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The Effects of Management Practices on Grassland Birds—Field Sparrow (*Spizella pusilla*)

Chapter BB of

The Effects of Management Practices on Grassland Birds

Professional Paper 1842–BB

U.S. Department of the Interior
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Cover. Field Sparrow. Photograph by Denis Gauthier, used with permission.
Background photograph: Northern mixed-grass prairie in North Dakota, by Rick Bohn, used with permission.

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By Jill A. Shaffer,[1] Lawrence D. Igl,[1] Douglas H. Johnson,[1] Marriah L. Sondreal,[1] Christopher M. Goldade,[1,2] Barry D. Parkin,[1] and Betty R. Euliss[1]

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The Effects of Management Practices on Grassland Birds

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Conversion Factors

International System of Units to U.S. customary units

Multiply	By	To obtain
	Length	
centimeter (cm)	0.3937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
	Area	
square meter (m^2)	0.0002471	acre
hectare (ha)	2.471	acre
square kilometer (km^2)	247.1	acre
square meter (m^2)	10.76	square foot (ft^2)
hectare (ha)	0.003861	square mile (mi^2)
square kilometer (km^2)	0.3861	square mile (mi^2)
square meter per hectare (m^2)	4.359	square foot (ft^2) per acre
	Mass	
kilogram (kg)	2.205	pound (lb)
	Density	
kilogram per hectare	0.892179	pound per acre

Abbreviations

2,4,5–T	2,4,5–Trichlorophenoxyacetic acid
AUM	animal unit month
BBS	Breeding Bird Survey
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
dbh	diameter at breast height
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
IESB	intensive early-season grazing followed by burning
n.d.	no date
PBG	patch-burn graze
ppm	part per million
sp.	species (an unspecified species within the genus)
spp.	species (applies to two or more species within the genus)
VOR	visual obstruction reading

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Capsule Statement

Keys to Field Sparrow (*Spizella pusilla*) management include providing shrub-dominated edge habitat adjacent to grasslands or grasslands with a shrub component (both of which must include dense grass and moderately high litter cover) and avoiding disturbances that eliminate woody vegetation. Field Sparrows have been reported to use habitats with 16–134 centimeters (cm) vegetation height, 20–145 cm visual obstruction reading (VOR), 17–90 percent grass cover, 2–45 percent forb cover, less than (<) 63 percent shrub cover, 3–7 percent bare ground, 14–30 percent litter cover, and 1–7 cm litter depth. The descriptions of key vegetation characteristics are provided in table BB1 (after the “References” section). Vernacular and scientific names of plants and animals follow the Integrated Taxonomic Information System (https://www.itis.gov).

Field Sparrow. Illustration by Christopher M. Goldade, U.S. Geological Survey.

Breeding Range

Field Sparrows breed from central Montana and Wyoming to eastern North Dakota, central Minnesota, northern Wisconsin and Michigan, southern Quebec, and Maine; and south through south-central Texas to northern Florida (National Geographic Society, 2011). The relative densities of Field Sparrows in the United States and southern Canada, based on North American Breeding Bird Survey (BBS) data, are shown in figure BB1.

Suitable Habitat

The Field Sparrow is a habitat generalist that inhabits woody edges and dry to slightly mesic, moderately tall-statured grasslands with moderately abundant litter and a shrub component (George, 1952; Ely, 1957; Stewart, 1975; Best, 1977, 1978, 2001; Johnsgard, 1980; Sousa, 1983; Dinsmore and others, 1984; Sample, 1989; Herkert, 1991a; Cunningham and Johnson, 2006, 2012, 2016; Kempema, 2007; Walk and others, 2010). Habitats with a low or moderate degree of woody vegetation are required by the species, as small trees and shrubs are used as song perches and often as nesting substrates (Johnston, 1947; Carey and others, 2020). Field Sparrows breed in a variety of grassland habitats, including shortgrass, mixed-grass, and tallgrass prairies that are idle, hayed, or grazed (Dinsmore and others, 1984; Zimmerman, 1993; Faanes and Lingle, 1995; Winter, 1998; Winter and Faaborg, 1999; Kempema, 2007; McLachlan, 2007; Doxon, 2009; Patten and others, 2011; Shahan and others, 2017; Igl and others, 2018; Sliwinski and others, 2019; Vold and others, 2019); dry sand prairies (Sample and Hoffman, 1989; Au and others, 2008); and semiarid grasslands and shrubsteppe habitats (Stewart, 1975; Hopkins, 1983; Bielfelt, 2013; Haun and others, 2024). Field Sparrows also breed in ecological transition areas between

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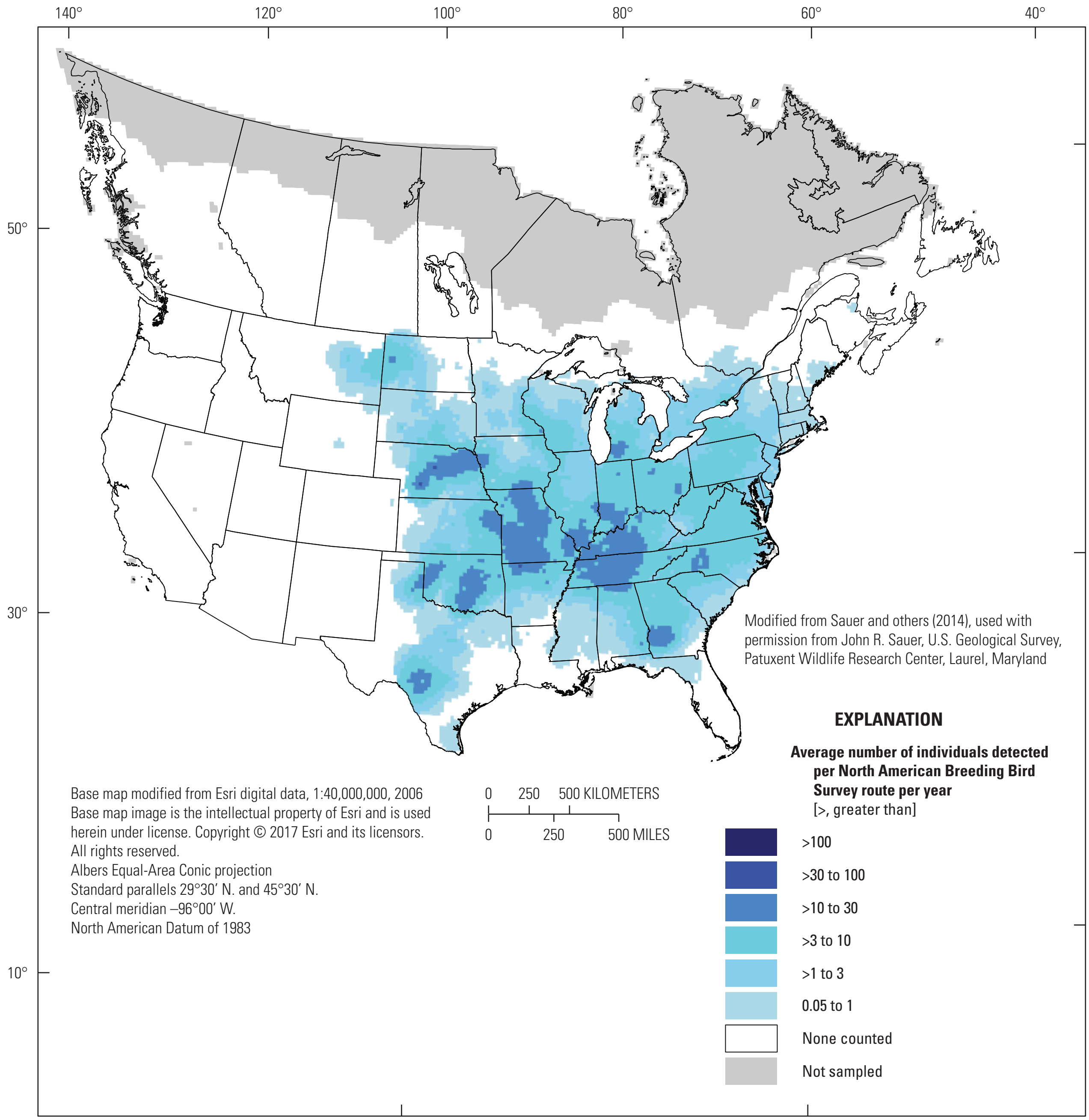

Figure BB1. The breeding distribution of the Field Sparrow (*Spizella pusilla*) in the United States and southern Canada, based on North American Breeding Bird Survey (BBS) data, 2008–12. The BBS abundance map provides only an approximation of breeding range edges.

grasslands and forested areas, including oak (*Quercus* species [spp.]) savannas, oak barrens, and sand shinnery oak (*Quercus havardii*) communities (Stewart, 1975; Davis and others, 2000; Cunningham and others, 2006; Grundel and Pavlovic, 2007a, 2007b; Vos and Ribic, 2011, 2013; Wood and others, 2011; Bar-Massada and others, 2012; Holoubek and Jensen, 2015; Vander Yacht and others, 2016; Davis and Miller, 2018); prairie parkland (Thompson and others, 2016; Taylor, 2018); sand mottes of honey mesquite (*Prosopis glandulosa*) (Lee, 2006; Bielfelt, 2013; Londe and others, 2021); pine (*Pinus* spp.) barrens (Mossman and others, 1991; Ryba, 2002); and grassland barrens currently and formerly used for blueberry (*Vaccinium* species [sp.]) production (Vickery and others, 1994). Field Sparrows occupy habitat edges, such as those between woodland and grasslands (George, 1952; Johnsgard, 1980; Dinsmore and others, 1984; Zimmerman, 1993); edges between agricultural fields and brushy grasslands (Graber and Graber, 1963; Dinsmore and others, 1984; Best, 2001); successional habitats, such as oldfields (that is, idle or neglected arable lands that have naturally reverted back to perennial cover) (Crooks, 1948; Ely, 1957; Graber and Graber, 1963; Walkinshaw, 1968; Kupsky, 1970; Davis and Savidge, 1971; Shugart and James, 1973; Evans, 1978; Johnsgard, 1980; Faanes, 1981; Lanyon, 1981; Kahl and others, 1985; Dechant, 1996); and powerline rights-of-way (Taylor, 2018).

The species inhabits woody habitats including hedgerows (Graber and Graber, 1963; de Zwaan and others, 2024), wooded draws (Stewart, 1975; Zimmerman, 1993), windbreaks (Cable and others, 1992), shrub thickets (Gabrielson, 1914), brushy fencerows (Walkinshaw, 1968), and river-channel islands (Faanes and Lingle, 1995). The species also nests in orchards (Graber and Graber, 1963), pine plantations (Fretwell, 1969; Faanes, 1981; Buech, 1982), gallery forests (Zimmerman, 1993), and upland and lowland forests (Sieg, 1991; Faanes and Lingle, 1995; Grundel and Pavlovic, 2007a; Drilling and others, 2016).

Planted cover, such as Waterfowl Production Areas (Thompson and others, 2016), Wildlife Production Areas (Hull, 2002), Wildlife Management Areas (Doxon, 2009), Conservation Reserve Program (CRP) grasslands (Best and others, 1997; Cox and others, 2014), Conservation Reserve Enhancement Program (CREP) grasslands (Wentworth and others, 2010; Wilson and Brittingham, 2012; Reiley and Benson, 2020), and other lands enrolled in cost-share conservation programs (Lituma and Buehler, 2020), provides breeding habitat. Pastures, hayfields, and reclaimed surface mines also provide breeding habitat (Crooks, 1948; Graber and Graber, 1963; Whitmore, 1980; Dechant, 1996; DeVault and others, 2002; Ingold, 2002; Galligan and others, 2006; Glass and Eichholz, 2023). Field Sparrows occasionally inhabit cultivated, untilled, or weedy agricultural fields (Dinsmore and others, 1984; Basore and others, 1986; Best and others, 1997; McGovern and others, 2024) and cropland margins (Best, 2001; Cox and others, 2014; Garfinkel and others, 2020), as well as grassed waterways, terraces, and prairie strips within cropland (Bryan and Best, 1991; Hultquist and Best, 2001; Schulte and others, 2016; Giese and others, 2024).

Vegetation Structure and Composition

Woody vegetation and heavy grass coverage are critical components of habitat suitability for Field Sparrows (Johnston, 1947; Kupsky, 1970; Lanyon, 1981; Sousa, 1983; Laubach, 1984; Herkert, 1991a). A Habitat Suitability Index Model developed by Sousa (1983) indicated that important features of breeding habitat for the Field Sparrow include percentage of shrub crown cover, percentage of total shrubs <1.5 meters (m) tall, percentage of grass canopy cover, and average height of herbaceous canopy. Optimal habitat was described as containing low-to-moderate shrub density with 50–75 percent of shrubs <1.5 m tall, 15–35 percent shrub cover, and areas larger than 2 hectares (ha) containing dense, moderately tall grass. Areas where most shrubs were <1.5 m in height lacked adequate numbers of perch sites, whereas areas where most shrubs were greater than (>) 1.5 m tall lacked adequate numbers of possible nest sites.

