

2002

Effects of Management Practices on Grassland Birds: Baird's Sparrow

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Dechant, Jill A.; Sondreal, Marriah L.; Johnson, Douglas H.; Igl, Lawrence D.; Goldade, Christopher M.; Nenneman, Melvin P.; and Euliss, Betty R., "Effects of Management Practices on Grassland Birds: Baird's Sparrow" (2002). *USGS Northern Prairie Wildlife Research Center*. 125.
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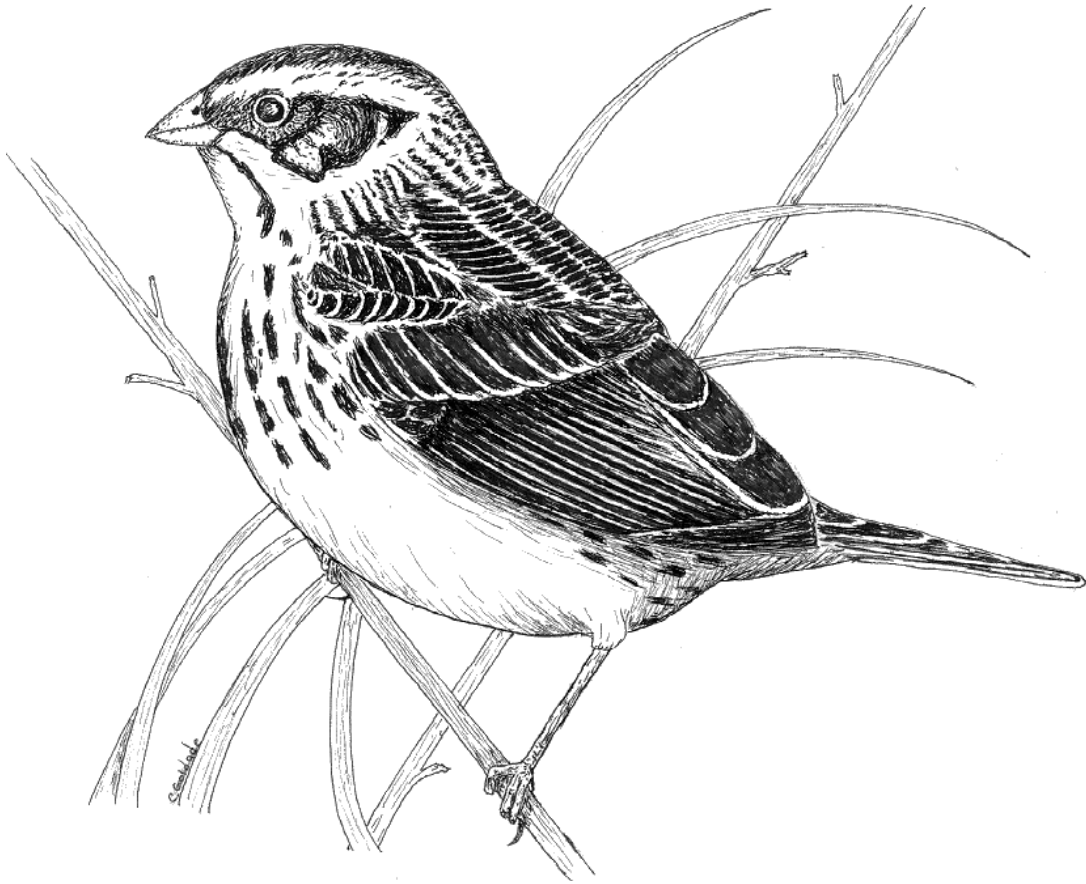
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EFFECTS OF MANAGEMENT PRACTICES ON GRASSLAND BIRDS:

BAIRD'S SPARROW



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This report is one in a series of literature syntheses on North American grassland birds. The need for these reports was identified by the Prairie Pothole Joint Venture (PPJV), a part of the North American Waterfowl Management Plan. The PPJV recently adopted a new goal, to stabilize or increase populations of declining grassland- and wetland-associated wildlife species in the Prairie Pothole Region. To further that objective, it is essential to understand the habitat needs of birds other than waterfowl, and how management practices affect their habitats. The focus of these reports is on management of breeding habitat, particularly in the northern Great Plains.

Suggested citation:

Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, M. P. Nenneman, and B. R. Euliss. 1998 (revised 2002). Effects of management practices on grassland birds: Baird's Sparrow. Northern Prairie Wildlife Research Center, Jamestown, ND. 19 pages.

