

The Effects of Management Practices on Grassland Birds— LeConte's Sparrow (*Ammospiza leconteii*)

Chapter JJ of

The Effects of Management Practices on Grassland Birds



Professional Paper 1842—JJ

U.S. Department of the Interior
U.S. Geological Survey

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By Jill A. Shaffer,¹ Lawrence D. Igl,¹ Douglas H. Johnson,¹
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The Effects of Management Practices on Grassland Birds

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Contents

Acknowledgments	iv
Capsule Statement.....	1
Breeding Range.....	1
Suitable Habitat.....	1
Area Requirements and Landscape Associations.....	5
Brood Parasitism by Cowbirds and Other Species	6
Breeding-Season Phenology and Site Fidelity	6
Species' Response to Management.....	6
Management Recommendations from the Literature	8
References.....	9

Figure

- JJ1. Map showing the breeding distribution of the LeConte's Sparrow (*Ammodramus leconteii*) in the United States and southern Canada, based on North American Breeding Bird Survey data, 2008–12.....2

Table

- JJ1. Measured values of vegetation structure and composition in LeConte's Sparrow (*Ammodramus leconteii*) breeding habitat by study.....14

Conversion Factors

International System of Units to U.S. customary units

Multiply	By	To obtain
Length		
decimeter (dm)	3.937	inch (in.)
centimeter (cm)	0.3937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
Area		
hectare (ha)	2.471	acre
hectare (ha)	0.003861	square mile (mi ²)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as
 $^{\circ}\text{F} = (1.8 \times ^{\circ}\text{C}) + 32$.

Abbreviations

AUM	animal unit month
BBS	Breeding Bird Survey
CRP	Conservation Reserve Program
DNC	dense nesting cover
n.d.	no date
PCP	Permanent Cover Program
PDSI	Palmer Drought Severity Index
PPR	Prairie Pothole Region
spp.	species (applies to two or more species within the genus)

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Capsule Statement

Keys to LeConte’s Sparrow (*Ammospiza leconteii*) management include controlling succession and providing uplands and lowlands with tall, thick herbaceous vegetation and thick litter. LeConte’s Sparrows have been reported to use habitats with 30–90 centimeters (cm) average vegetation height, 19–41 cm visual obstruction reading, 35–43 percent grass cover, 16–27 percent forb cover, less than (<) 18 percent shrub cover, <4 percent bare ground, 39–45 percent litter cover, and 2–6 cm litter depth. The descriptions of key vegetation characteristics are provided in table JJ1 (after the “References” section). Vernacular and scientific names of plants and animals follow the Integrated Taxonomic Information System (<https://www.itis.gov>), except for the genus of the LeConte’s Sparrow, which follows the 59th Supplement to the American Ornithological Society’s Check-list of North American Birds (Chesser and others, 2018).



LeConte’s Sparrow. Illustration by Christopher M. Goldade, used with permission.

Breeding Range

LeConte’s Sparrows breed from the southern Northwest Territories through south-central Manitoba and southern Quebec; south to north-central Montana and northern South Dakota; and east to northern Minnesota, northwestern Wisconsin, and southwestern Ontario (National Geographic Society, 2011). The relative densities of LeConte’s Sparrows in the United States and southern Canada, based on North American Breeding Bird Survey (BBS) data (Sauer and others, 2014), are shown in figure JJ1 (not all geographic places mentioned in report are shown on figure). In recent years, the species has been observed nesting south of its typical breeding range (Igl and Johnson, 1999; Leddy and others, 1999; Igl, 2009).

Suitable Habitat

LeConte’s Sparrows breed in a variety of mesic and xeric habitats, from wetlands to grasslands (Lowther, 2020). LeConte’s Sparrows use mesic habitats, including low wet prairies, the borders of wetlands and riparian areas, sedge (*Carex* species [spp.]) meadows, fens, and peatlands (Peabody, 1901; Walkinshaw, 1937, 1968; Davis, 1952; Murray, 1969; Richter, 1969; Stewart, 1975; Faanes, 1981; Niemi, 1985; Riffell and others, 2003; Morissette and others, 2013; Hillman and others, 2016; Igl and others, 2017; Lowther, 2020). The range of these mesic habitats include the boreal wetlands of Canada (Morissette and others, 2013), the wetland basins and riparian zones within the Prairie Pothole Region (PPR) of the northern United States and southern Canada (Stewart, 1975; Hillman and others, 2016; Taylor, 2018), the wet prairies, sedge meadows, and peatlands of northern Minnesota and of Wisconsin (Peabody, 1901; Faanes, 1981; Niemi and Hanowski, 1984; Niemi, 1985; Winter and others, 2005; Sidie-Slettedahl and others, 2015),

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2 The Effects of Management Practices on Grassland Birds—LeConte’s Sparrow (*Ammospiza leconteii*)