Woody Vegetation

Throughout the Great Plains, the Field Sparrow inhabits grasslands with a woody component. In North Dakota, Stewart (1975) described several woody and shrubby habitats inhabited by Field Sparrows, including silver sagebrush (*Artemisia cana*) flats (that is, mixed-grass prairie partially covered by an open canopy of low shrubs such as silver sage and plains pricklypear cactus [*Opuntia polyacantha*]); brushy draws occupied by Rocky Mountain juniper (*Juniperus scopulorum*), rubber rabbitbrush (*Ericameria nauseosa*), fragrant sumac (*Rhus aromatica*), and Saskatoon serviceberry (*Amelanchier alnifolia*); thickets of tall shrubs and small trees; and brushy, semiopen bur oak (*Quercus macrocarpa*) and green ash (*Fraxinus pennsylvanica*) woodlands on the slopes of badlands and buttes. In western North Dakota, Faanes (1983) found that Field Sparrows were attracted to wooded draws with a high shrub density. In South Dakota, Field Sparrows used a variety of habitats, including shrublands, openings in wooded areas, upland and lowland forests, second-growth forests, brushy pastures, and grasslands (Drilling and others, 2016). Within Badlands National Park in South Dakota, Sieg (1991) recorded Field Sparrows within Rocky Mountain juniper woodlands. Along the Platte River in Nebraska, Faanes and Lingle (1995) observed Field Sparrows most often in native grasslands invaded by Rocky Mountain juniper and containing an abundance of soapweed yucca (*Yucca glauca*). In wildlife management areas in southern Nebraska, Stuber and Fontaine (2018) estimated that the ideal proportions of grassland and woodland for Field Sparrows were 0.53 and 0.31, respectively.

Field Sparrows frequently occupy grasslands undergoing ecological succession containing young trees, such as eastern redcedar (*Juniperus virginiana*) and other species. Within southern mixed-grass prairies encroached by eastern redcedar in Oklahoma, Field Sparrow abundance was highest on study areas with redcedar coverage ranging from 13 to 26 percent (Chapman and others, 2004b). In the sand sagebrush (*Artemisia filifolia*) grasslands of northwestern Oklahoma, Field Sparrow abundance was positively related to coverage of live eastern redcedar and negatively related to dead redcedar coverage (Doxon, 2009). In southern mixed-grass prairies in central Kansas, Field Sparrow abundance increased with increasing canopy coverage of eastern redcedar (Schmidt, 2014). The categories of coverage were open grasslands (no eastern redcedar canopy cover), grasslands lightly encroached with eastern redcedar (<5 percent canopy cover), and grasslands moderately encroached with eastern redcedar (>5–25 percent canopy cover). In the Cimarron National Grassland in western Kansas, Field Sparrows were found only in areas encroached by dense stands of saltcedar (*Tamarix* sp.), and were absent from areas in which saltcedar was mostly eradicated and from open riparian woodlands dominated by eastern cottonwood (*Populus deltoides*) (Cable and others, 2015). In northern Texas, Field Sparrows occupied shrubland savanna pastures dominated by honey mesquite and lotebush

(*Ziziphus obtusifolia*) (Lee, 2006). In northwestern Arkansas, Field Sparrows were detected in high-to-moderate densities within fields in various seral stages of ecological succession (Shugart and James, 1973). Field Sparrow densities were highest in fields with an abundance of young trees and shrubs, such as common persimmon (*Diospyros virginiana*), sassafras (*Sassafras albidum*), winged sumac (*Rhus copallinum*), and an understory of broomsedge (*Andropogon virginicus*). Densities were moderate in glades containing redcedar and post oak (*Quercus stellata*), at forest edges with post oak, and in burned fields containing sassafras (Shugart and James, 1973). In another northwest Arkansas study, Field Sparrows were among the five most abundant species in successional fields containing broomsedge, eastern redcedar, sweetgum (*Liquidambar styraciflua*), common persimmon, and honeylocust (*Gleditsia triacanthos*) (Dechant, 1996).

In Wisconsin grasslands, Field Sparrow density was positively correlated to percentage of woody cover, total number of dead stems, and number of plant species (Sample, 1989). In riparian habitats in Iowa, Field Sparrow densities were positively correlated with horizontal patchiness of shrubs; vertical patchiness of trees; species richness of shrubs, evergreen trees, and grass-like vegetation; and slope (Stauffer and Best, 1980; Best and others, 1981). Densities were negatively correlated with tree density, tree size, species richness of vines, and vertical stratification of vegetation (Stauffer and Best, 1980; Best and others, 1981). In an idle pasture in Iowa, all 15 breeding territories of Field Sparrows were located on semiwooded hillsides or lowlands (Crooks and Hendrickson, 1953). In remnant tallgrass prairies in Iowa, Field Sparrows used grassy areas with shrubs or low trees (Laubach, 1984). In Illinois, the key to determining suitability of an area for nesting Field Sparrows was the availability of shrubs, trees, or other substrates that could be used as song perches; Field Sparrows stayed within or near the forest edge, not venturing deeper than a few meters into the forest and not farther than 12–15 m into surrounding fields (Johnston, 1947). In a second Illinois study, Field Sparrows preferred shrub-grasslands in which shrubs and trees were <8 m tall over adjacent grasslands or woodland edges; shrub-grasslands offered an assemblage of grasses, forbs, trees, and shrubs to accommodate temporal shifts in the nesting and foraging preferences of Field Sparrows (Best, 1974b, 1977). All available shrub-grassland habitat was encompassed within territories, whereas not all grassland or woodland-edge habitats were encompassed within territories. In Illinois tallgrass prairies, Field Sparrow densities were positively correlated with shrub and forb abundance and negatively correlated with total vegetation richness and live plant richness (Herkert, 1991a). At a reclaimed surface coal mine in southern Illinois planted to a mixture of native and nonnative species of grasses and forbs, Glass and Eichholz (2023) found that Field Sparrow abundance and nest density were positively related to woody cover at the within-patch level. In Missouri, grasslands and idle areas occupied by Field Sparrows were characterized by low-to-intermediate canopy height (2–8 m, never >8 m), dense ground vegetation, woody stems <2.5 cm diameter at breast height (dbh) at approximately 25–1,050 per ha, and moderate numbers of woody stems >2.5 cm dbh at approximately 25–250 per ha (Kahl and others, 1985). In northwestern Indiana habitats varying from little canopy coverage to savannas, woodlands, scrublands, and forest, Field Sparrow density decreased as canopy coverage increased (Grundel and Pavlovic, 2007a). Density was best predicted by an inverse relationship with the number of living trees >10 cm dbh (Grundel and Pavlovic, 2007b). On reclaimed coal-mine sites in southwestern Indiana, Field Sparrows nested in grasslands, grasslands with many scattered shrubs and trees, and grasslands with a few areas of shrubs; nest success was slightly lower in grasslands with scattered shrubs and trees and nearly equal in the other two grassland types (Galligan and others, 2006). In Pennsylvania, Field Sparrows inhabited edge habitats, oldfields encroached with blackberry (*Rubus* spp.), dogwood (*Cornus* spp.), and birch (*Betula* spp.); and oldfields with bigtooth aspen (*Populus grandidentata*) or with black locust (*Robinia pseudoacacia*) and a dense herbaceous understory (Davis and Savidge, 1971). In the Piedmont of Georgia, Johnston and Odum (1956) found that Field Sparrows were the most common species in 15-year-old idled fields consisting of 90 percent grass and 10 percent shrub and in 20-year-old idled fields consisting of 65 percent grass and 35 percent shrub. Predominant shrubs and trees on these fields were blackberry, American plum (*Prunus americana*), sassafras, smooth sumac (*Rhus glabra*), and young loblolly pine (*Pinus taeda*); fields had an understory of broomsedge. Field Sparrows also were common in 25-year-old forests that were formerly cultivated fields; these forests included shortleaf pine (*Pinus echinata*) and loblolly pine and many of the same species of shrubs as in the idled fields. These forests consisted of 44 percent open, grassy areas; 33 percent pines; and 23 percent thickets of blackberry and red sumac. Field Sparrows were much less common in 35- and 60-year-old forests and were not present in 100-year-old forests (Johnston and Odum, 1956). In grassland barrens in Maine, abundance was positively correlated with habitat patchiness, litter, shrub cover, and short grass, and negatively correlated with bare ground (Vickery, 1993; Vickery and others, 1994).

Throughout their range, Field Sparrows commonly inhabit savanna habitats. Within the tallgrass prairies and bur oak savannas of the Sheyenne National Grassland of North Dakota, Field Sparrows were most likely to occur in grasslands containing 30–60 percent tree cover within 200-m belt transects (Cunningham and Johnson, 2012) and were more likely to select moderate amounts of tree cover in open landscapes (<30 percent tree cover within 400-m radius) and wooded landscapes (>30 percent tree cover within 400-m radius) (Cunningham and Johnson, 2011, 2016). In the Anoka Sandplains of Minnesota, Field Sparrows inhabited oak savannas and woodlands dominated by bur oak, northern pin oak (*Quercus ellipsoidalis*), and northern red oak (*Quercus rubra*) (Davis and others, 2000; Au and others, 2008; Davis and Miller, 2018). In Wisconsin, Field Sparrows inhabited oak savannas (defined as 5–50 percent tree cover) and woodlands (>50 percent tree cover) dominated by bur oak, northern pin oak, northern red oak, white oak (*Quercus alba*), black oak (*Quercus velutina*), jack pine (*Pinus banksiana*), and black cherry (*Prunus serotina*) (Wood and others, 2011; Bar-Massada and others, 2012; Vos and Ribic, 2013). In an Iowa study of savanna and woodland bird communities, Field Sparrows were found only in restored oak savannas within an open landscape dominated by grasslands and rowcrop agriculture; Field Sparrows were not found in savannas surrounded by upland deciduous forests, woodlands in open landscapes dominated by grasslands and rowcrop agriculture, or woodlands surrounded by upland deciduous forests (Mabry and others, 2010). In the Cross Timbers ecoregion of Kansas, Holoubek and Jensen (2015) examined tolerance of bird species to varying levels of wooded habitats, including savanna (defined as 1–25 percent woody canopy cover), woodland (25–60 percent canopy cover), and forest (>60 percent canopy cover). Field Sparrow occupancy was high in savanna habitats but declined as canopy coverage within 50 m of point counts increased, which is indicative of an avoidance of denser woodlands (Holoubek and Jensen, 2015). Dominant oak species were blackjack oak (*Quercus marilandica*) and post oak (Holoubek and Jensen, 2015). In western Oklahoma, Field Sparrows were the second most common species observed in sand shinnery oak shrublands (Londe and others, 2021). In savanna and oak woodlands of Tennessee, Field Sparrow occupancy was higher in oak savannas than in oak woodlands subjected to October or March burns, and Field Sparrows were not present in untreated control forests (Vander Yacht and others, 2016).

Grass Cover and Other Factors

The Habitat Suitability Index Model indicated that grass cover provides Field Sparrows with nesting cover, abundant food sources, and ease of movement through vegetation at the optimal grass density of 50–90 percent canopy cover (Sousa, 1983). Optimal height of herbaceous vegetation during May and June is 16–32 cm; vegetation with an average height >40 cm provides suboptimal habitat and vegetation with an average height <5 cm provides inadequate concealment (Sousa, 1983). In Wisconsin, Field Sparrows preferred habitats that were relatively undisturbed, that were uncultivated, and that contained an average of 75 percent herbaceous cover (Sample, 1989). Field Sparrow densities were positively correlated with plant species richness (Sample, 1989). In Illinois tallgrass prairies, Field Sparrow densities were positively correlated to forb and shrub abundance and negatively correlated to grass species richness and to total vegetation richness (Herkert, 1991a). In an Illinois study within idle fields that were either tallgrass prairies, seeded to native tallgrass species, or seeded to tame species, Field Sparrow occurrence was positively related to mean vegetation height and negatively related to mean grass height (Herkert, 1994b). In a study of the relationship between predator activity and territory density in nature reserves in the greater metropolitan area of Chicago, Illinois, the densities of Field Sparrow territories were best predicted by vegetation structural complexity and not by predator activity (Thieme and others, 2015). In central Illinois, Field Sparrows preferred to nest in residual stands of Indiangrass (*Sorghastrum nutans*) more than in residual stands of big bluestem (*Andropogon gerardii*) because most of the big bluestem residual was prostrate, whereas the Indiangrass residual was primarily upright (Best, 1974b). In northern Illinois, Field Sparrow nest success in grassland restorations managed with American bison (*Bison bison*) grazing and prescribed fire was not affected by visual obstruction of vegetation or by proportion of grass around the nest (Herakovich and others, 2021b). At a reclaimed surface coal mine in southern Illinois planted to a mixture of native and nonnative species of grasses and forbs, Glass and Eichholz (2023) found that Field Sparrow nest survival was positively related to percentage grass cover at and around the nest site and with percentage bare ground around the nest site. In Tennessee and Kentucky, Field Sparrows selected nest sites with higher vegetation height and lower percentage cover of grass and bare ground than adjacent and available, but not selected, habitat (Buckley and others, 2022). In central Pennsylvania, Field Sparrows selected nest sites with higher percentage cover of all green vegetation less than or equal to (≤)5 m high within 5 m of a nest than systematically selected habitat patches within 30 m of the nest; no measured vegetation variables affected nest survival (Schill and Yahner, 2009).

In the sand sagebrush grasslands of northwestern Oklahoma, Field Sparrow nests had higher coverage of live vegetation and shrubs, higher VOR, and taller foliage height than random sites, but had lower coverage of grass, forb, litter, and bare ground (Doxon, 2009). Nest sites were about seven times higher in shrub coverage and about five times higher in VOR than random sites. Nest sites also had about 1.6 times less grass cover, nearly five times less forb cover, and nearly two times less bare ground cover than random sites (Doxon, 2009).

