

**Baird's Sparrow (*Ammodramus bairdii*):
A Technical Conservation Assessment**

**Prepared for the USDA Forest Service,
Rocky Mountain Region,
Species Conservation Project**

June 9, 2006

David A. Wiggins, Ph.D.
Strix Ecological Research
1515 Classen Drive
Oklahoma City, OK 73106

Peer Review Administered by
[Society for Conservation Biology](#)

Wiggins, D.A. (2006, June 9). Baird's Sparrow (*Ammodramus bairdii*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: <http://www.fs.fed.us/r2/projects/scp/assessments/bairdssparrow.pdf> [date of access].

ACKNOWLEDGMENTS

Brenda Dale, Stephen Davis, Michael Green, and Stephanie Jones provided reprints and unpublished information on Baird's sparrows – this assessment would not have been possible without their previous research work and helpful assistance. Greg Hayward and Gary Patton gave many useful tips for enhancing the structure and quality of this assessment. I also thank Rick Baydack, Scott Dieni, and Stephanie Jones for providing thorough reviews that greatly improved the quality of the assessment.

AUTHOR'S BIOGRAPHY

David Wiggins developed an early interest in ornithology. During his high school years, he worked as a museum assistant under Gary Schnell and George Sutton at the University of Oklahoma. He later earned degrees from the University of Oklahoma (B.Sc. in Zoology), Brock University (M.Sc. - Parental care in Common Terns, under the supervision of Ralph Morris), and Simon Fraser University (Ph.D. - Selection on life history traits in Tree Swallows, under the supervision of Nico Verbeek). This was followed by a National Science Foundation Post-doctoral fellowship at Uppsala University in Sweden, where he studied life history evolution in Collared Flycatchers, and later a Fulbright Fellowship working on the reproductive ecology of tits (Paridae) in Namibia and Zimbabwe. He currently splits time between ecological research work in Sweden and North America.

SUMMARY OF KEY COMPONENTS FOR CONSERVATION OF BAIRD'S SPARROW

Although considerable concern has been expressed over the conservation status of the Baird's sparrow, the species has no federal conservation status in Canada, and the U.S. Fish and Wildlife Service (USFWS) declined a petition to list the species as Threatened in 1999. Nonetheless, the USFWS lists the Baird's sparrow as a Bird of Conservation Concern at national and regional levels, and several Partners in Flight state bird conservation plans have ranked Baird's sparrow as a Priority Species.

Historically, the primary threats to Baird's sparrows have been the conversion of native grassland to cropland, as well as the degradation of remaining native grasslands on the breeding grounds, along migratory routes, and on wintering grounds. The total area of mixed-grass prairie in the northern Great Plains has declined dramatically since the mid-1800's. Suppression of prairie fires and invasion of shrubs and exotic grasses have also been cited as problems on the breeding ground of Baird's sparrows. Little is known of the species' distribution and habitat use during the winter, but overgrazing is thought to have contributed significantly to the degradation of this habitat. Thus, the primary threats to healthy populations of Baird's sparrows appear to be the result of habitat loss/degradation; these may be overcome with proper habitat management schemes.

Given the uncertain breeding status of Baird's sparrows in USDA Forest Service Region 2, the primary conservation concern in the Region is the preservation and management of suitable migratory habitat. Assuming that preferred migratory habitat is similar to that used for breeding, maintenance of large patches of native grassland should provide suitable foraging habitat for migrating birds as well as ideal breeding habitat in South Dakota. However, there is currently little information on the distribution and behavior of Baird's sparrows during migration. There is also very little information available on the distribution of Baird's sparrows during the winter; a better understanding of this species' winter distribution would be a first step in establishing whether conditions (e.g., habitat quality) on the wintering grounds are negatively impacting Baird's sparrow populations.