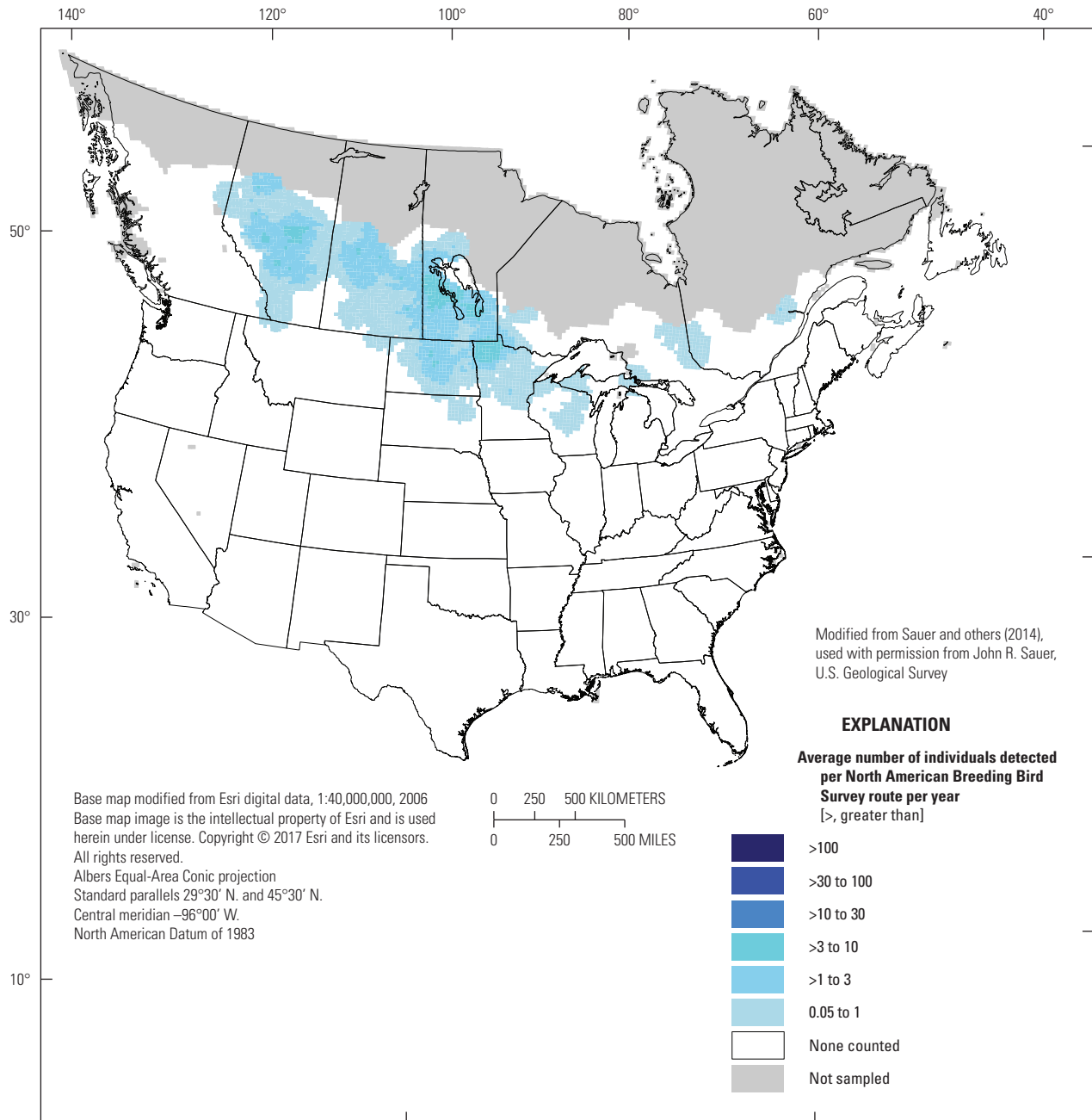


Figure JJ1. The breeding distribution of the LeConte’s Sparrow (*Ammospiza leconteii*) in the United States and southern Canada, based on North American Breeding Bird Survey (BBS) data, 2008–12. The BBS abundance map provides only an approximation of breeding range edges.

and the peatlands and coastal wetlands around the Great Lakes (Walkinshaw, 1937; Brewer and others, 1991; Riffell and others, 2003). The species breeds within shrublands and other open habitats associated with boreal forests (Charchuk and Bayne, 2018; Leston and others, 2018; Taylor, 2018). LeConte’s Sparrows inhabit mixed-grass and tallgrass prairies that are idle, burned, or grazed (Tester and Marshall, 1961; Stewart, 1975; Prescott and Murphy, 1996; Grant and others, 2010; Ranellucci, 2010; Cole, 2016; Carnochan and others, 2018). Planted cover, such as dense nesting cover (DNC) grasslands

and fields enrolled in the Conservation Reserve Program (CRP) and Permanent Cover Program (PCP), also provide suitable habitat (Renken, 1983; Renken and Dinsmore, 1987; Dale, 1993; Dhol and others, 1994; Hartley, 1994; Jones, 1994; Igl and Johnson, 1995, 1999; Prescott and Murphy, 1999; Horn and Koford, 2000; McMaster and Davis, 2001; Igl, 2009). LeConte’s Sparrows occasionally inhabit densely vegetated meadows; dry, upland pastures and hayfields; fallow fields; and cropland (Richter, 1969; Robbins, 1969; Stewart, 1975; Faanes, 1981; Cooper, 1984; Shutler and others, 2000; Mozel, 2010).

LeConte's Sparrows occupy many types of wetlands and mesic grasslands. In a survey of 1,190 wetlands throughout the PPR of North Dakota and South Dakota, LeConte's Sparrows were associated with 47 wetlands, ranging from fresh to saline and varying widely in size and permanence (Igl and others, 2017). The species was observed in a higher proportion of permanent or alkali wetlands than in temporary, seasonal, or semipermanent wetlands (wetland classification based on Stewart and Kantrud, 1971). Wetlands inhabited by LeConte's Sparrows were characterized as having an average of 40 percent open water, 31 percent wet meadow, 20 percent emergent vegetation, and 6 percent shore/mudflat (Igl and others, 2017). Typical vegetation in open, mesic habitats used by LeConte's Sparrows includes sedges (Stewart, 1975; Cooper, 1984; Niemi, 1985), river bulrush (*Bolboschoenus fluvialis*) (Stewart, 1975), softstem bulrush (*Schoenoplectus tabernaemontani*) (Walkinshaw, 1937, 1968), prairie cordgrass (*Spartina pectinata*) (Murray, 1969), and foxtail barley (*Hordeum jubatum*) (Murray, 1969). The largest population of LeConte's Sparrow in Michigan is located within a large monotypic sedge meadow at Seney National Wildlife Refuge on the Upper Peninsula (Lowther, 2020).

