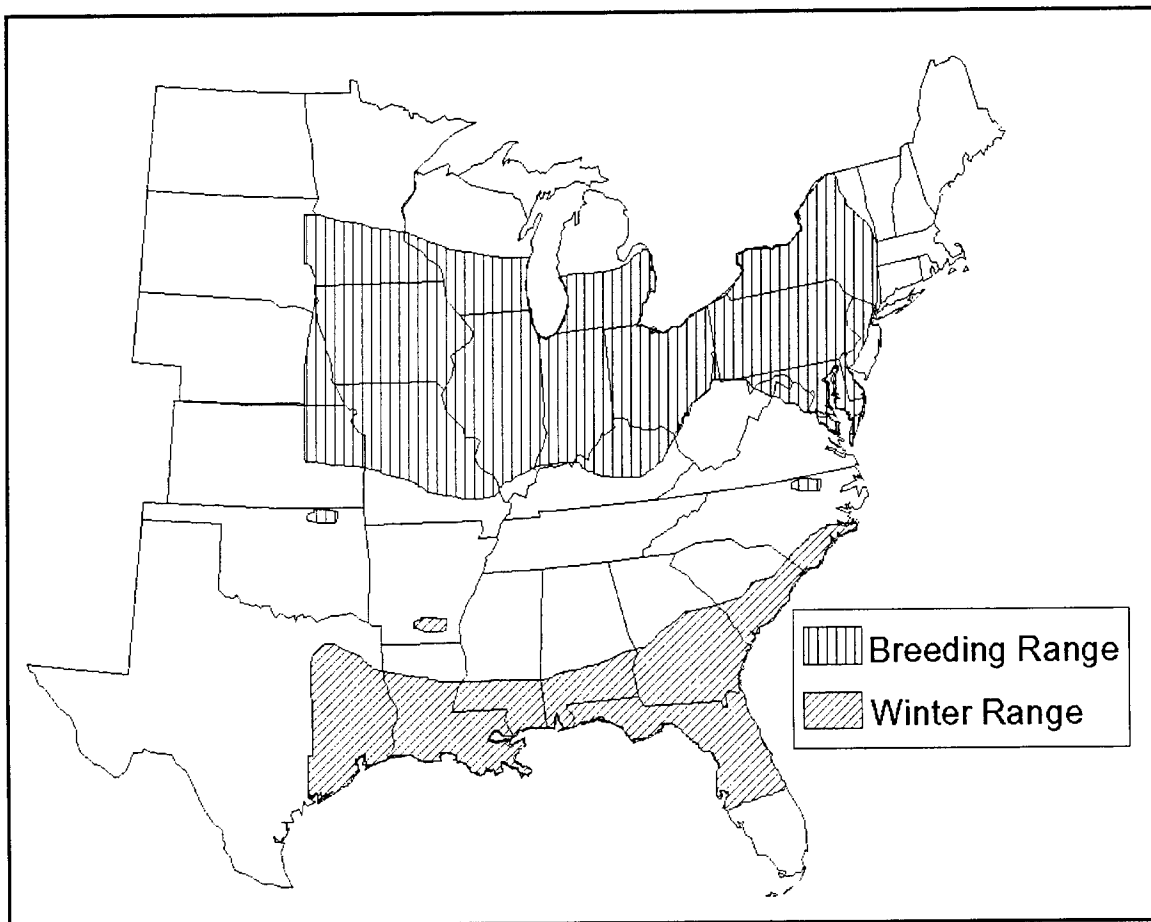


Figure 1. Breeding and wintering ranges of the Henslow's sparrow (American Ornithologists' Union 1983, USFWS 1996)

and Oklahoma. It reaches southward from Ontario to northern North Carolina and into northern and central Kentucky. Breeding populations in the southeastern States are rare and local, in addition to being erratic from year to year (Hamel 1992).

The nonbreeding (winter) range of the Henslow's sparrow extends from southern North Carolina to central Florida and west through Georgia, southern Alabama, and southern Mississippi into Louisiana and eastern Texas (Peterson 1980, National Geographic Society 1993, Stokes and Stokes 1996, USFWS 1996). Henslow's sparrows may be found casually north to Illinois, Indiana, New England, and Nova Scotia (Smith 1992). Winter populations are most common along the Texas coast, in the Florida panhandle, and around Cocoa Beach, Florida (Root 1988). This species tends to be very secretive during the nonbreeding season, and accurate determinations of population size are difficult to obtain from winter surveys (Hamel 1992). However, data from banding studies indicated that Henslow's sparrows may be much more abundant on wintering grounds than has been ascertained by surveys alone (Chandler and Woodrey 1995).