Planted Cover

Several researchers have compared Field Sparrow use of conservation fields planted to native and tame species of grasses relative to other habitats, such as native prairies or cropland. In southern Wisconsin, Blank and others (2014) evaluated Field Sparrow use of cropland and bioenergy (or biomass) plantings, including biomass grassland monocultures of warm-season grass species, grass-dominated conservation grasslands (that is, wildlife areas managed by Federal and State agencies and nonprofit conservation organizations with >50 percent live vegetation cover in warm-season grass species), and forb-dominated conservation grasslands (that is, <50 percent live vegetation cover in grass species). Field Sparrows were not present in cropland or grass monocultures and occurred at low densities in grass-dominated grasslands and in forb-dominated grasslands (Blank and others, 2014). In CREP fields in Illinois, Field Sparrow densities increased over time in hardwood tree plantings and riparian buffers and remained stable in sites enrolled as permanent wildlife habitat and in sites enrolled in wetland restoration (Reiley and Benson, 2020). In southern Illinois, Field Sparrows were most abundant in idle warm-season grasslands, followed by mowed warm-season grasslands, grazed warm-season grasslands, idle cool-season grasslands, mowed cool-season grasslands, and grazed cool-season grasslands; the species was not found in fields with annual weeds dominated by foxtail (*Setaria* spp.) and daisy fleabane (*Erigeron strigosus*) or within burned cool-season grasslands (Walk and Warner, 2000). In north-central Missouri CRP fields, McCoy and others (1999) indicated that fecundity of Field Sparrows over 3 years in CRP fields was high enough to maintain a stable population. Abundance did not differ between CRP fields planted to cool-season grasses and CRP fields planted to warm-season grasses (McCoy and others, 2001). In northern and western Missouri, Jaster and others (2014) found one Field Sparrow nest in warm-season grassland restorations and two nests in cool-season grassland restorations. In Pennsylvania CREP grasslands, Field Sparrow densities were negatively associated with the proportion of grasses that are cool-season grasses and positively associated with percent cover of woody vegetation (Wentworth and others, 2010). In Kentucky and Tennessee, Field Sparrow was the most abundant species in fields planted to native warm-season grass species used for pasture, hay, seed production, or biofuel feedstock production (West and others, 2016; Keyser and others, 2020).

Nests and Nest Sites

Field Sparrows nest on or above the ground (Walkinshaw, 1936, 1945, 1978; Crooks, 1948; George, 1952; Ely, 1957; Nolan, 1963; Kupsky, 1970; Best, 1978; Evans, 1978; Stauffer and Best, 1980; Best and others, 1981; Lanyon, 1981; Buech, 1982; Laubach, 1984; Carey and others, 2008, 2020; Luscier and Thompson, 2009). Nest heights in grasses and forbs ranged from 5 to 36 cm above ground (Kupsky, 1970; Best, 1978; Evans, 1978; Lanyon, 1981). Nest heights in shrubs and trees ranged from 7 to 300 cm above ground (Walkinshaw, 1945; Crooks, 1948; George, 1952; Ely, 1957; Nolan, 1963; Mengel, 1965; Fretwell, 1969; Stewart, 1975; Best, 1978; Evans, 1978; Lanyon, 1981; Buech, 1982; Laubach, 1984; Luscier and Thompson, 2009; Reinking and others, 2009; Dunkin and Guthery, 2010). Field Sparrows nest on or near the ground in weed clumps, grass tufts, or litter early in the breeding season (May–June) but nest in small shrubs and saplings later in the breeding season as vegetative cover increases in height (Walkinshaw, 1936, 1945, 1978; Crooks, 1948; Crooks and Hendrickson, 1953; Nolan, 1963; Best, 1974b, 1978; Evans, 1978; Sousa, 1983; Carey and others, 2008, 2020). Based on observations of one male that returned to the same Michigan site for 6 years, May nests were on the ground, whereas June and July nests averaged 26 cm and 40.5 cm above the ground, respectively (Walkinshaw, 1945). Based on a much larger dataset for southeastern Michigan covering several decades, Walkinshaw (1978) reported that 235 of 273 nests in May were on the ground. Of the 273 nests, the mean height was 7.46 cm. In June, only 36 of 239 nests were on the ground, and the mean height of 239 nests was 21.35 cm. The mean height of 240 nests in July was 30.64 cm, whereas the mean height of nests on August 9 was 30.8 cm (Walkinshaw, 1978). In another Michigan study, Evans (1978) characterized nest-building into four categories: (1) nests built so that the bottom of the nest was on the ground, (2) nests supported 5–25 cm above the ground by herbaceous vegetation, (3) nests built 5–90 cm above the ground in small woody saplings, and (4) nests built 7–90 cm above the ground in tree branches. In Iowa, Crooks (1948) stated that Field Sparrows in early May placed nests on the ground in clumps of weeds in idle pasture or other grassy areas. From the end of May to early June, nests were placed in small shrubs, and if not in shrubs, then in weed clumps on hills. Of 11 nests built in May, 45 percent of nests were on the ground and 55 percent were above the ground with an average height of 16.3 cm. Of 10 nests built in June, 60 percent were above the ground with an average height of 40 cm, 30 percent were on the ground, and one nest was in a tangle of grass and forbs. Of 11 nests built in July, all were above the ground with an average height of 51 cm (Crooks, 1948). In Indiana, Nolan (1963) found that 17 of 21 nests were built on the ground in May, with the first elevated nest occurring mid-May; by early June, all nests were built aboveground (a total of 66 nests were found during the breeding season). In Kentucky, Mengel (1965) stated that 12 nests initiated in May were built on the ground, whereas 34 nests initiated after May were built in shrubs, young trees, and forbs.

Some authors have suggested that Field Sparrows nest in woody vegetation after foliage becomes dense enough to conceal nests (Crooks, 1948; Nolan, 1963; Walkinshaw, 1978). Best (1978), however, found that Field Sparrows preferred to use residual grasses as a nesting substrate over live grasses or woody vegetation that had leafed out. If live grasses did not cover isolated clumps of residual grasses, Field Sparrows nested in residual grasses; once live grasses covered residual grasses, Field Sparrows nested in woody vegetation.

Nest substrates vary widely, reflecting the diversity of species of trees, shrubs, and sturdy forbs throughout the breeding range of the Field Sparrow. In North Dakota, Stewart (1975) reported nests <61 cm above the ground in silver sage and western snowberry (*Symphoricarpos occidentalis*). Within Theodore Roosevelt National Park, North Dakota, Hopkins (1983) found Field Sparrows to be one of the most common nesters in communities of silver sage, greasewood (*Sarcobatus vermiculatus*), and silver buffaloberry (*Shepherdia argentea*). In northwestern Nebraska, Gabrielson (1914) reported Field Sparrow nests in western snowberry. In south-central Oklahoma, Ely (1957) described finding four Field Sparrow nests on the edges of willow (*Salix* spp.) groves in tangles of greenbrier (*Smilax* spp.) and in juniper (*Juniperus* spp.) and young persimmon and winged elm (*Ulmus alata*) trees, at nest heights ranging from 61 to 91 cm. In north-central Oklahoma, five Field Sparrow nests were in Chickasaw plum (*Prunus angustifolia*) thickets in mixed prairie; nest heights ranged from 40 to 120 cm (Dunkin, 2008).

Faanes (1981) found Field Sparrows nesting in pine plantations in the early stages of development along the St. Croix River Valley in Wisconsin and Minnesota, and Buech (1982) found 10 Field Sparrow nests in Scots pine (*Pinus sylvestris*) plantations in Minnesota. Throughout several southern Michigan counties within 14 years of a 17-year period (1919–35), Walkinshaw (1936) described 70 nests as being built in grass, clover (*Trifolium* spp.), sorrel (*Oxalis* spp.), young oak trees, hazelnut (*Corylus* spp.) bushes, blackberry, and in cinquefoil (*Potentilla* spp.), with nests ranging in height from 5 to 120 cm, although most nest heights were 15–30 cm. Over a >30-year period within three counties in southern and west-central Michigan, Walkinshaw (1978) described May nests as being built under Carolina crabgrass (*Digitaria cognata*), with June nests built predominantly in New Jersey tea (*Ceanothus americanus*), followed by hawthorn (*Crataegus* spp.), blackberry, and young oak trees. Within an oldfield in southern Michigan, Evans (1978) recorded Field Sparrow nests built on the ground, and in forbs such as hairy lespedeza (*Lespedeza hirta*), stiff-leaved goldenrod (*Solidago rigida*), and northern dewberry (*Rubus flagellaris*), and in crotches of young trees such as black cherry, black oak, pignut hickory (*Carya glabra*), eastern redcedar, and common juniper (*Juniperus communis*). Field Sparrows seemed to prefer nesting in common juniper, possibly because nests built in junipers were more successful during the incubation and nestling periods than nests built in other substrates. On a southern Michigan dairy farm, George (1952) stated that most nests were built within 76 cm of the ground except for two nests in hawthorn each at 107 cm in height and two nests in rose (*Rosa* spp.) bushes each at 152 cm in height. In Iowa, Crooks (1948) reported ground nests in clumps of European stoneseed (*Lithospermum officinale*), stiff-leaved goldenrod, and dense tangle of Kentucky bluegrass (*Poa pratensis*) and black bindweed (*Fallopia convolvulus*). Above-ground nests were built in red hawthorn (*Crataegus mollis*) shrubs. Best (1974a, 1978) provided a list of major plant species used as nest substrates in an Iowa shrub/grassland complex; nest substrates included several grass species (Kentucky bluegrass, Indiangrass, and big bluestem), forb species (black raspberry [*Rubus occidentalis*] and Canada goldenrod [*Solidago altissima*]); and tree and shrub species (red hawthorn, prairie crabapple [*Malus ioensis*], *Prunus* sp., shingle oak [*Quercus imbricaria*], red sumac, multiflora rose [*Rosa multiflora*], and slippery elm [*Ulmus rubra*]). In another Iowa study, Laubach (1984) reported nests in wholeleaf rosinweed (*Silphium integrifolium*), field thistle (*Cirsium discolor*), and in small trees of American plum up to a height of 100 cm. Within deciduous scrub habitat in Indiana, Nolan (1963) stated that the three most used nesting substrates were American elm (*Ulmus americana*), blackberry, and hawthorn, although 48 species of plants harbored nests. Elevated nests heights ranged from 15 to 300 cm, with an average of 100 cm (Nolan, 1963). In Arkansas hayfields planted to tall fescue (*Schedonorus arundinacea*), Bermudagrass (*Cynodon dactylon*), clover, and Chinese lespedeza (*Lespedeza cuneata*), Luscier and Thompson (2009) found 14 Field Sparrow nests that were at least 15 cm above the ground. In Kentucky, Mengel (1965) stated that Field Sparrows preferred nesting in eastern redcedar and black locust; the species also nested in blackberries, yarrow (*Achillea* spp.), goldenrod (*Solidago* spp.), greenbrier, broomsedge, coralberry (*Symphoricarpos* spp.), and hay-scented ferns (*Dennstaedtia punctilobula*). For 32 nests, nest heights ranged from 10.2 to 167.6 cm. Of seven nests in Ohio, Kupsky (1970) found two nests on the ground, three nests in hawthorn, one nest in blackberry, and one nest in a shrub other than hawthorn. Nest heights of the seven nests were <25 cm, and nests were concealed by dead grass. In Pennsylvania, nest heights of 152 Field Sparrow nests were ≤152 cm (Preston and Norris, 1947). In New York oldfields, six Field Sparrow nests at an average height of 20 cm were built in shrubs; seven nests at an average height of 28 cm were built aboveground in herbaceous vegetation, and four nests were built on the ground; of the seven nests, six were built in *Solidago* spp. (Lanyon, 1981). In North Carolina, nests were in loblolly pine plantations with a broomsedge understory; nest heights were as high as 213 cm (Fretwell, 1969).

The quality of nest substrates may vary. In Michigan, nest success in junipers was significantly higher than in other substrates, although nests in junipers were parasitized by Brown-headed Cowbirds (*Molothrus ater*) at a slightly higher rate than in other substrates (Evans, 1978). In Pennsylvania oldfields, the effect of the invasive Morrow's honeysuckle (*Lonicera morrowii*) on nest success was evaluated (McChesney and Anderson, 2015). Morrow's honeysuckle, when used as a nesting substrate or found in dense patches surrounding nests in other substrates, negatively impacted nesting success. Predicted fecundity increased from about 1.64 to 1.95 female fledglings per adult female Field Sparrow when the proportion of nesting substrate that was Morrow's honeysuckle decreased from 1 to 0. Further predictions indicated that when >55 percent of nests are in honeysuckle, fecundity levels will not support the breeding population (McChesney and Anderson, 2015).

Climate

The future distribution of Field Sparrows and the timing of critical life stages, such as spring arrival date, may be affected by climate-induced changes to temperature and precipitation (Butler, 2003; Langham and others, 2015). Butler (2003) found that the average spring arrival date for Field Sparrows at study sites in New York and Massachusetts was notably earlier for the twentieth century; for example, Field Sparrows were arriving earlier for the period 1951–93 than for the period 1903–50 in Massachusetts. Under projected greenhouse gas emission scenarios described by the Intergovernmental Panel on Climate Change (2000), Langham and others (2015) categorized the Field Sparrow as a climate-stable species, indicating that the species would retain >50 percent of its current distribution by 2050 across all Intergovernmental Panel on Climate Change scenarios, with potential for range expansion. Currie and Venne (2017) analyzed BBS data over a 32-year period to examine whether Field Sparrow breeding distribution shifted relative to changes in breeding-season temperature. The authors concluded that temperature change was not a major driver of range shifts for this species and suggested that range shifts in recent decades were more likely caused by other drivers, such as land-cover change, metapopulation dynamics, and stochastic factors. Culp and others (2017) assessed the vulnerability of Field Sparrows to changes in climatic factors (that is, changes in temperature and moisture) across the species' full annual cycle in the Upper Midwest and Great Lakes regions. The assessment considered factors such as background risk (that is, factors unrelated to climate change that could affect resiliency to climate change), climate change exposure (that is, exposure to temperature and moisture changes throughout the annual life cycle), and climate sensitivity and adaptability (that is, the ability of a species to physiologically and evolutionarily tolerate change). Field Sparrows ranked moderate in the relative total vulnerability score (Culp and others, 2017). Using North American BBS data from the Badlands and Prairies Bird Conservation Regions, Gorzo and others (2016) reported that Field Sparrow abundance was not related to a standardized temperature index or a precipitation index. In western North Dakota, density of Field Sparrows declined during one of the most severe droughts on record but returned to normal levels 1-year postdrought (George and others, 1992). In northeastern Illinois, Field Sparrows exhibited an advanced lay date of 26.52 days between 1872 and 2015 with respect to increased carbon dioxide levels (Bates and others, 2023); carbon dioxide levels were used as a proxy for temperature. In northern Illinois, Field Sparrow nest success in grassland restorations managed with bison grazing and fire was not affected by total summer precipitation (Herakovich and others, 2021b).