The species tolerates some shrubby vegetation, such as scattered willows (*Salix* spp.) (Peabody, 1901; Walkinshaw, 1968; Taylor, 2018). Along an intermittent prairie stream in southern Alberta, Hillman and others (2016) reported that the LeConte's Sparrow occurred in true willow communities (that is, riparian zones inhabited primarily by Bebb's willow [*Salix bebbiana*] and sandbar willow [*Salix exigua*]). In boreal wetlands in Manitoba, Morissette and others (2013) observed the LeConte's Sparrow in marsh, thicket swamp, and shrubby and graminoid fen communities and described the LeConte's Sparrow as an indicator species of shrubby and graminoid fens. Shrub composition included willows, alders (*Alnus* spp.), and sweetgale (*Myrica gale*), and graminoid composition included buckbean (*Menyanthes trifoliata*) and woolly-fruit sedge (*Carex lasiocarpa*). In northern Minnesota peatlands, LeConte's Sparrows inhabited sedge fens with patchy areas of swamp birch (*Betula pumila*) and sweetgale; open bogs dominated by swamp birch and willow; low shrub communities dominated by *Ericacea* spp.; high shrub (that is, shrub swamp) communities dominated by willow, swamp birch, and alder; but did not inhabit black spruce (*Picea mariana*) communities (Nevers and others, 1981; Niemi and Hanowski, 1984). Niemi and Hanowski (1984) characterized the sedge fen and shrub swamp habitats in which LeConte's Sparrows were most abundant (greater than > 7.5 pairs per 10 ha) as having median shrub density > 250 stems per 0.0001 ha. In the low shrub and open spruce habitats in which LeConte's Sparrow abundance was lowest (< 5 pairs per 10 ha), shrubs were dense (< 75 stems per 0.0001 ha). Nevers and others (1981) characterized shrub swamp peatland communities as having shrub heights ranging from 0.3 to 4 m and open bogs and fens with shrub heights ranging from 0.3 to 2.3 m. Along the northern shoreline of Lake Huron in Michigan, LeConte's Sparrows inhabited seasonally or

shallowly flooded wet meadows dominated by sedges and hummock-forming grasses, such as bluejoint (*Calamagrostis canadensis*), and varying amounts of bulrush (*Scirpus* spp.), cattail (*Typha* spp.), and shrubs (Riffell and others, 2003).

LeConte's Sparrow occurrence and abundance are affected by vegetation composition and structure. In uplands, many species of tall, dense, herbaceous vegetation provide suitable habitat. These include Kentucky bluegrass (*Poa pratensis*) (Faanes, 1981; Dale, 1993), fescue (*Festuca* spp.) (Dale, 1993), wheatgrasses (formerly *Agropyron* spp.) (Renken, 1983; Dale, 1993; Madden, 1996; Igl and Johnson, 1999), timothy (*Phleum pratense*) (Peabody, 1901; Davis, 1952; Faanes, 1981), redtop (*Agrostis gigantea*) (Davis, 1952), smooth brome (*Bromus inermis*) (Faanes, 1981; Madden, 1996; Igl and Johnson, 1999), and legumes (Renken, 1983; Dale, 1993; Igl and Johnson, 1999). In PCP grasslands in Alberta, Saskatchewan, and Manitoba, the presence of LeConte's Sparrows was positively associated with the interaction between ecoregion and vegetation height, and negatively associated with bare ground, longitude, and narrow-leaved grass contacts in the first decimeter above the ground (McMaster and Davis, 2001). In 1 year of a 2-year study in mixed-grass prairies in Alberta, LeConte's Sparrow abundance was greater in planted than native grasslands (Davis and others, 2013). In fields converted from cropland to native and tame grass-forb mixtures in Saskatchewan and Manitoba, vegetation structure was a better predictor of bird density than management treatments such as burning or mowing; LeConte's Sparrow density was positively related to the number of contacts of broad-leaved grasses, standing-dead vegetation, and forbs, and negatively related to the quadratic function of the number of contacts of narrow-leaved grasses (Davis and others, 2017). In Manitoba tallgrass prairies, LeConte's Sparrow abundance was positively associated with grasslands with greater litter depth and shorter vegetation, surrounded by other grasslands (Mozel, 2010). In another Manitoba study, LeConte's Sparrow occupancy in rights-of-way (strips of grassland at least 30 meters [m] wide planted under power transmission lines) increased with increasing percentage grass cover (Leston and Koper, 2017). In mixed-grass prairies in North Dakota, LeConte's Sparrows were present in grasslands with higher percentage cover of smooth brome, quackgrass (*Elymus repens*), and tame legumes; lower percentage cover of native grasses and forbs; higher maximum vegetation height; and greater litter depth than in unoccupied grasslands (Grant and others, 2004). LeConte's Sparrow occurrence was not related to percentage cover of Kentucky bluegrass, live vegetation, shrubs > 1 m tall, or shrubs < 1 m tall. In another study in North Dakota mixed-grass prairies, LeConte's Sparrows were associated with a high amount of grass coverage, especially broad-leaved, introduced grasses (Madden, 1996). In DNC fields in North Dakota, LeConte's Sparrow territories were in areas with higher grass coverage and higher effective vegetation height than unoccupied areas (Renken, 1983). In North Dakota tallgrass prairies, LeConte's Sparrow abundance increased as vegetation height-density increased (Cole,

2016). In Minnesota and North Dakota tallgrass prairies, density of LeConte's Sparrows was highest in grasslands with moderate bare ground coverage; density increased with vegetation height at one of the three study areas (Winter and others, 2005).