The Henslow's sparrow has declined significantly across its range. Although it is most abundant in Minnesota and the western portions of the Great Lakes plains, this species can no longer be considered common anywhere (Smith 1992). Data from Breeding Bird Surveys indicate a large decline in the central portion of the breeding range (USFWS 1987) and in the northeastern United States (National Wildlife Federation (NWF) 1997).

Military installations

Table 1 represents the known status of the Henslow's sparrow on military installations in the southeastern United States. Only wintering Henslow's sparrows are found on these installations; however, breeding populations are nesting on installations in the northeastern and midwestern States. Fort Drum, New York, has an estimated 40 breeding pairs (Steve Joule, Personal Communication, 1998), and Godman Air Field at Fort Knox, Kentucky, has about 20 nesting pairs (Brainard Palmer-Ball, Personal Communication, 1998). Jefferson Proving Ground, Indiana, provides habitat for approximately 750 breeding pairs, which is one of the largest remaining Henslow's sparrow populations (Lori Pruitt, Personal Communication, 1998). Several thousands of breeding Henslow's sparrows were estimated from surveys on Fort Riley, Kansas (Jeff Keating, Personal Communication, 1998).

Life History and Ecology

Territories

Henslow's sparrows nest on territories within loose colonies, but territorial boundaries are not always rigidly defended (Terres 1991). Territories are usually contiguous (Hyde 1939, Wiens 1969, Johnsgard 1979) but may be separated by buffer zones with no breeding sparrows (Robins 1971a). In southwestern Michigan, Robins (1971a) found

Table 1 Status of Henslow's Sparrows on Military Installations in the Southeastern United States		
State	Installation	Status on Installation
GA	Fort Stewart	Documented onsite: wintering individuals have been observed on the installation (Tim Beatty, Personal Communication, 1996).
NC	Marine Corps Base (MCB) Camp Lejeune	Potential: Henslow's sparrows are known to winter sporadically in coastal North Carolina. There is a previous breeding season record for newly acquired property adjacent to MCB Camp Lejeune (Greater Sandy Run Area) during June 1986 (LeBlonde et al. 1994).
FL	Avon Park Air Force Range	Documented onsite; small wintering population (five individuals have been banded onsite) (Ann-Marie Holmes, Personal Communication, 1997).
	Tyndall Air Force Base	Potential (Stephen Shea, Personal Communication, 1996).
LA	Fort Polk	Documented onsite; large wintering population on the installation, many of which have been color leg-banded (Kenneth Moore, Personal Communication, 1997).

that 58 percent of suitable habitat was unoccupied at the height of the breeding season. The average size of a territory is 0.3 ha (0.8 acre) in southwestern Michigan (Robins 1971a) and 0.6 ha (1.5 acres) near Madison, WI (Wiens 1969). Average territory size is smallest and the population density is highest in areas with the tallest and densest vegetation (Robins 1971a). Territory size tends to increase throughout the summer (Robins 1971a, Johnsgard 1979).

Prior to the nestling period, males spend much time in territorial defense, often near the periphery of the territory (Robins 1971b). Rival males defend territories through formal "songfests" rather than by physical encounter (Hyde 1939, Robins 1971a). Singing begins at dawn and may continue throughout the night (Graber 1968). However, singing tends to be somewhat variable in the evening. Sutton (1928) reported singing peaks at sunrise and early evening, but Hyde (1939) found that singing lessened toward evening.

Males are in song upon arrival at the breeding grounds, and their singing increases in vigor and frequency during the courtship period (Graber 1968). However, they spend little time singing during the nestling period when foraging is of prime importance (Robins 1971b). A period of less intensive singing occurs in late July and early August but is terminated at the beginning of the postnuptial molt (Graber 1968). Hyde (1939) found that the average interval between songs during singing periods increased from 4.19 sec on June 17 to 8.7 sec on August 9.

Little is known about site fidelity, but several authors have commented that local populations tend to be unstable (Hyde 1939, Wiens 1969, Robins 1971a). However,

Henslow's sparrows have bred consistently in some undisturbed, protected areas, such as Hayden Prairie in Iowa (Ennis 1959) and Goose Lake Prairie in Illinois (Birkenholz 1983).