Species for which syntheses are available or are in preparation:

American Bittern	Grasshopper Sparrow
Mountain Plover	Baird's Sparrow
Marbled Godwit	Henslow's Sparrow
Long-billed Curlew	Le Conte's Sparrow
Willet	Nelson's Sharp-tailed Sparrow
Wilson's Phalarope	Vesper Sparrow
Upland Sandpiper	Savannah Sparrow
Greater Prairie-Chicken	Lark Sparrow
Lesser Prairie-Chicken	Field Sparrow
Northern Harrier	Clay-colored Sparrow
Swainson's Hawk	Chestnut-collared Longspur
Ferruginous Hawk	McCown's Longspur
Short-eared Owl	Dickcissel
Burrowing Owl	Lark Bunting
Sedge Wren	Bobolink
Horned Lark	Eastern Meadowlark
Loggerhead Shrike	Western Meadowlark
Sprague's Pipit	Brown-headed Cowbird

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Major Funding: Prairie Pothole Joint Venture, U.S. Fish and Wildlife Service
U.S. Geological Survey

Funding also provided by: U.S. Forest Service

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May 1998
(revised January 2002)

ORGANIZATION AND FEATURES OF THIS SPECIES ACCOUNT

Information on the habitat requirements and effects of habitat management on grassland birds were summarized from information in more than 4,000 published and unpublished papers. A **range map** is provided to indicate the relative densities of the species in North America, based on Breeding Bird Survey (BBS) data. Although birds frequently are observed outside the breeding range indicated, the maps are intended to show areas where managers might concentrate their attention. It may be ineffectual to manage habitat at a site for a species that rarely occurs in an area. The species account begins with a brief **capsule statement**, which provides the fundamental components or keys to management for the species. A section on **breeding range** outlines the current breeding distribution of the species in North America, including areas that could not be mapped using BBS data. The **suitable habitat** section describes the breeding habitat and occasionally microhabitat characteristics of the species, especially those habitats that occur in the Great Plains. Details on habitat and microhabitat requirements often provide clues to how a species will respond to a particular management practice. A **table** near the end of the account complements the section on suitable habitat, and lists the specific habitat characteristics for the species by individual studies. A special section on **prey habitat** is included for those predatory species that have more specific prey requirements. The **area requirements** section provides details on territory and home range sizes, minimum area requirements, and the effects of patch size, edges, and other landscape and habitat features on abundance and productivity. It may be futile to manage a small block of suitable habitat for a species that has minimum area requirements that are larger than the area being managed. The Brown-headed Cowbird (*Molothrus ater*) is an obligate brood parasite of many grassland birds. The section on **cowbird brood parasitism** summarizes rates of cowbird parasitism, host responses to parasitism, and factors that influence parasitism, such as nest concealment and host density. The impact of management depends, in part, upon a species' nesting phenology and biology. The section on **breeding-season phenology and site fidelity** includes details on spring arrival and fall departure for migratory populations in the Great Plains, peak breeding periods, the tendency to renest after nest failure or success, and the propensity to return to a previous breeding site. The duration and timing of breeding varies among regions and years. **Species' response to management** summarizes the current knowledge and major findings in the literature on the effects of different management practices on the species. The section on **management recommendations** complements the previous section and summarizes specific recommendations for habitat management provided in the literature. If management recommendations differ in different portions of the species' breeding range, recommendations are given separately by region. The **literature cited** contains references to published and unpublished literature on the management effects and habitat requirements of the species. This section is not meant to be a complete bibliography; a searchable, annotated bibliography of published and unpublished papers dealing with habitat needs of grassland birds and their responses to habitat management is posted at the Web site mentioned below.

This report has been downloaded from the Northern Prairie Wildlife Research Center World-Wide Web site, www.npwr.usgs.gov/resource/literatr/grasbird/grasbird.htm. Please direct comments and suggestions to Douglas H. Johnson, Northern Prairie Wildlife Research Center, U.S. Geological Survey, 8711 37th Street SE, Jamestown, North Dakota 58401; telephone: 701-253-5539; fax: 701-253-5553; e-mail: Douglas_H_Johnson@usgs.gov.

BAIRD'S SPARROW
(*Ammodramus bairdii*)