LeConte's Sparrows prefer fields of planted grassland cover over cropland. In Alberta, Saskatchewan, and Manitoba, LeConte's Sparrows occurred more frequently in PCP grasslands than in cropland (McMaster and Davis, 2001). In other studies in Alberta, Saskatchewan, and Manitoba, LeConte's Sparrows were not observed in cropland, including fallow cropland (Dale, 1993; Hartley, 1994; Jones, 1994; Prescott and Murphy, 1999). In Saskatchewan uplands, LeConte's Sparrows were more numerous in DNC fields than in organic cropland fields but were not present in conventional or minimum-tillage farmland (Shutler and others, 2000). In wetlands and their margins, the relative abundance of LeConte's Sparrow was higher in organic cropland fields than in conventional cropland fields or DNC fields, and the species was not present within minimum-tillage farmland (Shutler and others, 2000). In another Saskatchewan study, LeConte's Sparrows were less abundant on organic than conventional farms (Kirk and others, 2020). In a 2-year study in Manitoba, Mozel (2010) reported that LeConte's Sparrow abundance was significantly lower in agricultural areas than in tallgrass prairies in the first year of the study and that the species was absent from agricultural fields in the second year of the study. In North Dakota, singing male LeConte's Sparrows were observed in small-grain fields that were CRP grasslands the previous year (L.D. Igl and D.H. Johnson, unpub. data). Presence in these small-grain fields, however, may have been an expression of site fidelity to a previous breeding site. In North Dakota, low, wet areas provide optimal breeding habitat, but LeConte's Sparrows also nest in tame hayfields and former cropland fields planted to tame species of grasses (Stewart, 1975).

LeConte's Sparrows prefer areas with dense litter for nesting (Peabody, 1901; Tester and Marshall, 1961; Murray, 1969; Madden, 1996; Winter and others, 2005). In Minnesota and North Dakota, LeConte's Sparrows breed in hummocky alkali fens, bogs, mixed-grass prairie, tallgrass prairie, wet-meadow zones of wetlands, tame hayfields, and retired cropland (Johnsgard, 1979; Nevers and others, 1981; Madden, 1996). LeConte's Sparrows nest on the ground in dense herbaceous vegetation, usually in the drier borders of wetlands. Although LeConte's Sparrows nested among scattered small willows in Minnesota and Michigan, they seemed to prefer areas free of shrubs and other woody vegetation (Peabody, 1901; Walkinshaw, 1968; Robbins, 1969; Hanowski and others, 1999). In Minnesota mesic tallgrass prairies, nests were placed in areas with less bare ground and less woody vegetation than was generally available within the study plots (Winter and others, 2005). Nests were placed on or close to the ground; average height of 46 nests was 2.6 cm. These nests were surrounded by shorter vegetation with lower visual obstruction readings than the vegetation available within study plots. Of 44 nests, 96 percent were placed within litter, and 87 percent of 46 nests

were covered by surrounding live and dead vegetation. The average distance of 46 nests to the nearest tree or tree clump was 123.1 m. None of the measured vegetation variables (that is, visual obstruction reading, maximum vegetation height, percentage cover of various life forms, and litter depth) affected nest success. A successful nest was one in which at least one host young fledged. Nest success was most affected by distance from trees, such that nest success increased slightly with increasing distance from trees (Winter and others, 2005).

LeConte's Sparrow populations show dramatic local annual fluctuations, probably because of changes in seasonal moisture conditions (Peabody, 1901; Robbins, 1969; Stewart, 1975; Igl and Johnson, 1995, 1999; Madden, 1996). In an Alberta study examining boreal forest regeneration after harvesting, El Niño conditions were a strong predictor of LeConte's Sparrows returning to previously occupied harvest units in the subsequent breeding season (Leston and others, 2018). In North Dakota and Minnesota, Winter and others (2005) found no relationship between the Palmer Drought Severity Index (PDSI) or the Conserved Soil Moisture Index (that is, an index that indicates the weighted average of precipitation during the 21 months preceding May of a particular year) and density or nest success, possibly because climatic variability during this 4-year study was too low to detect an effect. Using two indices of regional moisture (that is, the number of wetland basins containing water during annual May waterfowl surveys and the PDSI), Niemuth and others (2008) reported that the abundance of LeConte's Sparrows along 13 BBS routes in northern North Dakota was positively associated with the number of wetland basins containing water in May of the same year and in May of the previous year. Dispersion (that is, percentage of 13 BBS routes on which the species was detected) was positively associated with the PDSI for the current and previous years. In a 6-year study in northern North Dakota, LeConte's Sparrow abundance was lowest in the first 2 years, when precipitation was highest, and highest in the third and fourth years of the study, when precipitation began to decline (Grant and others, 2010). During a 7-year period in four States in the northern Great Plains, Igl and Johnson (1999) reported that LeConte's Sparrow densities in CRP fields were positively correlated with precipitation.