Reproduction and development

The Henslow's sparrow is essentially a ground nester that raises one or two broods per breeding season (Stokes and Stokes 1996). Robins (1971a) reported that three broods are sometimes produced. Clutches usually consist of three to five eggs that are creamy or light green with dark marks or blotches (Stokes and Stokes 1996) and measure approximately 18.3×14.4 mm (0.7×0.6 in.) (Graber 1968). The first clutches are usually completed by May 30 in the central part of the species range (Hyde 1939, Graber 1968). Second nests are begun in July and August with some second nests extending into September (Robins 1971a). Only the female incubates the eggs and broods the young. The incubation period is about 11 days, and the young stay in the nest 9 to 10 days after hatching (Stokes and Stokes 1996).

Of the 11 nests found in a southern Michigan smooth brome (*Bromis inermis*) hayfield, six (54.5 percent) produced at least one young (Robins 1971a). Only 1 (9.1 percent) of the 11 nests successfully raised all of the young. Seventeen young were produced from a total of 46 eggs, indicating a success rate of 37.0 percent.

Food habits

Foraging behavior. About 50 percent of foraging trips by both sexes are made to areas outside the territories defended by males (Robins 1971b). Females forage closer to the nest and in different areas from the males, which enhances survival of the young, since females do the majority of feeding and all of the brooding. Robins (1971b) found the mean distance that males foraged from the nest was 31.1 m (34 yd), whereas the mean distance that females foraged was 24.7 m (27 yd).

Adult diet. Henslow's sparrows forage on the ground, mostly in grassy areas where the vegetation is 10 to 15 cm (4 to 6 in.) tall (Wiens 1969). In southern Michigan, Hyde (1939) found that adult summer diet consisted of 82-percent animal matter and 18-percent plant material. Orthopterans (crickets, grasshoppers, and katydids) composed 36 percent of the diet; beetles made up about 19 percent; vegetation (especially seeds of grasses, forbs, and sedges) contributed 18 percent; and spiders, butterfly larvae, and bees completed the diet.

Nestling diet. Hyde (1939) found that 80 percent of the nestling diet in a Michigan study consisted of orthopterans and lepidopteran larvae. In another Michigan study (Robins 1971b), the larvae of lepidopterans and scarab beetles were the most commonly fed foods, being given to young on 44 percent of the feeding trips made by adults. Other important dietary components included orthopterans (17 percent), leafhoppers (5 percent), and assassin bugs (5 percent). Larvae and small insects, including leafhoppers and assassin bugs, were the major items fed to nestlings during the first 2 days, whereas orthopterans were important the 3 days prior to fledging. The wings of moths, hind legs of

grasshoppers and crickets, and forelegs of mantids were removed before feeding to nestlings. Smooth brome florets were also fed when available.

The average feeding rate increases with nestling age (Robins 1971b). During the second half of the nestling period, nestlings in nests with only two young are fed more often than those in nests with several young. Females do most of the feeding during the first half of the nestling period and about half of the feeding during the last days.

Predation

Potential predators of Henslow's sparrows include mammals, snakes, and birds of prey. A thirteen-lined ground squirrel (*Citellus tridecemlineatus*) was observed picking up a young sparrow from its nest in southern Michigan (Robins 1971a). Hyde (1939) evicted a blue racer (*Coluber constrictor*) from a nest in Michigan. The remains of Henslow's sparrows have been found in the stomachs of northern harriers (*Circus cyaneus*) and sharp-shinned hawks (*Accipiter striatus*) (Hyde 1939, Graber 1968). Striped skunks (*Mephitis mephitis*), spotted skunks (*Spilogale putorius*), weasels (*Mustela* spp.), and raccoons (*Procyon lotor*) may also prey on nests. There have been very few reports of Henslow's sparrow nests being parasitized by the brown-headed cowbird (*Molothrus ater*) (Hyde 1939, Robins 1971a).

Habitat Requirements

The Henslow's sparrow winters on the coastal plain from eastern Texas to Florida in longleaf pine (*Pinus palustris*) forests, where open-canopy pine flatwoods, stretches of pine savanna and prairies, and mixed pine-hardwoods provide suitable wintering habitats (Hamel 1992). The ecology and habitat requirements of the Henslow's sparrow in the southeastern United States are poorly known, as most research has been directed toward breeding ecology and habitat. Therefore, this section will deal only with nesting habitat requirements.

Nesting habitat

The size of available blocks of habitat is a major factor in habitat selection by the Henslow's sparrow, which is typically restricted to large grassland tracts in the Midwest (Herkert 1994b) and Northeast (Peterson 1983, Smith 1992). Samson (1980) estimated that 10 to 100 ha (25 to 250 acres) represented the minimum amount of contiguous grassland habitat required to maintain a viable breeding population of Henslow's sparrows. Herkert (1994c) reported that the average size of a grassland tract occupied by Henslow's sparrows in Illinois was 421 ha (1,040 acres); the species was usually not found on grassland fragments of less than 100 ha (250 acres) and was not encountered on tracts <10 ha (25 acres). Although Henslow's sparrows defended territories of only 0.3 to 1.1 ha (0.7 to 2.7 acres) in Wisconsin (Wiens 1969) and 0.1 to 1.0 ha (0.25 to 2.3 acres) in Michigan (Robins 1971a), they only occupied grassland tracts >40 ha (100 acres). Henslow's

sparrows did not nest in pastures smaller than 30 ha (74 acres) in New York (Smith and Smith 1992).