Area Requirements and Landscape Associations

Territory Size

Male Field Sparrows have multipurpose territories (that is, defended areas in which feeding, mating, and rearing of young occur) (Carey and others, 2020). Sizes of male territories range from 0.2 to 2.4 ha (Walkinshaw, 1945, 1968, 1978; Crooks, 1948; Fitch, 1958; Nolan, 1963; Best, 1977; Evans, 1978; Laubach, 1984). In Illinois, territories that included suboptimal habitats, such as grasslands devoid of woody vegetation and woodlands, were larger than territories in habitats that included only optimal habitat, such as shrubby grasslands (Best, 1977).

Area Sensitivity

The Field Sparrow has shown a variable response to grassland patch size. The Habitat Suitability Index Model for Field Sparrows posited that breeding habitat should be >2 ha (Sousa, 1983). Kupsky (1970) and Petter and others (1990), however, reported that Field Sparrows were breeding on fields <2 ha. In Wisconsin grasslands, field size was not an important predictor of Field Sparrow density (Ribic and Sample, 2001). In Wisconsin oak barrens and dry prairies, relative abundance of Field Sparrows decreased as patch size increased (Vos and Ribic, 2011). Patches of 10.5 ha or smaller had 1.6 Field Sparrows per ha compared to larger patches of 45 ha, which had 0.8 Field Sparrow per ha. In Illinois, Field Sparrows were encountered on small (<10 ha) sites but were classified as moderately tolerant to habitat fragmentation because they were more frequently encountered on large than on small grassland fragments (Herkert, 1991a, 1991b). Field Sparrow abundance was more strongly affected by habitat structure than grassland area, and their absence from some small grassland areas may have been due to a lack of suitable habitat rather than an avoidance of small areas (Herkert, 1991a; J.R. Herkert, Illinois Audubon Society, Springfield, Ill., written commun., [n.d.]). Related studies in Illinois found that abundance was negatively associated with area (Herkert, 1994a) or unrelated to area (Herkert, 1994b). In fields enrolled in the CREP in Illinois, Reiley and Benson (2019) reported that Field Sparrow abundance was not related to patch size. At a reclaimed surface coal mine in southern Illinois planted to a mixture of native and nonnative species of grasses and forbs, Glass and Eichholz (2023) found that Field Sparrow abundance was positively related to patch size. In the Central Hardwoods Bird Conservation Region of the Southern United States, Field Sparrow occupancy was not related to mean patch perimeter-to-area ratio (that is, patch heterogeneity), indicating that the species is not area sensitive (Lituma and Buehler, 2020). In fields planted to various species of native warm-season grasses in Kentucky and Tennessee, Field Sparrow abundance was positivity related to field size; an increase in field size from 1.6 to 12.1 ha increased Field Sparrow abundance by 776 percent (Keyser and others, 2020). Using constant-effort mist-netting on six small (4–8 ha) and six large (13–16 ha) regenerating clearcuts in southern Ohio, Rodewald and Vitz (2005) found some evidence of area sensitivity and edge avoidance by Field Sparrows. Field Sparrows were captured more frequently in large clearcuts than in small clearcuts, but the overall pattern of area sensitivity was not statistically significant. Field Sparrows avoided mature-forest edges; seven times as many adult Field Sparrows were captured 80 m from edges compared to 20 m from edges (Rodewald and Vitz, 2005). In Maine, Field Sparrow occurrence was not affected by field size (Vickery and others, 1994). For Field Sparrows, no studies have investigated a relationship between patch size and nest success or patch size and rates of brood parasitism by Brown-headed Cowbirds.

Proximity to edges may affect Field Sparrow abundance and nest placement. Using BBS data, Bohannon and Blinnikov (2019) examined the relationship between Field Sparrow abundance on BBS routes and habitat fragmentation in western North Dakota and eastern Montana caused by oil-extraction activities. The local population did not significantly decline with increasing edge density (that is, the amount of linear edge per total landscape area). In northern Illinois, Field Sparrow nest success in grassland restorations managed with bison grazing and fire was not affected by distance of nest from nearest edge; edges included agricultural fields, forests, shrubby areas, and wetlands (Herakovich and others, 2021b). In an Illinois oldfield surrounded by woodland, six Field Sparrow nests that were parasitized by Brown-headed Cowbirds were an average of 13.4 m from the woodland (Best, 1978). In small (3–142 ha) patches of restored grasslands in southeastern Illinois, a significantly higher proportion of 143 Field Sparrow nests were near wooded edges (Walk, 2001; Walk and others, 2010). Nests within 50 m of woody edges were more frequently parasitized than nests >50 m from edges (Walk, 2001). Of 134 nests, 36 percent of 134 nests within 50 m of edges were parasitized, whereas no nests >50 m were parasitized. Distance to woody vegetation was the variable that best explained nest parasitism (Walk, 2001). In Missouri, Field Sparrow use of shrub habitats was not related to distance to habitat edges, and nest predation rates were not correlated with distance to edge (Woodward and others, 2001). In mature, second-growth forests in northwestern West Virginia, Field Sparrow abundance showed a positive response to forest edge density (that is, the aggregate lengths of all forest edges divided by the total landscape area) within 100 m of survey points and a negative response to percent forest within 500 m of survey points (Farwell and others, 2016).

Landscape Effects

Field Sparrow abundance may be affected by characteristics of the surrounding landscape. Veech (2006) used North American BBS data from the U.S. portion of the Great Plains to characterize the landscape within a 30-kilometer (km) radius of populations of Field Sparrows that were increasing or decreasing. CRP fields and rangeland constituted a greater proportion of the landscape for increasing Field Sparrow populations than for decreasing populations; rangeland was defined as the natural condition of native grasses, forbs, and shrubs that were used for grazing and browsing by livestock. The proportion of urban lands constituted a greater proportion of the landscape for decreasing populations (Veech, 2006). Within the tallgrass prairies and savannas of the Sheyenne National Grassland of North Dakota, Field Sparrow occurrence was positively associated with woodland cover and negatively associated with wetland cover at the 100-m scale and positively associated with tree cover at the 1,600-m scale (Cunningham and Johnson, 2006). In northwestern Oklahoma, species occurrence models indicated that high coverage of wooded areas with >60 percent canopy cover of juniper and deciduous tree cover within 800 m of BBS stops was an indicator of Field Sparrow occurrence (Coppedge and others, 2004). Encroaching juniper into CRP grasslands was beneficial to Field Sparrows as nesting substrate (Coppedge and others, 2001).

In a study encompassing a wide range of terrestrial and aquatic habitats throughout Iowa, Harms and others (2017) reported that Field Sparrow occupancy and colonization of the landscape were positively associated with the patch density of woodland within 500 m of sampled sites. In CREP fields in Illinois, Reiley and Benson (2019) reported that Field Sparrow density increased as distance to nearest tree increased, as the proportional area of grass within 200 m increased, and as the proportional area of agricultural lands within 1,200 m increased; density decreased with greater proportional area of CREP-restored habitat within 200 m. In Iowa, Field Sparrow occupancy was positively associated with woody cover and the presence of developed cover (variable not defined) within 200 m of autonomous recording units that captured the presence of the species (McGovern and others, 2024). At a reclaimed surface coal mine in southern Illinois planted to a mixture of native and nonnative species of grasses and forbs, Glass and Eichholz (2023) found that Field Sparrow abundance was negatively associated with percentage agriculture and positively associated with percentage forest in the landscape within 400 m of a study site, whereas nest survival was negatively related to percentage of water. Field Sparrows tended to nest near habitat edges regardless of edge type. In Pennsylvania, Field Sparrow abundance was 2.8 times greater at survey points with 100 percent area in CREP (measured within a 5,000-m radius around survey routes) compared to survey points with zero area in CREP (Pabian and others, 2013). In western Missouri, Jacobs and others (2012) reported that Field Sparrow abundance increased 65 percent over the increasing range of percentage of shrubland within 1 km of avian survey points; abundance was not affected by vegetation structure. In the Ozark Highlands of Missouri, avian use of oak savanna and oak woodland undergoing restoration via prescribed fire, tree thinning, and herbicide application were evaluated by Reidy and others (2014). Managed forest sites were compared to unmanaged forest sites (not treated for >30 years). The authors reported that Field Sparrow densities peaked at intermediate levels of forest cover but were negatively related to sapling density. In CREP fields in Kentucky, Field Sparrow abundance was positively related to landscape-scale grassland density and more positively affected by the closeness of patches to one another than to patch density; abundance was negatively related to grassland-forest edge density (Yeiser and others, 2021). In fields planted to various species of native warm-season grasses in Kentucky and Tennessee, Field Sparrow occupancy and abundance remained at moderate levels (about two individuals per point count) in areas where forest cover was >70 percent within 1 km of avian point counts, but abundance was negatively related to urban cover within 1 km (West and others, 2016; Keyser and others, 2020). In another study in Kentucky and Tennessee, Field Sparrow abundance increased with an increase in the density of forest edge and percentage grass cover within 250 m of point-count surveys (Lituma and others, 2022). In the Central Hardwoods Bird Conservation Region of the Southern United States, Field Sparrow occupancy was not related to any of land-cover categories or to conservation practices (Lituma and Buehler, 2020). Differences in Field Sparrow occupancy varied by ecoregion. In early successional forest habitat patches enrolled in the CREP in northeastern North Carolina, daily nest predation of Field Sparrow nests was lower in patches in landscapes with higher percent agriculture within 2.5 km (Shake and others, 2011).

Brood Parasitism by Cowbirds and Other Species

Brood parasitism of Field Sparrow nests by Brown-headed Cowbirds is common (Friedmann, 1963; Friedmann and others, 1977) but regionally variable (Burhans and others, 2001). Published rates of cowbird brood parasitism (Shaffer and others, 2019) varied from <1 percent of 681 nests in Pennsylvania (Burhans and others, 2001) to 80 percent of 20 nests in Iowa (Crooks, 1948; Crooks and Hendrickson, 1953). Field Sparrow nests may be multiply parasitized (Burhans and others, 2000). Because adult Field Sparrows commonly desert parasitized nests, the species may be a poor host (Walkinshaw, 1949, 1968, 1978; George, 1952; Crooks and Hendrickson, 1953; Ely, 1957; Best, 1978; Burhans, 2000; Burhans and others, 2000; Walk, 2001; Carey and others, 2008, 2020). In Michigan, 55 percent of 182 parasitized nests were deserted and only 12 percent of 234 cowbird eggs hatched (Walkinshaw, 1968). In Illinois, 20 percent of 25 active nests were parasitized; three of five cases of nest desertion were attributed to cowbird parasitism (Best, 1979). In another Illinois study, 48 percent of 29 parasitized nests were deserted, compared to none of 21 unparasitized nests (Strausberger and Burhans, 2001). In Michigan, only 28 percent of 29 cowbird eggs hatched and, of these, only one cowbird fledgling survived the first week (Crooks, 1948). In Missouri, 45 percent of 47 parasitized nests were deserted; of 54 cowbird eggs in 50 nests, only four cowbird chicks fledged from four nests (Burhans and others, 2000; Strausberger and Burhans, 2001).

Breeding-Season Phenology and Site Fidelity

Field Sparrows arrive on their breeding grounds from mid-March to early May and depart from late August to early November (Walkinshaw, 1936, 1945, 1968, 1978; George, 1952; Crooks and Hendrickson, 1953; Fitch, 1958; Easterla, 1962; Stewart, 1975; Best, 1977; Evans, 1978; Johnsgard, 1980; Faanes, 1981; Dinsmore and others, 1984; Laubach, 1984; Carey and others, 2008, 2020; Silcock and Jorgenson, 2024). In Michigan, females arrive from late April to early May, about 1–3 weeks later than males arrive (Evans, 1978; Walkinshaw, 1978). Multiple (as many as 10) nest attempts per pair have been reported following failure of previous nesting attempts (Walkinshaw, 1945, 1978; Crooks, 1948; George, 1952; Best, 1974a; Evans, 1978; Carey and others, 2008). There are several cases of Field Sparrows double- and triple-brooding (Walkinshaw, 1945; George, 1952; Evans, 1978; Carey and others, 2008; Giocomo and others, 2008). In Pennsylvania, 30 percent of 160 females successfully fledged two broods, and one percent successfully fledged three broods (Carey and others, 1994). Fidelity to breeding sites has been documented (Walkinshaw, 1945, 1978; George, 1952; Best, 1977, 1979; Carey and others, 2008, 2020; Schlossberg, 2009; Smith and others, 2017), but natal fidelity (that is, young returned and bred at the natal site) is rare (Fretwell, 1968; Lehnen, 2008; Schlossberg, 2009). Schlossberg (2009) summarized estimated rates of site fidelity for banded adult and yearling Field Sparrows in eastern North America, based on a meta-analysis of published studies; 49 percent of 290 adult Field Sparrows returned to former breeding sites, and 1 percent of 103 yearlings (Lehnen, 2008) returned to their natal sites. In Michigan, Walkinshaw (1945) documented that one male returned to the same breeding territory on a steep hillside for six consecutive summers. In a study evaluating the effect of blood sampling on annual survival and within-season site fidelity of adult Field Sparrows in northeastern Pennsylvania, Smith and others (2017) reported that bled individuals had a higher probability of annual survival than unbled individuals in both sexes, which is a result that the authors admitted defied easy explanation. Blood sampling did not seem to affect whether an adult female remained on site following capture (that is, within-year site fidelity), but males sampled for blood were more likely to stay on site than unbled males.