Wilsey and others (2019) compiled avian occurrence data from 40 datasets to project climate vulnerability scores under scenarios in which global mean temperature increases 1.5, 2, or 3 degrees Celsius (°C). LeConte's Sparrows ranked moderate in vulnerability during the breeding season at 1.5 °C and 2 °C increases and ranked high at a 3 °C increase, with a projected 95-percent loss of the modeled current breeding distribution. Using a combination of BBS, eBird (<https://www.ebird.org>; Sullivan and others, 2009), and point-count data, Nixon and others (2016) modeled the effect of future climate change scenarios on LeConte's Sparrow breeding distribution along the boreal forest-prairie ecotone in Alberta and predicted that LeConte's Sparrows would shift gradually northward within the next 80 years, with the potential for a decline in the area of suitable breeding

habitat. Under projected greenhouse gas emission scenarios described by the Intergovernmental Panel on Climate Change (2000), Langham and others (2015) categorized the LeConte's Sparrow as a climate-endangered species, indicating that the species would lose more than 50 percent of its current distribution by 2050 across all Intergovernmental Panel on Climate Change scenarios, with no net gain from potential range expansion.

Area Requirements and Landscape Associations

Little information is available regarding the area requirements of the LeConte's Sparrow. Estimates of breeding territory size in North Dakota and Minnesota were 0.2 hectare (ha) (Murray, 1969; Cooper, 1984; Lowther, 2020). In a 2-year study in Manitoba tallgrass prairies, Mozel (2010) found that patch metrics were important in LeConte's Sparrow habitat selection. In the first year of the study, LeConte's Sparrows chose larger, higher-quality prairies with a lower degree of fragmentation. In the second year of the study, LeConte's Sparrows selected prairies with greater litter depth and shorter vegetation that were surrounded by other grasslands. In tallgrass prairies of North Dakota and Minnesota, Winter and others (2005) found no relationship between patch size and LeConte's Sparrow density or nest success. In CRP fields in nine counties in the northern Great Plains, evidence of area sensitivity (that is, a preference for larger grasslands over smaller grasslands) was weak for the LeConte's Sparrow, but there was a tendency toward greater area sensitivity in eastern counties; patch size positively affected LeConte's Sparrow frequency of occurrence in one county in west-central Minnesota (Johnson and Igl, 2001).

LeConte's Sparrows may be affected by the composition of the surrounding landscape. Within the PPR of Canada, Fedy and others (2018) examined the effect of grassland, cropland, and wetland habitats at four scales (within 400; 800; 1,600; and 3,200 m of BBS stops) on the relative probability of occurrence of LeConte's Sparrow. The best model for predicting LeConte's Sparrow occurrence indicated that the species' preferred landscapes that consisted of tame and native grasslands and annually seeded cropland within 3,200 m, and that the species selected against landscapes with a high wetland area count within 3,200 m (Fedy and others, 2018). In a 2-year study in mixed-grass prairies in Alberta and Saskatchewan, LeConte's Sparrow abundance increased in 1 year in Alberta with the amount of native grassland within 400 m of grassland patches, whereas for both years in Saskatchewan, LeConte's Sparrow abundance was greater in landscapes dominated by native grasslands than in landscapes dominated by planted grasslands (Davis and others, 2013). In Saskatchewan hayfields, the number of LeConte's Sparrow

pairs was not affected by the amount of cropland or wetland within 1.6 kilometers (km) of study areas (McMaster and others, 1999). In Manitoba tallgrass prairies, LeConte's Sparrows relative abundance was higher in large tallgrass prairie patches with higher percentages of grassland and agricultural land cover in the adjacent matrix than in small patches with higher percentages of forest, wetland, and urban land cover in the adjacent matrix (Bruinsma, 2012). In another Manitoba study, LeConte's Sparrow occupancy in rights-of-way declined as the amount of urban land within 100 m of rights-of-way increased; occupancy was not related to amount of wooded land, cropland, or grassland within 100 m of rights-of-way (Leston and Koper, 2017). In tallgrass and mixed-grass prairie fragments in western Minnesota and eastern North Dakota and South Dakota, LeConte's Sparrow occupancy was higher in prairie remnants characterized by sparse vegetation and little open water, and embedded in landscapes with high matrix contagion (that is, a measure of the configuration of the different landscape element patches within the landscape) and more CRP edges (Shahan and others, 2017). In North Dakota and South Dakota, LeConte's Sparrows were observed around 47 wetlands that averaged 13 ha in size (Igl and others, 2017). Landscape composition within 800 m of these wetlands was 54 percent grassland, 25 percent agricultural, and 15 percent wetland; the average number of wetlands within 800 m of these wetlands was 20.

At a landscape scale, the amount of woodland surrounding a grassland patch may affect LeConte's Sparrow distribution and abundance. Within the PPR of Canada, Fedy and others (2018) examined the effect of shrubland and woodland habitats at four scales (within 400; 800; 1,600; and 3,200 m of BBS stops) on the relative probability of occurrence of LeConte's Sparrow. The best model for predicting LeConte's Sparrow occurrence indicated that the species avoided shrubby and wooded landscapes within 3,200 m (Fedy and others, 2018). In the boreal forest region in Alberta, LeConte's Sparrows were most closely associated with natural disturbance harvests, in which harvesting of timber approximated some elements of natural disturbances, such as fire (Charchuk and Bayne, 2018). In North Dakota mixed-grass prairies, Grant and others (2004) compared the tolerance of LeConte's Sparrows for woody encroachment at the territory and landscape levels and found that the species was sensitive at both levels. LeConte's Sparrows were present in grasslands with lower percentages of quaking aspen (*Populus tremuloides*) woodland within 100 and 500 m than in unoccupied areas. The species' maximum probability of occurrence never exceeded 55 percent within the study area, and the probability of occurrence declined to 40 percent at about 10 percent woodland cover within 500 m. In tallgrass prairies of North Dakota and Minnesota, Winter and others (2005) reported no relationship between LeConte's Sparrow density and nest success and the percentage of trees and shrubs within 1 km of the study areas.