Tall, dense, grassy vegetation is characteristic of habitat used by the Henslow's sparrow in the Northeast (Smith 1992). Typical habitat includes open fields and meadows covered by grass that is interspersed with forbs or shrubby vegetation, particularly in damp or low areas. Henslow's sparrows have been reported in wet meadows dominated by sedges, rushes, and grasses, in fields of seedling pines, and in the drier upland portions of salt marshes (Craig 1979). Nesting sparrows have also been found in moist upland meadows (Kibbe and Laughlin 1983), small swales, fields of thick timothy (*Phleum* spp.) and clover (*Trifolium* spp.) (Forbush 1929), and unmowed hayfields (Smith 1992). In central and western New York, Henslow's sparrows moved into fields that had succeeded from legume-dominated to grass-dominated communities during repeated hay cropping (Bollinger 1995).

In the Midwest and Great Plains regions, Henslow's sparrows historically bred in tall-grass prairie interspersed with forbs and occasional shrubs. This species still nests in native and restored tallgrass prairie (Robins 1971b, Zimmerman 1988, Sample 1989, Herkert 1994b). It also uses other habitats, such as idle grasslands, pastures and meadows with scattered shrubby vegetation, and hayfields with dense cover, usually in damp or low-lying areas (Whitney et al. 1978, Johnsgard 1979, American Ornithologists' Union 1983). In Ohio, Henslow's sparrows most often nest in fields overgrown with grasses, forbs, small trees, and shrubs, but it may also nest on reclaimed surface mines, grassy hayfields, and hillside grasslands dominated by broom sedge (*Andropogon virginicus*) (Peterjohn 1989). In southwestern Michigan, Robins (1971a) studied Henslow's sparrows nesting in a smooth brome - alfalfa (*Medicago sativa*) - red clover (*Trifolium pratense*) hayfield, which had an intermediate moisture range, a continuous cover of grasses and sedges about 0.8 m (2.5 ft) tall, occasional shrubs less than 0.9 m (3 ft) high, and accumulated litter. A nest in Hennepin County, Minnesota, was on top of a knoll where 80 percent of the vegetation was composed of common timothy (*Phleum pratense*) and a few shrubs, both approximately 0.5 m (1.6 ft) tall (Fall and Eliason 1982).

Skinner (1975) compared the occurrence of Henslow's sparrows in seven grassland types in Missouri and concluded that a direct relationship existed between vegetation height and sparrow numbers. Henslow's sparrows were not found in vegetation <10 cm (3.9 in.) tall, while 65 percent of those counted were in grassland vegetation >20 cm (7.8 in.). The direct relationship between sparrow numbers and vegetation height is not entirely supported by data from this study, as only 14 percent of the sparrows were found in the tallest vegetation, which was 45.7 cm (18 in.) in height. However, it indicated that vegetation heights between 10 and 50 cm (3.9 and 20 in.) are characteristic of grassland habitats selected by Henslow's sparrows.

Wiens (1969) compared the vegetation structure at Henslow's sparrow nests with the vegetation in unoccupied areas in Fitchburg, WI. Occupied areas had significantly lower forb density but greater forb height than the unoccupied areas. Forb height averaged 27 cm (10.6 in.) in the occupied area and 19 cm (7.5 in.) in the unoccupied area. In

occupied areas, the vertical vegetation density was also higher and the litter was deeper and covered a higher percentage of the soil surface. The average depth of litter in occupied areas was 4.3 cm (1.7 in.), and soil coverage was 93 percent.

The presence of deep litter and abundant standing dead vegetation from the previous year is characteristic of habitat preferred by the Henslow's sparrow (Wiens 1969, Samson 1980, Clawson 1991, Herkert 1991, Reinking and Hendricks 1993). Sparrows forage in the litter for seeds and insects and use the dead forbs and grasses as singing perches (NWF 1997). In Kansas (Zimmerman 1988) and Missouri (Clawson 1991), territories contained taller grasses and a greater amount of standing dead vegetation than was found outside territories. Herkert (1994b) found similar habitat conditions in Illinois, where occupied areas had a significantly taller mean herbaceous canopy, denser vegetation, and a higher proportion of standing dead plant material than did unoccupied areas. Occupied areas had an average grass height of 28 cm (11 in.) and a mean herbaceous canopy height of 47 cm (18.5 in.).