Species' Response to Management

This section evaluates the effect of management practices on Field Sparrow abundance, distribution, and productivity. Typical management of grassland ecosystems involves burning (fire), grazing, haying, or a combination of these practices (Shaffer and DeLong, 2019). Regardless of management treatment, complete removal of woody vegetation may make an area unattractive to Field Sparrows (Stauffer and Best, 1980; Sousa, 1983; Cable and others, 2015). This section also includes a discussion of the benefits and management requirements of planted habitats, such as CRP grasslands and cover strips within cropland. This section ends with an evaluation of Field Sparrow response to other landscape disturbances, such as pesticide application and urban and energy development.

Fire

Annual fire in grasslands is detrimental to Field Sparrows because the preferred mix of sturdy forbs and shrubby vegetation are removed (Best, 1979; Zimmerman, 1992). Fires that are too frequent, especially those that completely burn a treated area, eliminate woody vegetation that Field Sparrows use as nesting substrate; however, fires that are too infrequent allow for woodland succession and a closed canopy that is unsuitable to Field Sparrows (Best, 1979). Periodic fire in savanna and barrens habitats halts woodland succession and maintains short-statured trees and shrubs preferred by Field Sparrows (Ryba, 2002; Vander Yacht and others, 2016).

In mixed-grass and tallgrass prairies managed by fire, grazing, or a combination of fire and grazing by the U.S. Fish and Wildlife Service in Montana, North Dakota, South Dakota, and Minnesota, Field Sparrows occurred at low densities in mixed-grass prairies in only 1 of 3 years; the species was not observed in tallgrass prairies (Igl and others, 2018). In an Illinois park of shrub-grassland and grassland ringed by shrub-woodland, Best (1979) reported that an incomplete late April burn did not seem to affect Field Sparrow territory configuration, pair-bond success, or rate of mate desertion, or to cause territory abandonment. Field Sparrows did not use the unburned shrub-woodland more after the burn than before the burn but rather continued to occupy their preferred shrub-grassland habitat. Females built nests in the unburned patches of grass litter. Field Sparrows seemed tolerant to burning in shrubby grasslands if woody vegetation remained and burning occurred after territories had been established. Field Sparrows moved from the adjacent burned tallgrass and woodland edge into the shrubby grassland portions. Burning also caused a decrease in cowbird parasitism rates and in nest desertion associated with parasitism (Best, 1979). At the Konza Prairie Biological Station in the Flint Hills in northeastern Kansas tallgrass prairies, Field Sparrows were absent from annually burned (and ungrazed) prairies; the species occurred in prairies that were not burned or grazed (Zimmerman, 1992, 1993, 1997). At a reclaimed surface coal mine in southern Illinois planted to a mixture of native and nonnative species of grasses and forbs, Glass and Eichholz (2023) found that Field Sparrow abundance was negatively related to fire, indicating a preference for grasslands in later successional stages that have not been disturbed for several years. In another Illinois study, Field Sparrows preferred burned areas 3–4 years postburn but were not present >5 years postburn (Westemeier and Buhnerkempe, 1983; Herkert, 1991a, 1994b).

In oak savannas in east-central Minnesota, Field Sparrow abundance increased after prescribed burns, and abundance was strongly associated with high burn frequency (Davis and others, 2000; Au and others, 2008; Davis and Miller, 2018). In savannas and woodlands in Missouri, the Field Sparrow was the only species of 17 species examined whose density peaked in the year following a burn (Reidy and others, 2014). In grassland barrens in Maine, Field Sparrows avoided barrens that were 3 or more years postburn (Vickery, 1993).

Fire and Grazing

Throughout the Great Plains, the combination of burning and grazing of rangelands is a common management practice implemented by land managers of State and Federal grasslands and by livestock producers on privately owned lands (Fuhlendorf and Engle, 2001; Holcomb and others, 2014; Buckley and others, 2022). Given that the Field Sparrow prefers successional habitats and grasslands with a woody component, and that the breeding range of the Field Sparrow is concentrated in the mid-Southern United States (fig. BB1), there are relatively few studies comparing grazing systems. Although the Field Sparrow occurs within the Flint Hills, there are no studies for Field Sparrow that examine the effect of the region's traditional combination of annual or biennial burning and grazing, sometimes referred to as intensive early-season grazing followed by burning (IESB), in which spring burning is followed by intensive early cattle stocking. In response to declining populations of grassland bird species under IESB, Fuhlendorf and Engle (2001, 2004) promoted an alternative system of pyric herbivory, often referred to as the patch-burn graze (PBG) system, for use in the Flint Hills and other mesic grasslands. PBG is a management strategy in which only a portion (for example, one-third) of the landscape is burned annually, and livestock preferentially graze on these burned areas, generating heterogeneity in vegetation structure and composition (Fuhlendorf and Engle, 2001, 2004). Details of these systems and studies that have compared them for other species of grassland birds are covered thoroughly in Shaffer and others (2021, 2023).

Patch-Burn Grazing

Several PBG studies involving the Field Sparrow have occurred outside of the Flint Hills and have concluded that PBG does not confer noticeable advantages to Field Sparrow densities or reproductive success over season-long or rotational grazing systems (Holcomb and others, 2014; Buckley and others, 2022). In northwestern Oklahoma sand sagebrush grasslands, Doxon (2009) and Holcomb and others (2014) evaluated Field Sparrow density and nest success between PBG pastures and unburned pastures grazed continuously during the growing season (that is, season-long pastures). Field Sparrow densities were highest in season-long pastures and unburned portions of PBG pastures, and densities were lowest in patches that were burned <24 months before the surveys (Doxon, 2009). Field Sparrows reached higher densities as time since burn increased. Field Sparrow densities and nest survival were similar between PBG pastures and season-long pastures (Holcomb and others, 2014). Burning began 3 years before the study and was applied to study units on a 3-year interval, except for the first year of the study when a drought-induced burn ban occurred. Cattle were stocked in each pasture from early April to mid-September at a rate of 24.7 animal unit days per hectare (about 6.8 ha per steer), which is considered a light stocking rate for the region (Doxon, 2009; Holcomb and others, 2014).

In a 3-year study in Tennessee and Kentucky, Buckley and others (2022) compared nest success at three distinct study sites between PBG and a rotational grazing system. Grasslands had been converted from nonnative species of cool-season grasses to native species of warm-season grasses. PBG pastures were burned in mid-April; rotationally grazed pastures were not burned. Cattle grazed freely within PBG pastures and were rotated among three paddocks every 4–7 days in rotational pastures. Stocking density varied from 260 to 700 kilograms per ha, depending on study site. Field Sparrows did not select nest sites based on grazing treatment (Buckley and others, 2022). Daily survival rate and nest success decreased under the PBG and rotational systems. Daily survival rate and nest success were highest on pretreatment pastures (pastures before either PBG or rotational grazing were applied) and lowest on PBG pastures. Daily survival rate and nest success were statistically similar between pretreatment and rotationally grazed pastures but statistically lower on PBG pastures. The lower nest success was attributed to reduced vegetation height on pastures (Buckley and others, 2022). Lituma and others (2022) added an additional year to the study of Buckley and others (2022) and concluded that the relative abundance of Field Sparrows increased over pretreatment pastures at one of the three study sites following implementation of the two grazing systems. The most favorable conditions for Field Sparrows at the site with increased abundance included the combination of a forest edge density of 3.32 m per ha, 66 percent grass cover, and the use of PBG and rotational grazing.

Other Fire and Grazing Systems

Herakovich and others (2021a, 2021b) evaluated Field Sparrow response to burning and grazing that utilized grazing systems other than PBG. In northern Illinois, Herakovich and others (2021a) evaluated the effect of prescribed fire and the reintroduction of bison grazing on species richness of a suite of obligate and facultative grassland bird species that included Field Sparrow in remnant tallgrass prairies and restored grasslands over a 3-year period. Prescribed burns were conducted during spring or fall. Bison were reintroduced to study sites 2 years before the study, and bison grazing intensity ranged from 0.74 to 1.2 animal unit months (AUMs) per ha. Species richness did not change through time at sites where bison were present (Herakovich and others, 2021a). The authors concluded that species richness was not affected by low-intensity bison grazing, fire, or their interaction during the 3 years of the study. At the same site, Herakovich and others (2021b) also evaluated how bison reintroduction influenced grassland bird nests and concluded that bison reintroduction did not affect Field Sparrow nest density. Nest densities were similar in sites with bison and sites without bison, as well as in sites before and after bison reintroduction. Nest success was not affected by fire in the previous growing season. The effect of bison reintroduction on nest success was unclear because nest success increased after the first year of the study regardless of bison presence. More Field Sparrow nests were found in remnant patches of tallgrass prairie and in older (>8 years old) restored grasslands than in younger (<8 years old) restored grasslands (Herakovich and others, 2021b).

Grazing

Several researchers have conducted studies examining the effect of grazing alone, without the combination of fire, on Field Sparrow abundance. In the north-central portion of the Nebraska Sandhills, Kempema (2007) examined the effect of grazing system duration on Field Sparrow density. For short-duration grazing, average length of time and grazing intensity during the growing season (May 1 to September 30) were 3 days of grazing at 1.4 AUMs per ha; medium-duration grazing values were 23 days at 1.3 AUMs per ha; and long-duration grazing values were 78 days at 1.4 AUMs per ha (Kempema and others, 2023). Field Sparrow density was highest on the long-duration grazing system and lowest on the short-duration grazing system, for which only one bird was observed (Kempema, 2007). Within the same area of the Nebraska Sandhills, Sliwinski and others (2019, 2020) examined the relationship between five grazing systems (season-long continuous, deferred rotation, management intensive, dormant season only, fixed rotation) and avian abundance and diversity. Field Sparrows were among the 10 most common bird species within the study area. Field Sparrow abundance was best explained by stocking rate and grazing system. Field Sparrow abundance decreased by about one bird per 100-m plot with an increase in 1 AUM per ha. Field Sparrow abundance was highest at two birds per plot on management-intensive grazing units, and no Field Sparrows were detected on dormant-season only units (Sliwinski and others, 2019, 2020). However, the authors cautioned that these results likely were confounded by the presence of shrubby patches in the management-intensive and fixed-rotation grazing pastures. In another Nebraska study in the county east of the studies conducted by Kempema (2007) and Sliwinski and others (2020), Field Sparrow abundance did not differ between pastures grazed by cattle at 1 AUM per ha from May

15 to November 15 and a pasture grazed year-round by bison at 1.2 AUMs per ha, or between burned and unburned areas in the pasture grazed by bison (Griebel and others, 1998).

Grazing of Conservation Reserve Program Grasslands

Two studies investigated the effect of grazing of CRP grasslands on Field Sparrow abundance; the studies evaluated grazed mixed-grass prairies and CRP fields planted to monocultures of yellow bluestem (*Bothriochloa ischaemum*) (Chapman and others, 2004a; Hickman and others, 2006). Within grasslands west of the Kansas Flint Hills ecoregion, Hickman and others (2006) compared Field Sparrow abundances among grazed native prairie, former CRP grasslands that had been seeded to warm-season grasses, and CRP fields planted to monocultures of yellow bluestem. Native prairie was continuously or rotationally grazed at 1.37–1.61 AUMs per ha; expired CRP was grazed at 0.96–1.90 AUMs per ha; and fields of yellow bluestem were continuously or rotationally grazed at 0.26–6.91 AUMs per ha. Field Sparrows were found only in native grasslands and not in the grazed monoculture CRP fields (Hickman and others, 2006). In north-central Oklahoma, Chapman and others (2004a) compared Field Sparrow abundances between grazed mixed-grass prairies and CRP fields planted to yellow bluestem monocultures. Grazing intensity was visually estimated, some CRP grasslands were not grazed or hayed, and native prairies were either not grazed or were grazed at rates that the authors describe as light-to-moderate stocking rates. Field Sparrows had higher abundances in grazed native prairie than in CRP fields seeded to yellow bluestem under various disturbances (heavily grazed, hayed, undisturbed), but these abundance differences were not statistically significant (Chapman and others, 2004a).

Throughout the occupied range of the Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*) in Colorado, Kansas, New Mexico, Oklahoma, and Texas, Pavlacky and others (2021) evaluated the extent to which CRP restorations (including both native and tame plantings) and grazing practices designed to benefit Lesser Prairie-Chickens affect population densities of Field Sparrows and other grassland birds. The authors found that Field Sparrow density increased under the grazing practices and that the species was not found on CRP fields. Gary and others (2022) reported that management for the Lesser Prairie-Chicken serves a conservation umbrella of protection for the Field Sparrow and other nontarget grassland birds, and Field Sparrows were expected to receive a net conservation benefit from management for Lesser Prairie-Chicken.

Haying

Haying or mowing can be used to prevent encroachment of woody vegetation, but mowing height and frequency can affect habitat suitability for Field Sparrows. In Illinois, Field Sparrows selected idle areas over areas that were high-mowed (stubble higher than 30 cm remained on the field) and were absent in traditionally hayed areas (Westemeier and Buhnerkempe, 1983). In another Illinois study, Field Sparrows were absent from both tame hayfields and fallow fields (Herkert, 1991a). In a 1-year study of grasslands in Ohio, four circular 1.5-ha plots were cleared of vegetation and then mowed 2–4 times a month during the growing season for 4 years before the study and then mowed during the year of the study; an additional four plots were treated during the study with an herbicide mixture targeting grasses, forbs, and legumes; and four plots served as controls that were unmanaged herbaceous fields (that is, containing a variety of grass, forb, and legume plant species) (Washburn and Seamans, 2007). Field Sparrows were more common in the unmanaged plots than in the mowed or herbicide-treated plots.