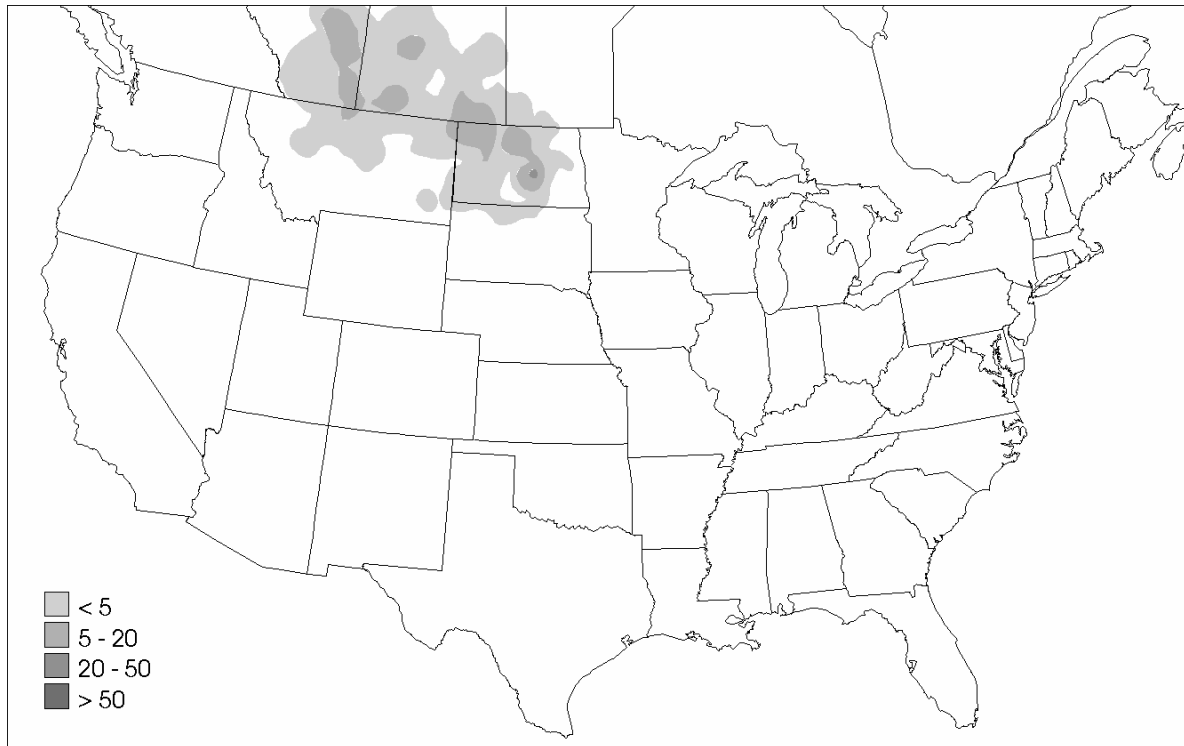


Figure. Breeding distribution of the Baird's Sparrow in the United States and southern Canada, based on Breeding Bird Survey data, 1985-1991. Scale represents average number of individuals detected per route per year. Map from Price, J., S. Droege, and A. Price. 1995. *The Summer Atlas of North American Birds*. Academic Press, London, England. 364 pages.

Keys to management are providing areas of native or tame grassland with moderately deep litter, controlling excessive grazing, and curtailing shrub encroachment.

Breeding range:

Baird's Sparrows are endemic to the northern Great Plains (Mengel 1970), breeding from southern Alberta to southern Manitoba, and from northern and eastern Montana through western Minnesota (National Geographic Society 1987). (See figure for the relative densities of Baird's Sparrows in the United States and southern Canada, based on Breeding Bird Survey data.)

Suitable habitat:

Baird's Sparrows prefer idle native or idle tame grasslands, and lightly to moderately grazed pastures (Owens and Myers 1973, Stewart 1975, Kantrud and Kologiski 1982, De Smet and Conrad 1991, Skeel et al. 1995, Sutter 1996, Davis and Duncan 1999). They sometimes use planted cover (e.g., Conservation Reserve Program and dense nesting cover), dry wetland basins, wet meadows, and dense stands of grass within hayland and cropland (Lane 1968, Stewart 1975, Renken 1983, Johnson and Schwartz 1993, Davis et al. 1996, McMaster and Davis 1998). General habitat requirements include moderately deep litter; vegetation height of >20 cm but <100 cm; moderately high, but patchy, forb coverage; patchy grass and litter cover; and little

woody vegetation. Shrub cover in areas occupied by Baird's Sparrows is lower than in random areas (Dale 1983, Arnold and Higgins 1986, Madden 1996, Jones and Green 1998), and shrub cover >25% may negatively impact habitat suitability (Sousa and McDonal 1983). In Manitoba, however, Baird's Sparrow densities were high in pastures with 10-50% shrub cover and >50% shrub cover, but dense shrub patches were avoided (De Smet and Conrad 1991).

Native prairie traditionally is regarded as optimal breeding habitat (Cartwright et al. 1937, Lane 1968, Owens and Myres 1973, Dale 1992, Dale et al. 1997, Jones and Green 1998), and some studies have shown that Baird's Sparrows do exhibit a preference for native grasses (Winter 1994, Madden 1996). However, some studies in Canada have found no preference between native and tame grasslands and suggest that Baird's Sparrows respond more strongly to vegetative structure than to species composition (Anstey et al. 1995, Sutter et al. 1995, Davis et al. 1996, Davis et al. 1999). Tame stands of smooth brome (*Bromus inermis*) and other broad-leaved (5-10 mm) grasses may be avoided, while stands of tame, narrow-leaved (2-4 mm) grasses (e.g., crested wheatgrass [*Agropyron cristatum*]) are readily used (Dale 1992, Anstey et al. 1995, Mahon 1995, Sutter et al. 1995, Madden 1996, Dale et al. *in review*).