Henslow's sparrow nesting habitat is characterized by little or no woody vegetation (Wiens 1969, Robins 1971a, Baskett et al. 1980, Falls and Eliason 1982, Peterson 1983, Sample 1989). Some occupied territories contain no woody species (Wiens 1969, Peterson 1983), while others have a few scattered woody stems <1 m (3.3 ft) tall (Peterson 1983, Sample 1989) or <2.5 cm (2 in.) diameter at breast height (Clawson 1991) and provide <2 percent cover (Sample 1989). Baskett et al. (1980) described optimal Henslow's sparrow habitat as having less than three shade-producing trees or shrub clumps per 50 m² (538 ft²).

Nests

Nests are either domed or cup-shaped and may be located on the ground or attached to grasses or forbs within 50 cm (19.7 in.) of the ground (Hyde 1939, Robins 1971a, Flanigan 1975). Hyde (1939) described a typical domed nest in southern Michigan as one that is located at the base of a clump of grass with dead grass from the clump forming an arched roof over the nest; a single entrance is placed at an oblique angle on the side of the nest. Occasionally, a nest is in a depression of the ground (Johnsgard 1979), but most nests are at least 2 cm (0.8 in.) above the ground.

The nest is loosely woven with dead grasses and lined with finer grasses and hair (Johnsgard 1979). In a southwestern Michigan hayfield, Robins (1971a) found that nests were constructed of an outer layer of large, smooth brome leaves and an interior lining of small, fine bluegrass (*Poa compressa* and *P. pratensis*) leaves; green vegetation was not a nest component. Since the grasses are loosely woven, the nest can expand as the nestlings grow. The female does most or all of the nest building, which requires 5 to 6 days (Johnsgard 1979). A new nest is constructed at each nesting attempt (Robins 1971a).

Habitat Assessment

Ideally, existing or potential nesting areas should be assessed annually to determine habitat suitability for the Henslow's sparrow. Characteristics of vegetation structure to be measured include percent total cover, density and height of woody and herbaceous vegetation (including standing dead plant material), plant species composition, and litter depth. The size of a potential nesting area should be estimated. This can be achieved by pacing the perimeter of smaller sites (Bollinger 1995) or by measurement of large tracts from aerial photographs. Sampling should be conducted in the spring when birds would be using nesting habitat; Herkert (1994c) sampled Illinois grasslands from 10 to 25 May.

Point sampling along line transects is the most effective method for sampling herbaceous vegetation and litter depth. There are numerous variations of this technique. Herkert (1994c) used it to sample vegetation at 40 randomly located sites within each bird census transect. He passed a 0.6-cm (0.25-in.) diameter metal rod vertically through the vegetation and counted the number of contacts by different vegetation types (live grasses, live forbs, and dead plant material) in successive 25-cm (10-in.) intervals of height. Zimmerman (1988) also used point sampling to assess the vegetation in Henslow's sparrow habitat in Kansas. Vegetation was sampled randomly and within known territories with a somewhat more complex sampling scheme than that used by Herkert (1994c). Descriptions of other point sampling methods are provided in Mitchell and Hughes (1995).

Although specific parameters of wintering habitat have not been determined, longleaf pine savannahs in the southern Atlantic and Gulf coastal plains should be assessed to determine the wintering potential for Henslow's sparrows. Sampling should be done in midwinter when the sparrows would most likely be using the habitat. Vegetation attributes can be measured by using the same techniques given above for sampling nesting habitat. Forest inventory methods should also be applied to determine characteristics such as tree density, height, and basal area, all of which may affect the quality and quantity of savannah grasses and shrubs.

Inventory and Monitoring

Ideally, existing and potential habitats should be censused every year. At least one breeding bird census should be conducted to collect baseline information, and known populations should be monitored for breeding activity in subsequent years. The best time to census Henslow's sparrows is at the height of the spring breeding season during the peak morning singing period (30 min to 1 hr before and after sunrise) (Hyde 1939, Robins 1971a). Herkert (1994b) conducted several censuses between mid-May and late June. However, additional censusing later in the season (late July and early August) will provide more complete population data (Robins 1971a).

Various methods have been used to census Henslow's sparrows. Zimmerman (1988) and Robins (1971a) mapped territories using locations of the singing males. Robins

(1971a) marked off the study area into a grid by placing stakes at 30.5-m (100-ft) intervals. During each census, singing locations were marked on maps that reproduced the grid, including its vegetational features. Singing locations were connected by straight lines to form polygons, which represented individual territories.