In Arkansas, Field Sparrows (combined with Dickcissels [*Spiza americana*] and Red-winged Blackbirds [*Agelaius phoeniceus*]) had higher densities and nest survival in unhayed and late-hayed (June 17–25) fields than in early-hayed (May 26–31) fields (Luscier and Thompson, 2009). In New York, Field Sparrows avoided fields mowed annually to eliminate woody vegetation and nested in oldfields 2–16 years following the cessation of cultivation; after 16 years, the fields were no longer attractive, probably because of lack of suitable nesting cover such as seedlings and small saplings, which provide support for nests and song perches for male Field Sparrows (Lanyon, 1981). In Pennsylvania, Field Sparrows were more abundant, and more nests were found, in hayfields and pastures planted to warm-season grasses than in fields planted to cool-season grasses (Giuliano and Daves, 2002).

Biomass (Bioenergy) Fields

CRP fields planted to switchgrass (*Panicum virgatum*) as a biomass fuel are harvested to provide a domestic energy source; switchgrass fields for biomass fuel differ from more traditional hayfields in that the former are typically harvested after the avian breeding season (Murray and Best, 2003). In Iowa switchgrass CRP fields, Murray and Best (2003) evaluated Field Sparrow abundance and nest success among fields that were completely mowed, fields in which 60 percent was mowed in strips with alternate unmowed strips, and fields that were completely unmowed. Harvesting occurred between November and March; switchgrass was cut to a height of 9 cm with a disk mower, baled, and removed from the field. Murray and others (2003) reported no differences in Field Sparrow abundance among treatment types. In Illinois, LaGory and others (2024) conducted a 3-year study that compared bird use of switchgrass fields to corn fields. Field Sparrows were observed frequently on both field types during the three years, with little difference between number of observations. Autonomous acoustic monitoring devices were used to record vocalizations; Field Sparrow vocalizations were higher in corn fields the first year of the study but similar for the other two years (LaGory and others, 2024).

Planted Cover

Field Sparrows commonly occupy other planted grasslands, such as CRP grasslands (including those not intended solely for biofuel production), CREP grasslands, and reclaimed surface mines. In a 19-year study of breeding birds in several hundred CRP fields in nine counties in North Dakota, South Dakota, Montana, and Minnesota, Field Sparrows were rare (Igl, 2009). An increasing population trend of Field Sparrows was related to the establishment of CRP fields in 12 States in the north-central United States (Herkert, 2009). In Pennsylvania, Field Sparrow numbers were estimated to be 19.4 percent higher in CREP grasslands than they would have been without the program (Wilson and Brittingham, 2012).

In Nebraska, Uden and others (2015) evaluated the effect of four scenarios of land-use change affecting the area of CRP fields on the abundance of Field Sparrows. The first scenario was a baseline condition in which some rowcrops are converted to switchgrass under current conditions of climate, irrigation limitations, commodity prices, ethanol demand, and continuation of the CRP. The second scenario converted more rowcrops to switchgrass. The third scenario converted all CRP fields to switchgrass, and the final scenario converted all CRP fields to rowcrops. Their models predicted Field Sparrow abundance increasing 5–10 percent under scenarios one and two, increasing <1 percent under scenario three, and decreasing by <1 percent under scenario four (Uden, 2012; Uden and others, 2015). In eastern Nebraska and western Iowa on Federal refuge lands restored to tallgrass species, Van Dyke and others (2004, 2007) examined the effect of burning and mowing on small (3–10 ha) grassland fragments restored to tallgrass species; Field Sparrow densities were twice as high on unburned sites than burned sites. No difference in densities were found between burned and mowed sites (Van Dyke and others, 2004). In eastern Nebraska and western Iowa on the same National Wildlife Refuge as Van Dyke and others (2004, 2007) plus one other refuge, Cox and others (2014) indicated that Field Sparrows were more closely associated with conservation grasslands (that is, National Wildlife Refuges, CRP grasslands, and restored and remnant prairies) than marginal lands (that is, field borders and terraces). In northwestern Oklahoma, Coppedge and others (2001) evaluated population trends for Field Sparrows on three BBS routes over a 30-year period relative to patterns of landscape change wrought by eastern redcedar encroachment into grasslands and conversion of cropland to CRP grasslands planted to Old World bluestem (*Bothriochloa* spp.) or lovegrass (*Eragrostis* spp.) species. The population trend for Field Sparrows increased on the BBS route in which the most severe redcedar encroachment was offset by increased area of CRP grasslands in a landscape that had the least amount of intact native grasslands within 0.4 km of BBS stops, indicating that Field Sparrow use of CRP fields might be related to the matrix of land uses in the surrounding landscape. In CRP conservation grassland buffers in northeastern Mississippi, Adams and others (2015, 2019) reported moderate densities of Field Sparrows and only a small number (five) of nests (Adams and others, 2013).

CRP contracts often require management midway through a contract period. In Illinois, Osborne and Sparling (2013) found no difference in Field Sparrow densities among idle CRP fields and CRP fields that were either disked in the fall, sprayed with glyphosate in the fall, or sprayed with glyphosate in the fall and then interseeded with legumes in the spring. In northwestern Illinois, Shew and others (2019) examined the effects on nest survival of a suite of above-ground nesting bird species that included the Field Sparrow of midcontract management techniques of disking, herbicidal spray, or herbicidal spray with a forb interseeding on warm- and cool-season seeded CRP grasslands. Above-ground nesting species as a suite had higher nest survival in cool-season CRP grasslands than in warm-season CRP grasslands and in those fields that had greater proportions of the field managed yearly and cumulatively (yearly percent of field treated with any form of midcontract management technique; cumulative percent over the course of the study). Predicted daily nest survival of above-ground nesting species was positively related to disking, in that disking conducted on fields the fall before the breeding season improved daily survival rate (Shew and others, 2019). In a related study, Shew and Nielsen (2021) reported that Field Sparrow densities were negatively related to the presence of warm-season CRP grasslands, with no relationship to the presence of CRP grasslands dominated by stands of smooth brome (*Bromus inermis*). In fields planted to various species of native warm-season grasses in Kentucky and Tennessee, Keyser and others (2020) examined the effect of three treatments—fields managed for forage (that is, hay or pasture), for seed production, or for biofuel feedstock production—on Field Sparrow abundance. Pastures were grazed by cattle in a rotational manner that involved greater than or equal to 1 rotation during May–June with stock densities at 7–11 animal units per hectare. Hay fields were harvested during June. Seed-production fields were burned annually in February or March, sprayed with herbicides for weed control, and harvested during August to October. Biofuel-production fields were harvested during November to January. Control fields were unmanaged (that is, undisturbed during study duration) that were in the CRP or that were Wildlife Management Areas and had been planted for >6 years before the onset of the study. Field Sparrow abundance and occupancy were lower on seed-production fields than in other treatment categories; abundance was similar in pasture and control fields (West and others, 2016; Keyser and others, 2020). In central Kentucky, fields in the early stage of vegetation succession were planted partially to native tree and shrub species and partially to native warm-season grass species (Slankard and others, 2024). Non-native woody vegetation and cool-season grass species were treated with herbicides, prescribed fire, and disking. Field Sparrows were captured in mistnets to determine a reproductive index based on the ratio of young-to-adult birds. Field Sparrows exhibited higher productivity (that is, a higher young-to-adult ratio after restoration than before restoration) (Slankard and others, 2024). In North Carolina, Moorman and others (2017) compared avian densities in planted grasslands, including seven native warm-season grass forage fields (four hayed and three grazed), seven non-native cool-season grass forage fields (four hayed and three grazed), and three native warm-season grass-forb fields managed for wildlife (one mowed annually and two burned about every 3 years). Field Sparrow densities were more than three times greater in wildlife fields than in all other grassland types.

Cropland

Field Sparrows occasionally use cropland during the breeding season, although in the habitats examined by Sample (1989) in Wisconsin, Field Sparrows were absent from hayfields and cropland. In Indiana, Iowa, Kansas, Michigan, Missouri, and Nebraska, Best and others (1997) found that Field Sparrows were more abundant within CRP grasslands than in corn (*Zea mays*), soybean (*Glycine max*), and sorghum (*Sorghum* spp.) fields, and nests were found only in CRP grasslands. In Illinois, Field Sparrows were observed more frequently in a corn field under no-till treatment than in a conventionally tilled corn field, possibly because there was greater availability of invertebrates in the no-till corn field (Warburton and Klimstra, 1984). In east-central Illinois, VanBeek and others (2014) found one Field Sparrow nest in no-till soybean fields but found none in conventionally tilled soybean fields. Throughout Illinois, Graber and Graber (1963) reported that Field Sparrows nested in low abundances within wheat (*Triticum aestivum*), oat (*Avena sativa*), soybean, corn, and legume fields.

Linear strip cover (that is, filter strips, conservation buffers, grassed waterways and terraces, fencerows, and roadside ditches) may aid in providing habitat for Field Sparrows within or adjacent to rowcrop fields and other habitats. Throughout a 14-State region in the east-central United States, Evans and others (2014) evaluated the effect on avian density of field buffers (9–37 m wide) planted to species of native grass around rowcrop fields. Field Sparrow densities were 58–106 percent greater in landscapes with buffered fields than landscapes without buffered fields. In central Iowa, Schulte and others (2016) examined the effectiveness of strips of native perennial vegetation (that is, prairie strips) planted within rowcrops to increase avian abundance, richness, and diversity. Treatments were 100 percent rowcrop (that is, the reference or control), 10 percent of area planted to native vegetation in one prairie strip on the footslope, 10 percent in multiple prairie strips on the contour, or 20 percent in multiple prairie strips on the contour. Overall abundance, species richness, and diversity of grassland birds were higher on native vegetation strips than the reference treatment. Compared to the pretreatment year, Field Sparrow abundance increased during the posttreatment years, with no differences in abundance found among treatments of prairie strips. In southwestern Iowa, Field Sparrows nested in low densities in strip cover (that is, grassed waterways and terraces, fencerows, and roadside ditches) and in untilled (idle in fall and spring and containing year-round crop residue in which soybeans were planted into corn residue) rowcrop fields (Basore and others, 1986). No Field Sparrow nests were found in corn planted in untilled corn residue, corn planted in untilled sod residue, and corn planted in tilled fields (Basore and others, 1986). In a southwestern Iowa study of avian use of grassed terrace systems in corn and soybean fields, Field Sparrows were moderately abundant and were nesting on terraces (Hultquist and Best, 2001). In central Iowa, grassed waterways in corn and soybean fields were planted primarily to smooth brome to reduce erosion; Field Sparrows nested in grassed waterways that were mowed the previous year but not in grassed waterways that were not mowed the previous year (Bryan and Best, 1991, 1994). In Ohio, Field Sparrows used fallow cropland, pasture, and small grains grown in strips between idle cropland (Good and Dambach, 1943). In Maryland, densities of Field Sparrows were higher in wide filter strips (>60 m) than in narrow (<30 m) or medium width (30–60 m) filter strips; filter strips were defined as strips of herbaceous vegetation planted along agricultural field margins adjacent to streams or wetlands and were established through CREP (Blank and others, 2011). In Mississippi, mean abundance of Field Sparrows was greater at forest-field edges with herbaceous buffers compared to unbuffered controls (Riffell and others, 2015).

Savannas

Savannas and grasslands encroached by woody vegetation are suitable habitat for Field Sparrows. To curtail woody succession, savanna habitats often are managed with prescribed fire, grazing, or tree thinning. The restoration and maintenance of savannas benefit Field Sparrows. In southeastern Minnesota, Field Sparrows were more abundant in savannas than in burned woodlands (Au and others, 2008). In northwestern Oklahoma, sand shinnery oak shrublands were maintained with primarily spring (January to March) fires and grazing conducted from April to July by cattle at moderate stocking rates (that is, 1.6 ha per AUMs). The highest relative abundance of Field Sparrows occurred in recently burned patches (that is, 0–12 months postburn). These time periods equated to ecological conditions in which the sand shinnery oak community had not yet fully recovered, and open areas of herbaceous species dominated (Londe and others, 2021). Thinning of trees may be necessary to prevent succession to woodlands. In Kansas, Holoubek and Jensen

(2015) recommended that savannas undergoing succession to forests should be thinned to <25 percent canopy coverage or <200 trees per ha to maintain habitat structure suitable to savanna-associated bird species. Although not providing goals for canopy coverage reductions for grasslands encroached by eastern redcedar, Chapman and others (2004b) emphasized the early prevention of tree encroachment, as increases in redcedar coverage seem to cause a decrease in the variation of grassland bird abundance. In savanna and oak woodlands of Tennessee treated with October or March burns, Field Sparrow occupancy increased linearly as tree live basal area (square meters per hectare) declined and as percent herbaceous ground cover increased (Vander Yacht and others, 2016).

Pesticides

Insecticides and herbicides may have direct effects (for example, mortality or reduced productivity) or indirect effects (for example, alterations in habitat or food resources) on Field Sparrows. In a study of organochlorine pesticide contamination in grassland passerines, Bartuszevige and others (2002) analyzed tissues from 20 Field Sparrows salvaged from building collisions or caught in mist nets in Illinois; six Field Sparrows were contaminated with dichlorodiphenyldichloroethylene (DDE), one with endrin ketone, five with alpha benzene hexachloride, and one with dieldrin. Of the 11 male Field Sparrows examined, the researchers found no feminization of testes. In a study examining the effects of dichlorodiphenyltrichloroethane (DDT) dust for tick control in Texas, numbers of nesting Field Sparrows decreased in the treated area (George and Stickel, 1949).