In Saskatchewan, Baird's Sparrows were common in both lightly grazed mixed-grass prairie and stands of crested wheatgrass (Sutter and Brigham 1998). In prairie, numbers of Baird's Sparrows were positively correlated to litter cover, litter depth, and vertical vegetation density; numbers of Baird's Sparrows were lower in areas with high percent grass and sedge cover and high maximum vegetation height than in areas with high litter depth and high number of plant contacts >10 cm tall. In crested wheatgrass, numbers of Baird's Sparrows were positively correlated to grass, sedge, and litter cover; maximum vegetation height; litter depth; and vertical vegetation density. Numbers of Baird's Sparrows were negatively related to bare ground and vertical heterogeneity (vertical heterogeneity values were derived from coefficients of variation for litter depth and grass and sedge cover, respectively). In both native vegetation and crested wheatgrass, numbers of Baird's Sparrows were higher in areas with high percent grass, sedge, and litter cover than in areas with high percent bare ground. Also in Saskatchewan, occurrence of Baird's Sparrows was positively associated with density of narrow-leaved grasses >20 cm tall and sparse shrub cover (Davis et al. 1999). Baird's Sparrows were as common in native pasture as in tame pasture and hayland, but were least common in cropland. Within grazed mixed-grass areas in North Dakota, abundance of Baird's Sparrows was positively associated with percent clubmoss (*Selaginella densa*) cover and plant communities dominated solely by native grass (*Stipa*, *Bouteloua*, *Koeleria*, and *Schizachyrium*) (Schneider 1998). Abundance was negatively associated with percent grass cover, litter depth, visual obstruction (vegetation height/density), vegetation density, density of low-growing shrubs (western snowberry [*Symphoricarpos occidentalis*] and silverberry [*Elaeagnus commutata*]), plant communities dominated by Kentucky bluegrass (*Poa pratensis*) and native grass, and plant communities dominated by wet-meadow vegetation. Strongest vegetational predictors of the presence of Baird's Sparrows were increasing clubmoss cover, decreasing bare ground, and decreasing litter depth.

Baird's Sparrows utilize drier areas in unusually wet years and moister areas in dry years, alternating between mesic areas, such as sloughs or wet meadows, and upland grasslands (Salt and Wilk 1958, Lane 1968, Kantrud and Faanes 1979, Faanes 1982, De Smet and Conrad 1991). A table near the end of the account lists the specific habitat characteristics for Baird's Sparrows by study.

Area requirements:

Little information is available regarding the area requirements of Baird's Sparrows. Breeding territories are 0.4-0.8 ha, and often are in close proximity to other Baird's Sparrow pairs (Lane 1968). In North Dakota, territory sizes ranged from 0.8 to 2.25 ha (Winter 1999). In Alberta, Manitoba, and Saskatchewan, Baird's Sparrows occurred more frequently in grasslands enrolled in the Permanent Cover Program (PCP) that were surrounded by grasslands than in PCP surrounded by cropland, wetland, woodland, or human residences (McMaster and Davis 1998). PCP was a Canadian program that paid farmers to seed highly erodible land to perennial cover; it differed from CRP in that haying and grazing were allowed annually in PCP. In Saskatchewan, occurrence was positively associated with area, and minimum area requirements were about 63 ha (SWCC 1997). Brood parasitism by Brown-headed Cowbirds (*Molothrus ater*) may be reduced on larger grassland areas; patches of 700-1600 ha may be needed to halve the current parasitism rate of 31%.

Brown-headed Cowbird brood parasitism:

Brood parasitism by Brown-headed Cowbirds may be increasing. In the past, anecdotal observations indicated that Baird's Sparrows were rare hosts, apparently because nests placed in open grasslands were inconspicuous to female Brown-headed Cowbirds (Lane 1968). More recent studies in Canada, however, indicated that parasitism rates varied from 0% of 11 nests (Maher 1973) to 36% of 76 nests (Davis and Sealy 1998). Refer to Table 1 in Shaffer et al. (2003) for rates of cowbird brood parasitism. Baird's Sparrows may be multiply-parasitized (Friedmann 1963, Friedmann and Kiff 1985, SWCC 1997, Davis and Sealy 2000). In Saskatchewan, parasitized nests had significantly lower productivity than non-parasitized nests (Davis and Sealy 1998). In Manitoba, mean number of host young fledged from successful, unparasitized nests was significantly higher than from successful, parasitized nests; cowbird parasitism cost Baird's Sparrows 1.4 young/successful nest (Davis and Sealy 2000). Distance to cowbird perch sites was not significantly different between parasitized and unparasitized nests (S. K. Davis, *unpublished data*). However, unparasitized nests had significantly less concealment cover than did parasitized nests.

Breeding-season phenology and site fidelity:

Baird's Sparrows may arrive on the breeding grounds as early as late April, with the peak arrival occurring in early to mid-May (Lane 1968, Maher 1973, De Smet 1992, Davis and Sealy 1998, Jones and Green 1998). Nesting occurs from late May through mid-August (Maher 1973, Stewart 1975, Davis and Sealy 1998, Jones and Green 1998). Little information is available concerning double broods. Lane (1968) suggested that there was low probability of second broods. However, other studies have noted two peaks in clutch initiation dates (late May-early June, and mid-late July), suggesting that the species may be double brooded (Maher 1973, Davis and Sealy 1998); one banded female in Manitoba successfully raised two broods in one season (Davis and Sealy 1998). Baird's Sparrows depart for the wintering grounds from mid-September to October (Maher 1973, Jones and Green 1998).