Brood Parasitism by Cowbirds and Other Species

Rates of brood parasitism by Brown-headed Cowbirds (*Molothrus ater*) in LeConte's Sparrow nests are low to moderate (Shaffer and others, 2019; Lowther, 2020), although the effect on productivity is unknown (Peabody, 1901; Friedmann, 1963; Murray, 1969; Friedmann and Kiff, 1985). Rates of cowbird brood parasitism varied from 0 percent of 36 nests (Richter, 1969; T.C. Erdman, personal commun. [n.d.] in Lowther, 2020) to 29 percent of 14 nests (Peabody, 1901), as summarized in Shaffer and others (2019). Multiple parasitism has been documented (Igl and Kantrud, 2003; Winter and others, 2005; Igl and Johnson, 2007).

Breeding-Season Phenology and Site Fidelity

The breeding season of the LeConte's Sparrow extends from about early May until late August or early September (Murray, 1969; Stewart, 1975; Faanes, 1981; Lowther, 2020). LeConte's Sparrows will renest following the loss of a nest, but double-brooding has not been reported (Walkinshaw, 1968; Johnsgard, 1979). In North Dakota, one of seven banded male LeConte's Sparrows returned to the breeding site of the previous year in the year after banding, and none of six banded females returned (Murray, 1969). In Minnesota, one female of 93 banded birds of both sexes returned to the breeding site of the previous year (Winter and others, 2005). In Michigan, a male banded as a juvenile was encountered nearly 30 km from his banding location at the age of 4 years and 1 month (Johnson and Usyk, 2009).

Species' Response to Management

In mesic wetland habitats, periodic treatments such as burning or shearing may be needed to control woody vegetation. In northeastern Minnesota, LeConte's Sparrows were more abundant in emergent wetlands managed with burning and shearing of shrubby vegetation than in unmanaged wetlands (Hanowski and others, 1999). In a study at Seney National Wildlife Refuge that evaluated the response of burning as a management tool to reduce the encroachment of woody vegetation into fens for the management of species such as the LeConte's Sparrow, Austin and Newton (2019) concluded that neither spring nor summer burning under moderate fire conditions is effective in controlling encroachment. Along riparian areas, river flow can affect LeConte's Sparrow habitat; Hillman and others (2016) reported that increased river flow along a prairie stream in southern Alberta benefitted the spread of willow shrub communities, a habitat preferred by

LeConte's Sparrow. In the PPR, restored wetlands can provide habitat for the species; Igl and others (2017) reported that LeConte's Sparrows were observed in nearly equal proportions in natural and restored wetlands.

In upland habitats, periodic treatments, such as burning, mowing, grazing, or combinations thereof, may be needed to maintain optimal habitat for LeConte's Sparrows. Although little information is available, LeConte's Sparrows seem to respond favorably to the effects of burning in some parts of their range. In a study of grasslands in Manitoba and Saskatchewan converted from cropland to native and tame grass-forb mixtures and managed for 1–9 years by burning or mowing, Davis and others (2017) reported that the occurrence of LeConte's Sparrows was most strongly affected by years postmanagement in Manitoba only. LeConte's Sparrow reached its greatest densities 4–5 years postmanagement, but the effect was stronger in only 1 of 2 years. In North Dakota mixed-grass prairies, the species increased in abundance with repeated fires and was absent from prairies that had not been burned for long periods (Madden, 1996). LeConte's Sparrows reached highest abundance 2 years postburn (Madden, 1996; Madden and others, 1999). Abundance was highest in grasslands that had been burned 4 times in the previous 15 years, compared to unburned areas and areas burned 1–2 times in the previous 15 years. In another study in North Dakota mixed-grass prairies, the number of indicated pairs of LeConte's Sparrows was lowest during the first growing season postfire but increased and stabilized within two to three postfire growing seasons (Grant and others, 2010, 2011). LeConte's Sparrow abundance was positively associated with increasing standing dead vegetation, which increased by 39 percent during the second postfire growing season (Grant and others, 2010). Litter depth increased 1–2 cm during each growing season postburn. LeConte's Sparrows in Minnesota avoided burned areas immediately after burning, but they were present the following year after litter and vegetation regrowth increased (Tester and Marshall, 1961). In western Minnesota and northwestern Iowa, Ahlring and others (2019) examined the effect of grassland type (remnant prairie or restored grassland), land ownership (publicly or privately owned), or management history (time since fire or grazing) on LeConte's Sparrow abundance beyond that of local vegetation and landscape variables. Fire history best explained additional variation in the abundance of LeConte's Sparrows, although a second model containing fire and grazing history also was competitive. LeConte's Sparrows were least abundant during years when grasslands were burned.

Annual haying may negatively affect breeding LeConte's Sparrows (Murray, 1969; Dale and others, 1997; Igl and Johnson, 2016). In addition to direct destruction of nests by mowing, repeated mowing reduces the dense litter layer preferred by the species (Dale and others, 1997). In Alberta, Saskatchewan, and Manitoba, the frequency of occurrence of LeConte's Sparrows was higher in hayed PCP fields than in grazed PCP fields (McMaster and Davis, 2001). In Saskatchewan, LeConte's Sparrows preferred periodically mowed