Quinn and others (2017) examined the response of grassland birds to multiple measures of agricultural change over a 40-year period along the 41st parallel within Colorado, Wyoming, Nebraska, and Iowa. Within this region and time, total land area planted to cropland increased 40 percent, biomass yield increased 100 percent, and chemical use increased 500 percent. The abundance of Field Sparrows increased with increased area farmed and decreased with increased chemical use and biomass production, although none of the measures were statistically significant (Quinn and others, 2017). On reclaimed surface mines in Ohio, Lautenbach and others (2020) examined the effect of the removal of woody vegetation on Field Sparrows. For 4 years, herbicides were applied over two areas, followed by mechanical cutting and shredding or hand cutting. Herbicide treatments had no significant effect on Field Sparrow densities, and estimated woody canopy cover was not a good predictor of Field Sparrow abundance (Lautenbach and others, 2020). In New York, carbaryl was sprayed on shrubs at normal levels and at levels six times the normal dose (Bart, 1979). Field Sparrows were not affected by either level of spraying. The number of singing male Field Sparrows did not significantly differ between the treated areas and the control areas. In another New York study, Field Sparrows did not breed for 18 years in a field where vegetation was removed by a one-time application of 2,4,5–Trichlorophenoxy-acetic acid (2,4,5–T) and kerosene, after which vegetation was maintained by annual fall mowing (Lanyon, 1981). In Oklahoma, Martin (1965) reported that the number of male Field Sparrows did not differ between an area sprayed with 2,4,5–T to control post oak and blackjack oak and an unsprayed area. In a Texas study examining the effects on avian density of disking, spraying of the herbicide 2,4,5–T about 14 years earlier, and construction for gamebirds of brush shelters, there were no effects on grassland sparrows as a group (Gruver and Guthery, 1986). Field Sparrows were grouped with other grassland and brushland sparrows, but the effects on individual species were not examined.

Urban Development

Few researchers have examined the effect of urbanization on Field Sparrows during the breeding season. In Missouri, Burhans and Thompson (2006) tested factors affecting nest survival, cowbird brood parasitism, and Field Sparrow abundance in shrubland habitats in rural and urban landscapes; Field Sparrows were more abundant in rural sites, and their nests were only found in rural sites. In eastern Oklahoma, Engle and others (1999) evaluated the response of Field Sparrows to low-density urban sprawl in two study areas: a sparsely populated rural area and an area close to metropolitan Tulsa. Human density increased from three humans per square kilometer [km^2] in 1902 to seven humans per km^2 in 1990 in the sparsely populated area and from 12 humans per km^2 in 1902 to 44 humans per km^2 in 1990 in the high human density area. Field Sparrow occurrence decreased in the low human density area between 1902 and 1990; the decrease in occurrence paralleled the decrease in deciduous forest and increase in burned and cleared lands. Occurrence remained stable in high human density area (Boren and others, 1999; Engle and others, 1999). From 92,869 records of mortality across numerous bird species, Loss and others (2014) estimated the collision risk of bird species to the building categories of 1–3-story residences, low-rises, and high-rises. Based on 10 studies, the Field Sparrow was estimated to be 1.8 times more likely to collide with buildings than the estimated average overall avian mortality rate owing to building collisions. Broken down by building type, Field Sparrows were 48.3 times more likely to collide with a 1–3-story residence, 4.4 times more likely with a low-rise building, and 2.5 times more likely with a high-rise building (Loss and others, 2014). At a reclaimed surface coal mine in southern Illinois planted to a mixture of native and nonnative species of grasses and forbs, Glass and Eichholz (2023) found that Field Sparrow nest survival was higher for nests farther from roads. In Ohio, Schmidt and others (2013) found that Field Sparrows were at low risk of colliding with aircraft because the species did not occur in airfield grasslands, even though the species did occupy adjacent native warm-season grasslands. In shrublands in western Massachusetts, Schlossberg and others (2011) studied the effect of landscape-scale, low-density housing development on abundance and nesting success of Field Sparrows. Field Sparrow abundance and nest success did not change with housing development within 1 km of the study sites.

Energy Development

Wind-energy and gas development may affect Field Sparrow distribution and abundance. Beston and others (2016) developed a prioritization system to identify avian species (428 species evaluated) most likely to experience population declines in the United States from wind facilities based on the species' current conservation status and the species' expected risk from wind turbines. The Field Sparrow scored a 3.23 out of nine, where nine indicated high risk, and Beston and others (2016) estimated that 4.14 percent of the Field Sparrow breeding population in the United States may be exposed to wind facilities. Loss and others (2013) reviewed published and unpublished reports on collision mortality at monopole wind turbines (that is, with a solid tower rather than a lattice tower) in the contiguous United States; four Field Sparrow mortalities were reported at two wind facilities. Erickson and others (2014) compiled data from 116 studies on small-passerine fatalities caused by collisions with turbines at wind-energy facilities in the United States and Canada. The Field Sparrow was among the 20 most common small-passerine species that were found as a fatality during a 17-year period, but <1 percent of the continentwide population of Field Sparrows is estimated to be killed annually by collisions with wind turbines.

At an unconventional shale gas development site in northern West Virginia, Farwell and others (2016, 2019) reported that Field Sparrow abundance within 50-m radius buffers of survey points was not significantly related to distance to shale gas well pads (that is, pads, buffers, fluid impoundments, and storage areas) or linear shale gas infrastructure (that is, pipelines and access roads). In a study on the effect of shale gas development on shrubland songbird nest success in southwestern Pennsylvania and northern West Virginia, Field Sparrow nest survival was reduced close to gas wells but increased near pipelines and roads; however, nest survival was higher on the site impacted by gas development than on sites not impacted by gas development (Davis, 2014).

Lead-mining activities may affect Field Sparrow nest survival. Brasso and others (2023) and Thompson and others (2024) examined the effect of metal contamination from lead mines. Brasso and others (2023) investigated the relationship between mean soil lead surrounding nest sites and reproductive success in the Southeast Missouri Lead Mining District. Blood lead concentrations of eight species of adult songbirds, including Field Sparrow, were 10 times higher in birds on contaminated mine sites than on reference sites. No effect of local lead concentration on Field Sparrow clutch size, hatching success, or number of young fledged was found; mean local lead concentrations in soil around nests ranged from 19 to 4,295 parts per million (ppm). Nest survival of Field Sparrows increased from 20 to 27 percent as lead concentrations increased from 18 to 4,400 ppm. The addition of habitat variables (that is, nest concealment, percent ground cover, percent shrub cover, number of sapling-sized trees, number of pole timber-sized trees, or number of saw timber-sized trees) did not improve the nest-survival model by explaining variation in nest survival. However, percent ground cover and numbers of sapling-sized trees were consistently lower on contaminated sites and reference sites, respectively. Based on lead tissue levels, two Field Sparrow broods were categorized as clinically poisoned and three broods as subclinically poisoned at two of the three mine sites. Thompson and others (2024) reported that daily nest survival for Field Sparrows slightly increased as soil-lead concentration increased. The probability of fledging one or more young increased from 57 to 64 percent as soil-lead concentrations around a nest increased from 20 to 4,000 ppm. However, mean annual productivity declined from 2.28 to 2.24 young per female per year.

Management Recommendations from the Literature

Habitat Protection and Restoration

Throughout the Field Sparrow's breeding range, the protection, maintenance, and restoration of habitats such as savannas, grasslands restored under the CRP, and unburned prairies that support sturdy forbs and shrubby grasslands may be especially beneficial in maintaining Field Sparrow populations (Herkert, 1994b, 2009; Cox and others, 2014; Reiley and Benson, 2020; Londe and others, 2021). Complete removal of woody vegetation from areas occupied by Field Sparrows may be detrimental to this species (Best, 1979; Stauffer and Best, 1980; Herkert, 1994b). In areas where fragmentation is high owing to urbanization and agriculture development, public lands protect imperiled habitats upon which Field Sparrow rely; examples include the Fort McCoy Military Installation in Wisconsin and the Sheyenne National Grasslands in North Dakota for oak savanna (Cunningham and others, 2006; Cunningham and Johnson, 2012; Vos and Ribic, 2013), DeSoto National Wildlife Refuge in Iowa and Nebraska for tallgrass prairies (Van Dyke and others, 2007; Cox and others, 2014), and Fort Campbell in Kentucky and Tennessee for grassland barrens (Giocomo and others, 2008). Federal policies that protect grasslands on public land may be key to preserving declining habitats inhabited by Field Sparrows (Vos and Ribic, 2011, 2013). Active management by State and

Federal governments and nongovernmental organizations to maintain shrubland and shrub-grassland habitats in Eastern States will remain important; Schlossberg and King (2015) evaluated the role of State and Federal land-management agencies and nongovernmental organizations in maintaining shrubland habitat in Massachusetts for Field Sparrows and other shrubland-dependent bird species. An average of 20 percent of the shrubland habitat in Massachusetts exists because of active management by agencies or nongovernmental organizations, with about one-half of the habitat for Field Sparrow existing in Massachusetts because of active management.

Maintenance of suitable habitat within urban parks may benefit Field Sparrows (Thieme and others, 2015), but new housing developments could be detrimental if they cause loss of early successional habitat (Schlossberg and others, 2011). Thieme and others (2015) further suggested that activities or structures, such as food stations, that promote use by avian predators, particularly corvids, may be deterrents to passerine occupancy and their use should be eliminated.

Privately owned lands (especially pastureland generally referred to as working lands) can provide habitat and protect native ecosystems, as over 70 percent of the United States is held in private ownership (Ciuzio and others, 2013). Veech (2006) found that rangeland constituted a greater proportion of the landscape for increasing Field Sparrow populations than for decreasing populations. Conservation partnerships between Federal, State, and Tribal agencies; nongovernmental organizations; and private landowners result in programs like grassbanks. Gripne (2005) described a grassbank as a conservation tool that exchanges the value of a given amount of forage for conservation benefits. Field Sparrows may benefit from grassbanks for the grassland habitat that is protected and the high nest-success rates on private rangeland (Kempema, 2007). Public/private partnerships can improve existing grasslands; Federal programs that promote the planting of warm-season grasses rather than cool-season grasses in pastures and hayfields on private lands may benefit bird populations (Giuliano and Daves, 2002). Keyser and others (2020) found that increasing the number of grasslands seeded to native grass species offer conservation benefits for multiple grassland avian species, including Field Sparrow. Keyser and others (2020) suggested conservation planning for grassland-associated birds should target landscapes with <30 percent forest cover and prioritize larger field sizes.

Partnerships between government agencies and private landowners also create new grasslands (McCoy and others, 2001; Veech, 2006; Uden, 2012; Wilson and Brittingham, 2012; Pabian and others, 2013). Former coal mines that are eligible for reclamation also are good targets for grassland creation and preservation as they often are large (>2,000 ha), owned by a single entity, and not desirable for agricultural uses (Galligan and others, 2006). Federal landowner incentive programs like the CRP can provide valuable conservation benefits to many wildlife species, and the effectiveness of this program in providing breeding habitat for the Field Sparrow has been well established (Herkert, 2009). Blank and others (2014) reported that newer programs to create grasslands as sources for bioenergy create habitat for Field Sparrows that is more preferred than corn fields; thus, incentives to convert grasslands to corn fields would be detrimental to the species (Blank and others, 2014; Uden and others, 2015). Blank and others (2014) indicated that creating bioenergy grasslands with high plant diversity and forb coverage in a landscape of other grassland parcels maximizes the benefit to grassland bird species. Decreasing herbicide use on bioenergy fields would increase forb abundance (Murray and Best, 2003). To increase habitat diversity in switchgrass fields to benefit multiple avian species, Uden and others (2015) urged harvesting switchgrass fields at different times and at varying heights, as well as investigating how switchgrass hybrids affect stand structure. Conservation practices such as the development and maintenance of riparian buffers, wetland restorations with tree plantings, and tree planting conservation programs will help maintain Field Sparrow populations (Riffell and others, 2015; Reiley and Benson, 2020). Shew and others (2019) suggested that disking as a midcontract management treatment on CRP grasslands might improve nest survival for species, including Field Sparrow. Because many species benefit from conservation programs but have different habitat requirements, Yeiser and others (2021) have provided a prioritization framework to predict how different avian species will respond to differing conservation treatments in Kentucky. For example, Northern Bobwhites (*Colinus virginianus*) were predicted to benefit from future grassland conservation programs more so than Field Sparrows, so prioritization frameworks can aid decisions on how to allocate financial resource to recovering avian species in agricultural ecosystems.

Fire, Grazing, and Haying

Some researchers have suggested that disturbances, such as burning and mowing, are best avoided before breeding territories have been established, approximately March to early April (Herkert, 1994b; Carey and others, 2008). Best (1979) suggested that incomplete burns conducted from mid- to late April in Illinois will not interfere with Field Sparrow territory establishment and maintenance, especially for returning males exhibiting strong site tenacity. However, burns conducted in early April or March, before territory establishment, might interfere with the process of site selection and might cause reduced population densities (Best, 1979). Several researchers have suggested that burning should be used to prevent heavy encroachment of woody vegetation, but some woody vegetation should be preserved (Best, 1979; Herkert, 1994b; Carey and others, 2008, 2020). On prairie fragments larger than 80 ha, Field Sparrows will benefit from burning on a rotating schedule with 20–30 percent of the area treated annually (Herkert, 1994a). Herkert (1994b) recommended that small, isolated prairie fragments should not have >50–60 percent of the total area burned at a time, and where several small prairie fragments are present, a rotating schedule can be implemented to provide adjacent burned and unburned areas. In hayed grasslands, early mowing and annual haying are detrimental to Field Sparrows (Lanyon, 1981; Luscier and Thompson, 2009). To prevent the destruction of nests and young, Luscier and Thompson (2009) recommended delaying haying until mid- to late June in Arkansas, whereas Bryan and Best (1991) recommended delaying haying until late August or early September in Iowa. Giuliano and Daves (2002) suggested the conversion of some planted cool-season hayfields to warm-season grasses to increase Field Sparrow abundance and nest density. A conversion of 20–30 percent of fields would increase avian diversity while maintaining viable annual forage production and associated economic returns for landowners.