Baird's Sparrows are irruptive, and nesting densities shift as local habitat conditions change (De Smet and Conrad 1991, Wershler et al. 1991, Green 1992).

Species' response to management:

Grasslands need periodic disturbance such as burning, mowing, grazing, or combinations thereof to improve habitat for Baird's Sparrows; optimal frequency of disturbance varies regionally and by vegetative composition (Renken 1983, Dale et al. 1997). Generally, long-term idled habitats with thick vegetation and dense litter are avoided (Renken 1983, Johnson and Schwartz 1993, Hartley 1994, Winter 1994, Madden 1996). However, in drier portions of the species' range, idle grasslands with moderate litter and minimal shrub cover can support high densities of breeding Baird's Sparrows (Owens and Myres 1973, Maher 1973, Renken 1983, De Smet and Conrad 1991, Sutter et al. 1995, Dale et al. 1997). Baird's Sparrow density within Conservation Reserve Program fields is lower than densities within idle native and idle tame grasslands or lightly grazed grasslands, but higher than those within cropland (Johnson and Schwartz 1993, Johnson and Igl 1995). In Alberta, Manitoba, and Saskatchewan, Baird's Sparrows were more common in grasslands enrolled in PCP than in cropland; frequency of occurrence was higher in hayed PCP than in grazed PCP (McMaster and Davis 1998).

Prescribed burns can improve habitat by reducing excess litter, decreasing shrub encroachment, and maintaining native grass communities. Vegetative structure, encroachment of woody vegetation, and accumulation of residual vegetation and litter are determined by prairie type and moisture conditions; fire treatment intervals should approximate historic fire return intervals (Madden 1996). Baird's Sparrows typically experience population declines during the first growing season postfire (Pylypec 1991, Madden 1996, Johnson 1997), with populations recovering to or exceeding prefire levels in 1-5 yr (Pylypec 1991, Winter 1994, Madden 1996, Johnson 1997). In North Dakota, abundance of Baird's Sparrows was positively related to a fire index that calculated the amount of fire an area received based on number of burns in the last 15 yr and number of years since last fire (Madden et al. 1999). Abundance was highest in grasslands that had been burned four times in the previous 15 yr, compared to unburned areas and areas burned one to two times in the previous 15 yr. Also in North Dakota, Baird's Sparrow densities were highest on areas burned four times during the previous 24 yr (four-burn), compared to areas left idle (zero-burn) or burned twice during the same period (two-burn) (Winter 1999). They were absent from zero-burn areas and had lower numbers and larger territories in two-burn areas than in four-burn areas. Within four-burn areas, Baird's Sparrows were absent from areas where there was no litter. Density of Baird's Sparrows in two- and four-burn plots was positively related to maximum and mean vegetation height. Density was negatively related to litter depth, but only at intermediate litter depths of 0.5-2.5 cm. Density declined at minimum and maximum litter depths.

Effects of mowing on Baird's Sparrows depend on timing, frequency, vegetation type (native vs. exotic), and amount of cover removal (B. C. Dale, Canadian Wildlife Service, Edmonton, Alberta, Canada, pers. comm.). Native hayland seems to be preferred to tame hayland (Kantrud 1981, De Smet and Conrad 1991), although mixed-grass areas dominated by rough fescue (*Festuca scabrella*) were avoided 1 yr after mowing in Alberta (Owens and Myres 1973). Native hayland may be preferable to tame hayland because native grasslands usually are cut later in the season, and often only the densest portions of the field are cut, leaving some areas uncut each year (B.C. Dale, pers. comm.). In Alberta, however, native hayfields that were both mowed and winter-grazed were avoided, probably due to removal of vegetation and litter (Mahon 1995). In tame hayfields of alfalfa (*Medicago sativa*), smooth brome, and Kentucky bluegrass in Saskatchewan, Baird's Sparrows were more abundant in annually cut hayfields than hayfields cut every 3-8 yr, presumably because annual mowing was needed in exotic grasses to

prevent excess litter accumulation (Dale et al. 1997). In southern Saskatchewan hayfields, number of pairs was not affected by amount of cropland or wetland within 1.6 km of study areas (McMaster et al. 1999). Baird's Sparrows used hayland at least as often as pasture in North Dakota, Manitoba, and Saskatchewan (Kantrud 1981, Davis 1994, Davis et al. 1996).

Heavy or continuous grazing that reduces residual vegetation and litter is detrimental in both moist and dry parts of the species' breeding range (Owens and Myres 1973, Kantrud 1981, Dale 1983, De Smet and Conrad 1991, Davis 1994, Anstey et al. 1995, Sutter et al. 1995). Grazing systems that provide range in good (moderate vegetative and litter cover) condition provide suitable habitat (Anstey et al. 1995, Mahon 1995). In Saskatchewan, Baird's Sparrows were equally frequent in mixed-grass pasture as in pastures planted to pure crested wheatgrass or to crested wheatgrass/grass and crested wheatgrass/legumes (Davis and Duncan 1999). Rotational grazing systems in North Dakota seem to support higher numbers of Baird's Sparrow than other (e.g., continuously grazed, short-duration) grazing systems (Messmer 1990). However, in Alberta, Baird's Sparrow frequency of occurrence did not significantly differ between four grazing treatments: early-season tame (grazed from late April to mid-June), early-season native (grazed in early summer), deferred-grazed native (grazed after 15 July), and continuously grazed native (Prescott and Wagner 1996). Grazing at a stocking rate of 0.32-0.41 ha/animal unit months in November and December in both mixed-grass pastures dominated by rough fescue and in crested wheatgrass/alfalfa pastures provided suitable habitat for Baird's Sparrows (Mahon 1995).