(idle for 3–8 years) tame haylands more than annually mowed tame haylands or idle mixed-grass prairies (Dale and others, 1997). Hayfields mowed at longer than 1-year intervals provided stands of introduced, broad-leaved grasses attractive to LeConte's Sparrows. In Manitoba rights-of-way, LeConte's Sparrow occupancy was not related to any of the management treatments used to maintain rights-of-way, which were mowing and herbicide spraying once or twice per year without haying, mowing and haying once per year, or no mowing except for tree removal (Leston and Koper, 2017). In North Dakota, highest abundances of LeConte's Sparrows occurred on hayland that had been mowed 1 year previously, providing tall grass growth that was preferred for nesting (Kantrud, 1981). In another North Dakota study, LeConte's Sparrows were marginally more abundant in the year after mowing in idled portions of CRP fields than in mowed portions (Horn and Koford, 2000). Igl and Johnson (2016) assessed the effects of haying on grassland breeding birds in 483 CRP fields in nine counties in four States in the northern Great Plains between 1993 and 2008. LeConte's Sparrows occurred in CRP fields in 8 of the 9 counties. Compared to breeding densities in CRP grasslands that had been idled for 5 or more years, LeConte's Sparrow densities generally were lower in the first year after haying, but there was no consistent pattern among counties in subsequent years. In Minnesota, 21 percent of 24 territories were within annually cut hayland; the remaining territories were mostly in idle grass and fallow fields (Cooper, 1984).

The effects of grazing on LeConte's Sparrow habitat are not clear (Bock and others, 1993). In Manitoba mixed-grass prairies, Ranellucci and others (2012) and Carnochan and others (2018) examined the effects of twice-over rotational grazing (grazing twice per season at an average 0.31 animal unit month [AUM] per ha, with about a 2-month rest in between grazing), and season-long grazing (continuously grazing at an average 0.35 AUM per ha). Ranellucci and others (2012) reported no difference in the abundance of LeConte's Sparrows among twice-over, season-long, and ungrazed pastures. Carnochan and others (2018) reported a similar number of nests between grazing systems, but sample sizes were low. For a suite of ground-nesting species that included LeConte's Sparrow, nest success was lower in twice-over than in season-long grazing systems; the probability of a nest succeeding on twice-over grazed pastures was 4 times lower during 1 year of the 2-year study, and 2.4 times lower in the second year (Carnochan and others, 2018). In Alberta, LeConte's Sparrows occurred more frequently in tame pastures than in native pastures, but they were absent from native parklands that were grazed under a season-long grazing system (Prescott and Murphy, 1996). In tame pastures, LeConte's Sparrows preferred high grass biomass and low proportion of forbs relative to grasses; in native pastures, the species preferred low-to-moderate cover diversity and moderate-to-tall grass of uniform height (Prescott and Murphy, 1996). LeConte's Sparrows used actively grazed areas in Minnesota and idle

pastures in Minnesota and Wisconsin, provided that adequate litter was present (Tester and Marshall, 1961; Robbins, 1969).

LeConte's Sparrows regularly inhabit thick, undisturbed cover provided by CRP, DNC, and PCP plantings (Renken, 1983; Renken and Dinsmore, 1987; Dale, 1993; Igl and Johnson, 1995, 1999; Prescott and Murphy, 1999; McMaster and Davis, 2001; Igl, 2009). In Alberta, Prescott and others (1995) found that LeConte's Sparrows were abundant in native and tame DNC fields. LeConte's Sparrows were rare or absent in DNC fields that were <2 years old, increased in abundance through the fifth year, and decreased in abundance after the fifth and final year of the study (Prescott and Murphy, 1999). In that study, DNC fields were mostly planted to tame vegetation, although a native component was present. In Saskatchewan, Dale (1993) observed LeConte's Sparrows in tame DNC fields planted to intermediate and tall wheatgrasses (*Thinopyrum intermedium*, *Thinopyrum ponticum*), alfalfa (*Medicago sativa*), and sweetclover (*Melilotus* spp.). LeConte's Sparrows also were very common in low nesting cover consisting of Kentucky bluegrass and creeping red fescue (*Festuca rubra*) (Dale, 1993). In another Saskatchewan study, LeConte's Sparrows bred in native and tame DNC fields that were 3–5 years old (Hartley, 1994). In Manitoba, LeConte's Sparrows were detected in native grassland, native DNC fields, tame DNC fields, and hayland (Jones, 1994). In another Manitoba study, LeConte's Sparrows were more abundant in native DNC fields than in idle native grasslands, but no difference in abundance was found between native and tame DNC fields or between tame DNC fields and native grasslands; no difference in productivity among the three habitats was detected (Dhol and others, 1994). In North Dakota, LeConte's Sparrows used DNC fields of alfalfa and intermediate and tall wheatgrasses that were idle for 6–9 years (Renken and Dinsmore, 1987). In a 7-year study in the northern Great Plains, Igl and Johnson (1995, 1999) reported that LeConte's Sparrows were one of the most abundant species in CRP grasslands in 3 of the 7 years.

Energy development may negatively affect LeConte's Sparrow distribution and abundance. Graff and others (2016) reported one mortality of a LeConte's Sparrow from carcass searches conducted around two wind facilities in North Dakota and South Dakota during a 12-month period. Beston and others (2016) developed a prioritization system for 428 avian species to identify those species 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 LeConte's Sparrow scored a 3.32 out of nine; 5.11 percent of the LeConte's Sparrow breeding population in the United States were estimated to be exposed to wind facilities. In northern Minnesota peatlands, Niemi and Hanowski (1984) concluded that habitat differences between treatment and control areas hindered a conclusive determination of whether a 500-kilovolt transmission line affected LeConte's Sparrow density.