Herkert (1994b) collected census data from strip transects (after Conner and Dickson 1980) in grasslands of Illinois. The transects were 300 m (984 ft) long by 150 m (492 ft) wide and were dispersed to provide representative samples of the available habitat within grassland fragments. The distance between transects eliminated the possibility of counting the same bird on two different transects. The locations of all singing males were recorded, and bird census transects were classified as occupied or unoccupied.

Known occurrences of Henslow's sparrows need to be censused regularly to monitor the stability of the population. Nesting success data such as clutch size, number of young produced, and causes of nest failure may be collected. Occurrences of Henslow's sparrows are tracked by the Natural Heritage programs in Georgia, Louisiana, and Virginia.

Impacts and Causes of Decline

Henslow's sparrow populations have declined by approximately 70 percent in the United States over the last 30 years (Herkert 1994c), and the Henslow's sparrow is now on the National Audubon Society's Blue List of Species of Concern (Arbib 1979). In the Midwest (Iowa, Illinois, Missouri, Indiana), populations have declined precipitously in the past 25 years. The Illinois Natural History Survey censused grassland bird populations in northern and central Illinois in 1957-58 and 1978-79 (Illinois Natural History Survey 1983). During this 20-year span, 65 to 75 percent of grassland habitat disappeared, and the density of Henslow's sparrow populations decreased from 2.2 birds per 100 ha (0.90 birds per 100 acres) in 1958 to 0.54 birds per 100 ha (0.22 birds per 100 acres) in 1979 (Drilling 1985). The Survey estimated that populations of Henslow's sparrows in Illinois had declined by 94 percent between 1958 and 1978 (Illinois Natural History Survey 1983).

In the east-central portion of its range (New York, Pennsylvania, Ohio), the species is locally common (Bull 1976, USFWS 1996) but is declining in the more urbanized areas (Bull 1974). Forbush (1929) listed the Henslow's sparrow as a "rare to common local resident" in Massachusetts in the early part of this century. However, only three occurrences were documented in 1974, followed by one record in 1983 (Komar 1983) and documentation of one breeding pair in 1994 (USFWS 1996). Henslow's sparrows were rare, yet reliably found, in New England in the early 20th century but have almost disappeared; only one breeding colony was known in 1983 (Kibbe and Laughlin 1983).

Habitat loss

Loss of breeding habitat, both primary and secondary, is the most likely factor causing population declines in the Henslow's sparrow throughout its range, especially in the

midwestern United States (USFWS 1987, Hands et al. 1989, Smith 1992). Tallgrass prairie was the Henslow's sparrow's primary breeding habitat before pioneer settlement of the Midwest. In Iowa the loss of native grasslands to agriculture and, consequently, the loss of native birds were noted early in this century by Tinker (1914) and DuMont (1931). Major changes have been brought about by agricultural development, urbanization, and grassland abandonment with subsequent conversion to shrubland and forest (Bowles et al. 1981, Smith 1992, Herkert 1994b). A conversion in agricultural practices from hay production and grazing to intensive production of specialized crops, such as corn and soybeans, has made a significant contribution to habitat loss throughout the midwestern States (Illinois Natural History Survey 1983; Drilling 1985, Herkert et al. 1996). In the eastern part of Henslow's sparrow range, increased urbanization, encroachment of woody species, and reduction of land into small plots are causing the loss of large amounts of suitable breeding habitat (Drilling 1985). Decline of secondary habitat, such as hayfields and pastures, has also contributed to loss of nesting habitat for the Henslow's sparrow (Herkert 1991). For example, in Illinois secondary habitat has been reduced by more than 75 percent since 1906.

Fragmentation of habitat into small, scattered parcels is a serious result of habitat loss, especially in the midwestern States. For example, of the original 8.5 million ha (21 million acres) of native prairie in Illinois, only a few tracts totaling about 1,000 ha (2,500 acres) now remain (Iverson 1988). The Henslow's sparrow requires at least 10 ha (25 acres) for breeding habitat (Samson 1980) but prefers areas of at least 30 ha (74 acres) in the eastern United States (Smith and Smith 1992) and 100 ha (250 acres) in the Midwest (Herkert 1994c). The effects of normal population fluctuations are more drastic on smaller habitat segments, and it is more difficult for populations to recover.