In denser, taller habitats (such as moist mixed-grass prairie), or during wet years, light to moderate grazing can improve habitat by providing shorter, sparser vegetation (Kantrud 1981, Dale 1983, Renken 1983, Messmer 1990, Wershler et al. 1991, Anstey et al. 1995). During two dry summers in Saskatchewan, grazing virtually eliminated Baird's Sparrows; following a moist winter and spring, new growth on grazed pastures was twice the height of the previous season's growth and Baird's Sparrows were present (Dale 1984).

In a Saskatchewan study that examined whether the abundance of grassland birds differed between roadsides and trailsides, Baird's Sparrows were significantly more abundant along trailsides than along roadsides (Sutter et al. 2000). Roads were defined as traveling surfaces with adjacent drainage ditches planted to smooth brome and ending with a fence 11-18 m from the traveling surface. Trails were defined as a single pair of wheel ruts visually indistinct from surrounding habitat in terms of plant structure and composition. Habitat along roads and trails were parcels of lightly to moderately grazed native prairie >256 ha.

Management Recommendations:

Timing and type of management must be adjusted according to local and regional differences (soil types, climate, vegetation types) and annual precipitation (Madden 1996, Jones and Green 1998).

Protect native grasslands that support breeding populations of Baird's Sparrows, and establish additional suitable grasslands where possible (Winter 1994, Anstey et al. 1995, Mahon 1995). Protect both wet and dry habitats (e.g., wet meadows and mesic grasslands). Even if not used every year, these habitats may be essential as alternative breeding sites during drought or wet

periods (Wershler et al. 1991, Johnson 1996). Collaborate with farming and ranching interests to maintain native prairie (Johnson 1996).

Prevent encroachment of woody vegetation. Prescribed burning, mowing, and grazing can be used to maintain the early successional stage preferred by Baird's Sparrows, including moderate litter and low shrub cover (Berkey et al. 1993, Winter 1994, Madden 1996, Johnson 1997).

Encourage vegetative diversity within grasslands; scattered forbs, a mixture of grass heights, and patches of litter-covered ground are important to Baird's Sparrows (Winter 1994, Mahon 1995).

Provide large tracts of grassland, with at least enough area to support multiple Baird's Sparrow territories (Berkey et al. 1993, Winter 1994). Large areas also may decrease rates of nest depredation and Brown-headed Cowbird brood parasitism of grassland passerine nests (Johnson and Temple 1990, Davis and Sealy 1998).

Burn large areas on a rotational basis, burning portions of the total area each year, and burn small areas periodically (Renken 1983, Renken and Dinsmore 1987, Johnson 1997). Ensure that adjacent areas are burned in different years to create a variety of successional stages (Madden 1996, Johnson 1997). Treat small, isolated areas as part of a larger mosaic, ensuring a variety of successional stages (Renken 1983, Renken and Dinsmore 1987, Madden 1996, Johnson 1997). Use treatment intervals that approximate the historic fire return intervals for the region (i.e., 3-4 yr intervals in tallgrass prairie, 4 yr in sandhill prairie, 6 yr in northern mixed-grass prairie, 5-10 yr in shortgrass prairie, and up to 25 yr in dry, western mixed-grass prairie) (Madden 1996).

Whereas use of prescribed burns may be necessary to sustain Baird's Sparrow populations in the eastern part of its range in the mixed-grass prairie, exercise caution in use of burning in the western portion of the breeding range where burning may not be necessary (Winter 1999).

When possible (e.g., on federal lands or through cooperation with private landowners), delay mowing of hayfields until mid-July or August, which would allow many birds to raise at least one brood in years with normal breeding phenology; mowing should be delayed further if nesting is delayed by inclement spring weather (Mahon 1995, Dale et al. 1997). When mowing must be done during the breeding season, divide large fields, mowing only half each year, or mow individual fields every other year to provide refuge for fledglings (Dale et al. 1997).

Prevent overgrazing in pastures utilized by Baird's Sparrows. Graze using a deferred rotational system to ensure that only part of the range is grazed during the growing season (Messmer, 1990, Berkey et al. 1993, Mahon 1995). Use a complementary system when grazing cannot be restricted to winter, i.e., graze seeded range during the growing season, and native grasses in fall or winter (Mahon 1995). Grazing tame pastures in spring allows native pastures to be deferred, which improves habitat in the native pastures for Baird's Sparrows (Prescott and Wagner 1996).