Management Recommendations from the Literature

Protection of mesic habitats throughout the LeConte's Sparrow breeding range will benefit this species (Lowther, 2020). Within the PPR, grassland landscapes that include wetland complexes with a gradient of water permanencies and wetland sizes will provide suitable LeConte's Sparrow breeding habitat during both wet and dry years (Igl and others, 2017). Restored wetlands within grassland landscapes also support LeConte's Sparrows during the breeding season (Igl and others, 2017). Along prairie streams, ample river flow ensures the survival of willow communities that support LeConte's Sparrows (Hillman and others, 2016). In the boreal zone, protection of peatlands is necessary to maintain breeding habitat for the LeConte's Sparrow (Hanowski and others, 1999; Riffell and others, 2003; Morissette and others, 2013). Near the Great Lakes, Riffell and others (2003) recommended protection of landscapes consisting of wet meadows and other forms of emergent, coastal wetlands, including woody wetlands, shrub swamp communities, and streams. Within the Great Plains, Fedy and others (2018) recommended the identification of landscapes consisting of high amounts of grassland and wetland habitats and low amounts of woodland to enhance managers' ability to prioritize habitat management actions and define areas that may provide successful conservation outcomes.

In upland habitats, maintaining unbroken native prairie or converting agricultural fields to grasslands will be beneficial to LeConte's Sparrows (Mozel, 2010; Davis and others, 2017). Johnson (1996) and McMaster and Davis (1998) emphasized the importance of protecting native grasslands through conservation easements, land purchases, and development of farm programs with wildlife habitat conservation priorities. Shahan and others (2017) indicated that effective management of LeConte's Sparrows will require attention to the landscape composition and configuration within which remaining grassland patches are embedded. Davis and others (2013) suggested that converting cropland to non-native grassland near existing parcels of native grassland, especially in cropland-dominated landscapes, will benefit grassland bird species.

Tailoring the frequency, timing, and type of management may be necessary to account for differences in grassland type and annual precipitation (Davis and others, 2017). Burning every 2–4 years in mesic, mixed-grass prairies may benefit LeConte's Sparrows; in North Dakota, the species reached its highest abundances 2–3 years postburn and avoided unburned prairie (Madden, 1996; Madden and others, 1999; Grant and others, 2010). In native grasslands on

U.S. Fish and Wildlife Service lands in the northern Great Plains, Grant and others (2010) warned that burning as a management tool is used too infrequently, and that the extent and frequency of prescribed burns need to increase above current levels (that is, long-term rest) in order to maintain and restore the ecological integrity of native prairies. Davis and others (2017) recommended that some form of management of planted grasslands should occur every 4–6 years to maintain a mosaic of sites that create habitat for the suite of generalist grassland bird species.

Annual mowing may destroy nests and reduce dense litter needed for nesting (Murray, 1969; Dale and others, 1997). In Saskatchewan, dense cover can be maintained by mowing some fields in alternate years while leaving others idle for at least 3 years (Dale and others, 1997). Grasslands mowed at longer (2–9 years) intervals also may be suitable (Renken and Dinsmore, 1987). If fields need to be mowed at <2-year intervals, productivity of hay and of birds may benefit from dividing large fields in half and mowing each half in alternate years (Dale and others, 1997). Delaying mowing of hayfields until after July 15 or until after most nests have fledged young may protect many nests from destruction (Dale and others, 1997). In Manitoba, Leston and Koper (2017) suggested that unmowed urban grassy rights-of-way might benefit the LeConte's Sparrow. Mowing or grazing of CRP land during extremely wet years may negatively affect breeding LeConte's Sparrows because this species may only breed in this habitat under moist conditions (Igl and Johnson, 1995).

Ranellucci and others (2012) suggested that traditional grazing systems, such as season-long grazing, may be more beneficial to grassland bird management than rotational systems. Carnochan and others (2018) advised caution in applying a twice-over grazing system for the management of grassland birds. For the suite of grassland birds that included LeConte's Sparrow, a season-long grazing system conferred greater reproductive success, including lower rates of nest destruction owing to cattle trampling.

Periodic disturbances may be necessary to prevent the accumulation of excessive litter and the encroachment of woody vegetation (Robbins, 1969; Kantrud, 1981; Dale and others, 1997). Tester and Marshall (1961) suggested that idling for longer than 1 year in Minnesota tallgrass prairies may allow litter to exceed that which is suitable for use by LeConte's Sparrows. Grant and others (2004) suggested that managers focus initial restoration efforts on grasslands with <20 percent woodland encroachment because these grasslands would have the most immediate and lasting conservation benefit for LeConte's Sparrows and other grassland birds. Grant and others (2004) discouraged the implementation of programs that plant trees and tall shrubs within grasslands.

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Table JJ1. Measured values of vegetation structure and composition in LeConte's Sparrow (*Ammodramus leconteii*) 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; --, no data; DNC, dense nesting cover; >, greater than]

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)
Grant and others, 2004	North Dakota	Mixed-grass prairie	Multiple	55	--	--	--	17.3	--	--	4.3
Madden, 1996	North Dakota	Mixed-grass prairie	Burned	--	19 ^a	42.7	27.3	17.7	--	--	4.3
Niemi, 1985 (territories)	Minnesota	Peatland	--	90	--	--	--	--	--	--	--
Renken, 1983 ^b	North Dakota	Tame grassland (DNC)	Idle, grazed	--	41 ^a	88.8	35.4	0	0.3	99	2.4
Tester and Marshall, 1961	Minnesota	Tallgrass prairie	Multiple	>30 ^c	--	--	--	--	--	--	--
Winter and others, 2005	Minnesota, North Dakota	Tallgrass prairie	Idle, grazed	46.8	26 ^a	35	20.7	1.4	3.3	38.7	5.2
Winter and others, 2005 (nests)	Minnesota, North Dakota	Tallgrass prairie	Idle, grazed	37.3	19 ^a	37.6	15.6	0.2	0.5	45.3	6.1

^aVisual obstruction reading (Robel and others, 1970).

^bThe sum of the percentages is >100%, based on the modified point-quadrat technique of Wiens (1969).

^cGrass height.

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