Few studies have dealt with wintering habitat of the Henslow's sparrow, but the loss of wintering grounds may be a key factor in the population decline of this species. Suitable winter grassland habitat in the southeastern United States decreased substantially between 1950 and 1987 (Lynn 1991). Savannas associated with longleaf pine forests of the Southeast provide habitat for Henslow's sparrows, but a large percentage of these forests have been converted to industrial pine plantations and row crops. Additionally, more than 99 percent of the tallgrass prairie in Louisiana and Texas has been destroyed (NWF 1997). Research is needed to determine the importance of wintering habitat and the effects of its loss on Henslow's sparrow populations.

Other causes

Unmanaged regimes of grazing, mowing, and burning have probably contributed indirectly to the decline of this species by rendering habitat unsuitable for nesting sparrows. Skinner (1975) found few Henslow's sparrows on grazed areas with vegetation shorter than 20.3 cm (8.0 in.), and Smith (1963) noted that Henslow's sparrows abandoned hayfields that were mowed in mid-to-late June. Although burning can be beneficial in providing conditions necessary for producing the dense herbaceous vegetation required by nesting sparrows, it may prevent or delay nesting if burns are too frequent and suitable herbaceous cover does not have time to reestablish (Bowles 1981).

Management and Protection

Recovery

A recovery plan has not been developed for the Henslow's sparrow, as it is not a Federally listed species; but the application of current knowledge can provide protection for the reestablishment of populations. Land-use management in appropriate ecosystems should provide for adequate tracts of grassland, or similar habitat, suitable for nesting Henslow's sparrows (Herkert 1994c). However, protection alone is not sufficient for population recovery. Active management of grasslands is necessary to maintain nesting habitat for Henslow's sparrows and other grassland species (Smith and Smith 1992, Herkert 1994a). Without management, upland grasslands will be invaded and replaced by woody vegetation that will eventually exclude Henslow's sparrows from suitable breeding habitat.

Management of nesting habitat

Habitat suitability can be maintained by periodically setting back succession and producing dense herbaceous vegetation at least 30 cm (1 ft) tall with a few scattered trees and shrubs (Herkert 1994b). Three management practices currently used to prevent woody invasion are spring burning, mowing, and controlled grazing (Skinner et al. 1984; Zimmerman 1988; Smith and Smith 1992; Herkert 1994a,b). While these practices tend to reduce the amount of habitat available for Henslow's sparrows for one or two seasons, the habitat needs of other grassland species may be met during this time. A rotational system incorporating these methods can be used to maintain the grassland successional stage that is essential habitat for the Henslow's sparrow and other grassland species (Zimmerman 1988, Herkert 1994a, Swengel 1996). Herkert (1994c) suggested that management units be at least 20 to 30 ha (49 to 74 acres) in size. On large grassland tracts (>100 ha, 250 acres), 20 to 30 percent of the area should be burned or mowed each year on a rotational basis. Suggested use of these management techniques is provided below.

Burning. Prescribed burning can be a valuable tool for managing the Henslow's sparrow because it stimulates productivity of grasses and produces dense standing dead vegetation in subsequent years (Zimmerman 1988). This species prefers litter for foraging (Wiens 1969, Samson 1980, Clawson 1991, Herkert 1991, Reinking and Hendricks 1993), and burning affects litter depth. Burning should be managed on a scheduled rotation, as Henslow's sparrows avoid nesting in grasslands burned the previous spring (Baskett et al. 1980; Zimmerman 1988, 1992; Sample 1989; Verser 1990; Clawson 1991; Volkert 1992; Reinking and Hendricks 1993; Herkert 1994 a,b). However, sparrows may use recently burned grasslands for foraging and loafing areas by midsummer and throughout fall (Herkert 1994a). Research has shown that Henslow's sparrows will nest in grasslands the second summer following spring burning (Zimmerman 1988, Clawson 1991, Reinking and Hendricks 1993). Herkert (1994b) found that nesting densities were significantly reduced the second growing season postfire but returned to normal by the third growing season postfire. Herkert (1994a) also found Henslow's sparrow nests in small patches (1 ha, 2.5 acres) of unburned grassland surrounded by large areas (120 ha,

296 acres) of burned grassland. Herkert et al. (1996) recommended a midlength rotational burn program of 3 to 5 years for birds on midwestern grasslands, particularly Henslow's sparrows.