When re-seeding public lands, or private pasture and haylands, use native grasses where possible to benefit grassland birds (Berkey et al. 1993, Rodenhouse et al. 1995, Dale et al. 1997).

Table. Baird's Sparrow habitat characteristics.

Author(s)	Location(s)	Habitat(s) Studied*	Species-specific Habitat Characteristics
Anstey et al. 1995	Saskatchewan	Cropland, mixed-grass pasture, tame hayland, tame pasture	Abundance was positively associated with litter depth and standing dead vegetation ≤ 10 cm tall; abundance was negatively associated with shrubs ≤ 1 m tall and broad-leaved grasses ≤ 10 cm tall
Dale 1983	Saskatchewan	Idle mixed-grass, mixed-grass pasture	Territories had an average litter depth of 0.8-1.1 cm, shrub cover of 1-8%, and an effective vegetation height averaging 21 cm
Dale 1992	Saskatchewan	Idle native, idle native/tame, tame hayland	Preferred areas with moderate litter and narrow-leaf grasses and within or near native grasslands, and avoided areas with deep litter and extremely tall vegetation; density was negatively correlated to abundance of broad-leaf grasses
Davis et al. 1999	Saskatchewan	Aspen parkland, cropland, mixed-grass pasture, tame hayland, tame pasture	Occurred as frequently in native pasture as in tame pasture and hayland and occurred least frequently in cropland; occurred most frequently in mixed grassland, followed by moist-mixed grassland, aspen parkland, and cypress upland; grazing did not affect occurrence of Baird's Sparrows on native pasture; occurrence on native pastures was positively associated with moist-mixed grassland, density of narrow-leaved grasses > 20 cm tall, and sparse shrub cover
Davis and Sealy 1998	Saskatchewan	Idle mixed-grass, idle tame hayland, mixed-grass hayland, mixed-grass pasture	Nests were placed at the base of or within vegetation clumps, particularly smooth brome (<i>Bromus inermis</i>) (23% of nests) and fringed sagewort (<i>Artemisia frigida</i>) (16% of nests)
De Smet and Conrad	Manitoba	Cropland, idle mixed-	Used pastures with high shrub cover (≥ 10 -50%); highest

1991		grass, idle tame, mixed-grass hayland, mixed-grass pasture, tame hayland, tame pasture	densities were on idle grasslands, followed by hayland and pasture; very low densities were in cropland
Kantrud and Kologiski 1982	Colorado, Montana, Nebraska, North Dakota, South Dakota, Wyoming	Mixed-grass pasture, shortgrass pasture, shrubsteppe	Used areas with typic boroll soils; average percent bare ground on these soils was 5%, and average vegetation height was 30 cm; abundance was positively associated with Junegrass (<i>Koeleria pyramidata</i>), needle-and-thread (<i>Stipa comata</i>), fringed sagewort, and clubmoss (<i>Selaginella densa</i>)
Lane 1968	Rangewide	Cropland, hayland, idle, pasture	Preferred dense grasslands, and avoided areas that have been disturbed (i.e., burning, grazing, mowing, or cultivating)
Madden 1996	North Dakota	Burned mixed-grass, burned tame, idle mixed-grass, idle tame	Occupied areas with significantly lower shrub cover and visual obstruction, and significantly greater grass cover and frequency of native grasses than unoccupied areas; average vegetation characteristics on occupied areas were 20.1% shrub cover, 16 cm visual obstruction, and 44.4% grass cover
Maher 1973	Saskatchewan	Burned mixed-grass, idle mixed-grass, mixed-grass hayland, mixed-grass pasture	Preferred ungrazed grasslands without shrubs; density in ungrazed areas was five times the density in grazed areas
Mahon 1995	Alberta	Tame pasture	Used areas with high densities of low and middle (<20cm) canopy grasses and high forb coverage at both native and non-native sites; standing grass provided cover for adults and nests, and tall forbs provided perches for singing males; structure was more important than species composition
McMaster and Davis 1998	Alberta, Manitoba,	Cropland, Permanent Cover Program (PCP;	Were more common in PCP than in cropland, and were more common in PCP surrounded by grasslands than in PCP