In some ecosystems, the type of burning-and-grazing system or the species of grazing animal may be less important to avian species abundance and richness than the amount of vegetation cover maintained or removed (Griebel and others, 1998; Holcomb and others, 2014; Herakovich and others, 2021a; Lituma and others, 2022). In northwestern Oklahoma, Holcomb and others (2014) recommended focusing on maintaining a 3-year fire interval in sand sagebrush landscapes that, when combined with grazing, can create spatially and temporally diverse habitat patches ranging from bare ground to tall, dense vegetation with a thick litter layer. In northern Illinois, Herakovich and others (2021a) recommended a combination of different management techniques with low stocking densities across sites. In eastern grasslands in Kentucky and Tennessee, the maintenance of a litter layer and adequate vegetation height is important to provide adequate nesting cover for Field Sparrows; grazing systems that remove cover or that do not provide vegetation heterogeneity will be detrimental to the species (Buckley and others, 2022). Similarly, Hickman and others (2006) found that grazing of grasslands planted to Old World bluestem in Kansas failed to provide adequate vegetation height, litter layer, and arthropod biomass to sustain bird populations. A balance between maintaining nesting cover for birds but also preventing grasslands from transitioning to woody environments will require considerations in management timing; short-term results from the 2-year posttreatment grazing period in Kentucky and Tennessee indicated that Field Sparrows tolerated this lower limit of years of rest (Buckley and others, 2022). Lituma and others (2022) suggested that different grazing systems can achieve similar management outcomes for avian abundance, but that bird response could be mediated by landscape-level factors such as the amount of grassland and woodland in the surrounding landscape; thus, relationships with multiple private landowners may be necessary to achieve avian management goals, similar to the recommendations of Sliwinski and others (2019) mentioned in the following paragraph.

In grazing-only systems, managing stocking rates to achieve optimal grazing intensity for Field Sparrows likely depends on context-specific (that is, local) factors, including grassland type and landscape composition and abiotic factors such as interannual variability in precipitation levels, topoedaphic conditions, and range and soil productivity potential (Kempema, 2007). Similarly, the effect on vegetation of abiotic factors may be as important as grazing system in governing the abundance and distribution of bird species (Kempema, 2007). In tallgrass prairies in Nebraska, Kempema (2007) suggested that medium- and long-duration grazing systems during periods of drought may be better at maintaining avian richness than short-duration grazing systems, especially for Field Sparrows. Sliwinski and others (2019) suggested that treating private-lands management as a coordinated effort among many pastures and developing relationships with multiple private landowners will be important to maintain grasslands for a diversity of bird species because higher vegetation heterogeneity may be found among pastures than within a single pasture, indicating the importance of viewing an individual pasture in the context of a landscape of other pastures. The application of a variety of long-term measures, such as heavy grazing, long-term rest, or patch-burn grazing, across a large landscape may be necessary to realize vegetation heterogeneity that would be beneficial to multiple species (Sliwinski and others, 2019).

Cropland

Field Sparrows may benefit from conservation agricultural practices, including reduced and minimum tillage, conversion of annually tilled croplands to grasslands, and planting of grassland strips within cropland (Basore and others, 1986; Bryan and Best, 1994; Uden and others, 2015). Implementation of minimum-tillage practices is advantageous because reduced and conservation tillage allows 15 to >30 percent of crop residue to remain, whereas conventional tillage leaves little or no crop residue on the soil surface (Basore and others, 1986; Koford and Best, 1996). Conversion of annually tilled croplands to grassland plantings benefits Field Sparrows; predictive models developed by Uden and others (2015) indicated that the conversion of rowcrops to switchgrass provided notable increases in the abundance of Field Sparrows. Agricultural areas may be enhanced for Field Sparrows by establishing grassed waterways and grass terraces within cropland fields and grassy filter strips along cropland field edges (Bryan and Best, 1991, 1994; Hultquist and Best, 2001; Evans and others, 2014; Schulte and others, 2016). Bryan and Best (1991, 1994) provided several recommendations for increasing the utility of grassed waterways for grassland birds. These recommendations included delaying the mowing of grassed waterways until late August or early September to avoid the peak nesting period and to increase avian nest success, but not delaying the mowing past September to allow sufficient vegetation regrowth for winter and spring cover. Mowing at heights of 15–30 cm facilitates sufficient regrowth for winter and spring cover. Annual mowing is discouraged to allow unmowed areas to serve as refugia and to counteract disturbances in other mowed habitats, such as hayfields and roadways, that are mowed annually. Weed control could occur through spot herbicide spraying or spot mowing. However, as Field Sparrows nest in some forbs that may be considered weeds, these nesting substrates could be maintained unless they are designated as noxious weeds (Bryan and Best, 1991, 1994). To increase grassland coverage on field terraces, Hultquist and Best (2001) differentiated between terrace types and recommended converting older grassed backslope terraces (the front slopes of which have a cropland component) to narrow-base terraces (which consist of all grass). Planting narrow-base terraces with a diversity of plant species, rather than a monoculture, also may promote avian diversity (Hultquist and Best, 2001).

Woody Vegetation

Complete removal of woody vegetation, whether through burning, chemical means, or mechanical means, is detrimental to the species (Carey and others, 2008, 2020). In Ohio, Lautenbach and others (2020) recommended reducing woody vegetation on reclaimed surface mines to ≤10 percent woody canopy coverage through such means as herbicides and mechanical shredding. In Iowa, manipulations of forested riparian habitats that benefit Field Sparrows include reducing woody vegetation to narrow strips, partially removing woody canopy, and thinning shrubs and saplings (Stauffer and Best, 1980).

Within savanna habitats, thinning of trees may be necessary to prevent succession to woodlands (Holoubek and Jensen, 2015; Londe and others, 2021). In Minnesota, Davis and others (2000) advocated for prescribed burning of savanna habitat to restore vegetation to a condition suitable for Field Sparrows. In Wisconsin savannas and woodlands, Bar-Massada and others (2012) recommended maintaining tree canopy cover <50 percent to maximize avian species richness. In Iowa, Mabry and others (2010) found that the restoration of savannas in landscapes dominated by perennial grassland and rowcrop fields was beneficial to Field Sparrows. In Kansas, Holoubek and Jensen (2015) recommended that savannas undergoing succession to forest should be thinned to <25 percent canopy coverage or <200 trees per ha. In Oklahoma, a rotational fire schedule for sand shinnery oak shrublands may benefit Field Sparrows, as the species reached highest abundance in recently burned patches (that is, 0–12 months postburn) (Londe and others, 2021). These time periods equated to ecological conditions in which the sand shinnery oak community had not yet fully recovered and open areas of herbaceous species dominated (Londe and others, 2021). Although not providing goals for canopy coverage reductions for grasslands encroached by eastern redcedar, Chapman and others (2004b) emphasized the early prevention of tree encroachment, as increases in redcedar coverage seem to cause a decrease in the variation of grassland bird abundance. To prevent oak savannas and oak woodlands from succeeding to closed-canopy forests and to provide habitat for a diverse avian community on the Cumberland Plateau, Vander Yacht and others (2016) recommended recurrent prescribed fires to decrease the coverage of woody plants and increase groundcover (that is, grasses and forbs). To maximize the presence of early and late-successional avian species, they suggested a restoration target of tree live basal area of 10 square meters per ha and herbaceous groundcover of 20 percent. To benefit only early successional bird species, including Field Sparrow, Vander Yacht and others (2016) suggested that greater reductions in live basal area would further increase early successional occupancy.

In stands of Rocky Mountain juniper in South Dakota, Sieg (1991) suggested monitoring woodland stands for overuse by livestock that cause erosion issues, decreasing livestock numbers, protecting damaged areas with fences, or offering livestock feed away from imperiled woodland stands. In pine barrens in Wisconsin, prescribed fires or timber harvests maintained the vegetation characteristics preferred by Field Sparrows (Ryba, 2002).

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Table BB1. Measured values of vegetation structure and composition in Field Sparrow (*Spizella pusilla*) breeding habitat by study. The parenthetical descriptors following authorship and year in the "Study" column indicate that the vegetation measurements were taken in locations or under conditions specified in the descriptor; no descriptor implies that measurements were taken within the general study area.

[cm, centimeter; %, percent; >, more than; <, less than; --, no data; CRP, Conservation Reserve Program; CREP, Conservation Reserve Enhancement Program]

Study	State or province	Habitat	Management practice or treatment	Vegetation height (cm)	Vegetation height-density (cm)	Grass cover (%)	Forb cover (%)	Shrub cover (%)	Bare ground cover (%)	Litter cover (%)	Litter depth (cm)
Blank and others, 2011	Wisconsin	Planted grassland	Warm-season seeding mixture, >50% grass	--	36[a]	66	11	--	--	--	6.5
Blank and others, 2011	Wisconsin	Planted grassland	Warm-season seeding mixture, <50% grass	--	66[a]	31.6	29.1	--	--	--	6.7
Chapman and others, 2004[a]	Oklahoma	Mixed-grass prairie	Grazed	--	48.7[a]	--	--	--	--	--	--
Chapman and others, 2004[a]	Oklahoma	Tame grassland (CRP)	Seeded to yellow bluestem (*Bothriochloa ischaemum),* grazed	--	39.6[a]	--	--	--	--	--	--
Doxon, 2009 (nests)	Oklahoma	Sand sagebrush	Grazed	102	70.1[a]	16.8	1.7	62.6	7.4	15.3	--
Giuliano and Daves, 2002	Pennsylvania	Tame grassland	Warm-season seeding mixture	43.6–133.5	--	--	--	--	--	--	--
Giuliano and Daves, 2002	Pennsylvania	Tame grassland	Cool-season seeding mixture	26.1–82.6	--	--	--	--	--	--	--
Hickman and others, 2006	Kansas	Mixed-grass prairie	Grazed	31.7	--	54	38.1	--	--	--	1.2
Keyser and others, 2020; West and others, 2016[b]	Kentucky, Tennessee	Tame grassland (CRP, CREP)	Warm-season seeding mixture, idle	73.4	91.9[a]	33	41.7	6.4	--	96.8	5
Keyser and others, 2020; West and others, 2016[b]	Kentucky, Tennessee	Tame grassland	Biofuel planted to switchgrass (*Panicum virgatum*)	131	144.5[a]	66	18	<1	--	76.5	1.5
Keyser and others, 2020; West and others, 2016[b]	Kentucky, Tennessee	Tame grassland	Warm-season seeding mixture, harvested for seed	48.3	58.6[a]	81	6.6	1.2	--	53.6	1.4
Keyser and others, 2020; West and others, 2016[b]	Kentucky, Tennessee	Tame grassland	Warm-season seeding mixture, grazed	40.5	49.4[a]	48.8	15.8	0	--	79.3	1.4
Keyser and others, 2020; West and others, 2016[b]	Kentucky, Tennessee	Tame grassland	Warm-season seeding mixture, hayed	76.4	85.1[a]	52.1	20.2	1.3	--	73.9	2
McCoy and others, 2001[b]	Missouri	Tame grassland (former CRP)	Cool-season seeding mixture	--	51[a]	46	33	1	12	75	2.6
McCoy and others, 2001[b]	Missouri	Tame grassland (CRP)	Warm-season seeding mixture	--	80[a]	54	27	<1	11	74	2.2

Table BB1. Measured values of vegetation structure and composition in Field Sparrow (*Spizella pusilla*) breeding habitat by study. The parenthetical descriptors following authorship and year in the “Study” column indicate that the vegetation measurements were taken in locations or under conditions specified in the descriptor; no descriptor implies that measurements were taken within the general study area.—Continued

[cm, centimeter; %, percent; >, more than; <, less than; --, no data; CRP, Conservation Reserve Program; CREP, Conservation Reserve Enhancement Program]

Study	State or province	Habitat	Management practice or treatment	Vegetation height (cm)	Vegetation height-density (cm)	Grass cover (%)	Forb cover (%)	Shrub cover (%)	Bare ground cover (%)	Litter cover (%)	Litter depth (cm)
Murray and Best, 2003	Iowa	Tame grassland (CRP)	Total-harvested switchgrass	80.9	71[a]	51.6	19.6	0.4	5	23.2	1.9
Murray and Best, 2003	Iowa	Tame grassland (CRP)	Strip-harvested switchgrass	81.7	75[a]	53.3	17.5	0.1	2.8	29.6	3.5
Murray and Best, 2003	Iowa	Tame grassland (CRP)	Unharvested switchgrass	78.1	71[a]	32.9	25.4	2.1	2.9	22.9	5.5
Osborne and Sparling, 2013[b]	Illinois	Tame grassland (CRP)	Idle	--	56.5[a]	47.4	23.3	--	8.5	--	6.0
Osborne and Sparling, 2013[b]	Illinois	Tame grassland (CRP)	Disked	--	52[a]	47.7	22.5	--	16.1	--	5.4
Osborne and Sparling, 2013[b]	Illinois	Tame grassland (CRP)	Glyphosate-sprayed	--	56.7[a]	23.8	37.5	--	12.9	--	4.1
Osborne and Sparling, 2013[b]	Illinois	Tame grassland (CRP)	Glyphosate-sprayed and seeded	--	53.7[a]	29.3	31.3	--	15.5	--	3.6
Wentworth and others, 2010	Pennsylvania	Tame grassland (CREP)	Warm- and cool-season seeding mixture	56.8	47.1[a]	33.1	45.1	1.4	6.8	13.5	--
Sample, 1989	Wisconsin	Multiple	--	72.2	20.3[a]	--	74.6[c]	7.1	7.1	14.1	--
Sousa, 1983[d]	Rangewide	Multiple	--	16–32[e]	--	50–90	--	15–35	--	--	--

[a]Visual obstruction reading (Robel and others, 1970).

[b]The sum of the percentages is greater than 100%, based on methods described by the authors.

[c]Herbaceous vegetation cover.

[d]Values from Habitat Suitability Index Model.

[e]Herbaceous vegetation.

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