Mowing. Henslow's sparrows will nest in hayfields that are mowed annually (Hyde 1939, Illinois Natural History Survey 1983). However, timing of mowing is crucial in managing for this species. Birds may abandon hayfields mowed in early summer (Smith 1963) or have nests destroyed by haying operations in late summer (Kibbe and Laughlin 1983). Herkert (1994b) reported a significant reduction in nesting densities in Illinois when regular mowing occurred from January through April, and Sample (1989) found lower densities of Henslow's sparrows on mowed than unmowed areas in Wisconsin. However, Smith (1992) reported that Henslow's sparrows in New York nested in grasslands that were mowed annually after mid-August. Therefore, early fall mowing may be a viable alternative for maintaining suitable habitat for this species, as it permits sufficient vegetative regrowth prior to the subsequent nesting season whereas spring mowing does not.

Grazing. Because they require tall, dense herbaceous cover, Henslow's sparrows are typically associated with ungrazed or lightly grazed grasslands (Baskett et al. 1980, Peterson 1983, Zimmerman 1988, Hands et al. 1989, Verser 1990). Skinner (1975) provided no data on the intensity or frequency of grazing on his study area in Missouri, but >50 percent of Henslow's sparrows were found on grazed lands with vegetation 20.3 to 30.4 cm (8.0 to 12.0 in.) high; only a few birds were found on grazed areas with shorter vegetation heights. Moderate grazing of grasslands in Kansas resulted in only 20- to 40-percent vegetative cover that was at least 25 cm (10 in.) tall, thus rendering them unsuitable as Henslow's sparrow habitat for up to 1 year after the removal of cattle (Zimmerman 1988).

In addition to reducing vegetation height and density, grazing can also result in nest loss due to trampling (Paine et al. 1996). In Wisconsin, Paine et al. (1996) found that trampling destroyed an average of 73 percent of simulated pheasant nests in pastures with low-intensity rotation (nine head cattle/ha) commonly used in dairy farming. Using a grazing cycle with a short-duration grazing period and a relatively high stocking density can maximize the amount of time that pasture is left undisturbed between grazing events and causes no more nest destruction than longer grazing cycles using lower stocking densities. Some nest protection may be gained by introducing animals into the paddock at a greater vegetation height density and leaving a relatively large amount of residue post-grazing. Manipulation of vegetation status may increase nest survival at high stocking densities but will have a minimal effect at lower stocking densities.

To provide optimal nesting habitat for the Henslow's sparrow in Illinois, Herkert et al. (1993) recommended that grasslands not be grazed. However, Smith (1992), summarizing unpublished data, reported that Henslow's sparrows nested successfully in pastures grazed by cattle from mid-May to mid-October in Missouri and New York. Grass height averaged 20 to 30 cm (7.9 to 11.8 in.) in Missouri and 61 cm (24 in.) in New York. On

grazed lands, a rotational system is most desirable that provides a majority of areas being lightly to moderately grazed (Herkert et al. 1996).

Management of wintering habitat

Management for Henslow's sparrows should also include the protection and maintenance of grassland areas on wintering grounds (Herkert 1994c). However, the literature provides little guidance on the management of wintering habitat for this species. Historically, wintering populations of Henslow's sparrows were associated with the longleaf pine ecosystem. Rehabilitation and restoration of this ecosystem as part of red-cockaded woodpecker (*Picoides borealis*) management on military installations will probably benefit the Henslow's sparrow as well. Guidelines for managing red-cockaded woodpecker habitat are found in "Environmental Assessment of Army-Wide Management Guidelines for the Red-cockaded Woodpecker" (U.S. Army Construction Engineering Research Laboratories (USACERL) 1994).

Effective management techniques for both the red-cockaded woodpecker and Henslow's sparrow are those that open longleaf pine midstory, which will aid in establishing and maintaining herbaceous vegetation for both food and foraging cover (Conner and Dickson 1997). These techniques include (a) brush clearing and fuel removal within buffer areas surrounding cavity trees, (b) prescribed burning, (c) pine thinning and hardwood control, (d) erosion control, and (e) longleaf pine regeneration (USACERL 1994). Prescribed burning on a 3-year rotation will reduce the shrub and midstory woody vegetation and promote a well-established herbaceous layer. In areas that support wintering Henslow's sparrows, burning should be done during the growing season to avoid impacts to food supplies, and natural fire breaks should be used to minimize disturbance of the ground cover. Natural regeneration of longleaf pine stands and reduction of erosion will increase wintering habitat for Henslow's sparrows.

Research Needs

Research needs for Henslow's sparrow include (a) establishing the current species distribution; (b) developing a habitat suitability index model; (c) determining the effect of various intensities and timings of burning, mowing, and grazing on populations; (d) determining the effect of preserve size and habitat fragmentation on populations; (e) researching the degree of site and mate fidelity, mortality, and reproductive success rates; (f) determining winter habitat use and requirements; and (g) determining the status of appropriate habitats on wintering grounds in the southeastern United States.

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