	Saskatchewan	idle tame, tame hayland, tame pasture)	surrounded by cropland, wetland, woodland, or human residences; frequency of occurrence was higher in hayed PCP than in grazed PCP
McMaster et al. 1999	Saskatchewan	Hayland, PCP (tame hayland)	Amount of cropland or wetland within 1.6 km of study areas did not affect number of indicated pairs
Owens and Myres 1973	Alberta	Cropland, idle mixed-grass, mixed-grass hayland, mixed-grass pasture	Nested on undisturbed plots of mixed-grass; needed heavy grass cover
Renken 1983, Renken and Dinsmore 1987	North Dakota	DNC (idle tame), idle mixed-grass, mixed-grass pasture	Avoided idle plots; mean vegetation values for used areas were: 57.7% grass cover, 23.8% forb cover, 99.7% litter cover, 0.9% shrub cover, 0.3% bare ground, 13 cm effective vegetation height, and 3.6 cm litter depth
Schneider 1998	North Dakota	Mixed-grass pasture, tame pasture, wet-meadow pasture	Abundance was positively associated with percent clubmoss cover and plant communities dominated solely by native grass (<i>Stipa</i> , <i>Bouteloua</i> , <i>Koeleria</i> , and <i>Schizachyrium</i>); abundance was negatively associated with percent grass cover, litter depth, visual obstruction (vegetation height/density), vegetation density, density of low-growing shrubs (western snowberry [<i>Symphoricarpos occidentalis</i>] and silverberry [<i>Elaeagnus commutata</i>]), plant communities dominated by Kentucky bluegrass (<i>Poa pratensis</i>) and native grass, and plant communities dominated by wet-meadow vegetation; strongest vegetational predictors of the presence of Baird's Sparrows were increasing clubmoss cover, decreasing bare ground, and decreasing litter depth
Sousa and McDonal 1983	Rangewide	Cropland, hayland, idle, pasture	Optimal grass canopy heights ranged from 25 to 100 cm and optimal visual obstruction of residual vegetation ranged from

			15 to 40 cm
Sutter 1996	Saskatchewan	Idle mixed-grass, mixed-grass pasture, tame pasture	Within a moderately moist site, abundance was not strongly correlated to any habitat variables; within a more arid site with introduced vegetation, abundance was positively correlated to grass and sedge (<i>Carex</i>) cover, maximum height and litter depth, and negatively correlated with bare ground cover and vertical heterogeneity; within a more arid site with native vegetation, abundance was positively correlated with litter cover and litter depth
Sutter and Brigham 1998	Saskatchewan	Mixed-grass pasture, tame pasture	Were common in mixed-grass prairie and crested wheatgrass; in prairie, numbers were positively correlated to litter cover, litter depth, and vertical vegetation density; numbers were lower in areas with high percent grass and sedge cover and high maximum vegetation height than in areas with high litter depth and high number of plant contacts >10 cm tall In crested wheatgrass, numbers were positively correlated to grass, sedge, and litter cover; maximum vegetation height; litter depth; and vertical vegetation density; numbers of Baird's Sparrows were negatively related to bare ground and vertical heterogeneity (vertical heterogeneity values were derived from coefficients of variation for litter depth and grass and sedge cover, respectively) In both native vegetation and crested wheatgrass, numbers were higher in areas with high percent grass, sedge, and litter cover than in areas with high percent bare ground
Sutter et al. 1995	Saskatchewan	Idle mixed-grass, mixed-grass pasture, tame pasture	Abundance was positively correlated with grass, sedge, and litter cover, and negatively correlated with bare ground; abundance was greatest on ungrazed native prairie
Sutter et al. 2000	Saskatchewan	Mixed-grass pasture	Abundance in mixed-grass prairie was 42% lower along roadsides than along trailsides

Wershler et al. 1991	Alberta	Cropland, idle mixed-grass, idle tame, mixed-grass pasture, parkland, wet meadow	Were found in dry, alkali wetland basins
Winter 1999	North Dakota	Burned mixed-grass, idle mixed-grass	Were absent from unburned plots (zero-burn) and occurred in lower numbers and had larger territories in areas burned twice during the previous 24 yr (two-burn) than in areas burned four times during the same period (four-burn); within four-burn areas, Baird's Sparrows were absent from areas where there was no litter; density of Baird's Sparrows in two- and four-burn plots was positively related to maximum and mean vegetation height and was negatively related to litter depth, but only at intermediate litter depths of 0.5-2.5 cm; means for measured vegetation variables in zero-burn plots were 16.3 cm visual obstruction, 42.8 cm maximum vegetation height, 23.9 cm mean vegetation height, and 3.3 cm litter depth; means in two-burn plots were 13.7 cm visual obstruction, 39.5 cm maximum vegetation height, 18.5 cm mean vegetation height, and 2.8 cm litter depth; means in four-burn plots were 6.3 cm visual obstruction, 30.2 cm maximum vegetation height, 13.8 cm mean vegetation height, and 0.08 cm litter depth

*In an effort to standardize terminology among studies, various descriptors were used to denote the management or type of habitat. "Idle" used as a modifier (e.g., idle tallgrass) denotes undisturbed or unmanaged (e.g., not burned, mowed, or grazed) areas. "Idle" by itself denotes unmanaged areas in which the plant species were not mentioned. Examples of "idle" habitats include weedy or fallow areas (e.g., oldfields), fencerows, grassed waterways, terraces, ditches, and road rights-of-way. "Tame" denotes introduced plant species (e.g., smooth brome [*Bromus inermis*]) that are not native to North American prairies. "Hayland" refers to any habitat that was mowed, regardless of whether the resulting cut vegetation was removed. "Burned" includes habitats that were burned intentionally or accidentally or those burned by natural forces (e.g., lightning). In situations where there are two or more descriptors (e.g., idle tame hayland), the first descriptor modifies the following descriptors. For example, idle tame hayland is habitat that is usually mowed annually but happened to be undisturbed during the year of the study.

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