TABLE OF CONTENTS

ACKNOWLEDGMENTS	2
AUTHOR'S BIOGRAPHY	2
SUMMARY OF KEY COMPONENTS FOR CONSERVATION OF BAIRD'S SPARROW	3
LIST OF TABLES AND FIGURES	6
INTRODUCTION	7
Goal	7
Scope and Limitations of Assessment.....	8
Treatment of Uncertainty	8
Publication of Assessment on the World Wide Web	8
Peer Review	8
MANAGEMENT STATUS AND NATURAL HISTORY	9
Management Status	9
Existing Regulatory Mechanisms, Management Plans, and Conservation Strategies	9
Biology and Ecology.....	12
Systematics.....	12
Distribution and abundance.....	12
Global perspective	12
Regional distribution and abundance	13
Regional discontinuities in distribution and abundance	17
Population trend	17
Activity pattern and movements	18
Habitat	18
Nesting habitat.....	18
Foraging habitat.....	19
Food habits	19
Breeding biology	20
Courtship and pair formation.....	20
Nest-site selection.....	20
Clutch and brood size	21
Parental care and offspring behavior	21
Timing of breeding and breeding success	22
Demography	22
Genetic characteristics and concerns.....	22
Life history characteristics	22
Social patterns and spacing	23
Factors limiting population growth	23
Community ecology	23
Predators and relationship to habitat use	23
Competitors	23
Effects of brood-parasitic brown-headed cowbirds.....	23
CONSERVATION.....	24
Threats.....	24
Grassland conversion	24
Overgrazing	24
Lack of habitat disturbance	24
Elimination of landowner incentives.....	26
Brood parasitism	26
Other disturbances.....	26
Conservation Status of Baird's Sparrows in Region 2	26
Management of Baird's Sparrows in Region 2	27
Implications and potential conservation elements	27
Tools and practices	28

Habitat management28
Inventory and monitoring28
Information Needs.....29
REFERENCES31

EDITOR: Gary Patton, USDA Forest Service, Rocky Mountain Region

LIST OF TABLES AND FIGURES

Tables:

Table 1. Management status of Baird’s sparrows according to Partners-in-Flight state Bird Conservation Plans from states within and surrounding USDA Forest Service Region 2.....	9
Table 2. State-based management status of Baird’s sparrows within USDA Forest Service Region 2 and surrounding states.	10
Table 3. Summary of published habitat management recommendations for Baird’s sparrows.	11
Table 4. Summary of published management recommendations for Baird’s sparrows within Partners in Flight State Bird Conservation Plans.	11
Table 5. Long-term trends in the abundance of Baird’s sparrows on Breeding Bird Survey routes in the United States and Canada.	17
Table 6. Vegetative cover around Baird’s sparrow nest sites.	19
Table 7. Summer and winter diets of Baird’s sparrows, as well as vegetative cover in fields used by foraging Baird’s sparrows during spring migration.	20
Table 8. Timing of Baird’s sparrow arrival on and departure from the breeding grounds.	21
Table 9. Clutch size and reproductive success of Baird’s sparrows.	21
Table 10. Approximate timing of breeding of Baird’s sparrows based on known nesting attempts.....	22
Table 11. Frequency of parasitism by brown-headed cowbirds on Baird’s sparrows.....	24

Figures:

Figure 1. Map of national forests and grasslands within USDA Forest Service Region 2.....	7
Figure 2. Current breeding and wintering distribution of Baird’s sparrows.	14
Figure 3. Areas of confirmed, predicted, and probable suitable habitat for breeding Baird’s sparrows in South Dakota.....	15
Figure 4. Presumed areas of suitable habitat for breeding and migrating Baird’s sparrows in Wyoming.....	16
Figure 5. Envirogram showing the relationship of Baird’s sparrows to their environment, competitors, and predators.....	25

INTRODUCTION

This conservation assessment is one of many being produced to support the Species Conservation Project for the Rocky Mountain Region (Region 2) USDA Forest Service (USFS) (**Figure 1**). The Baird's sparrow (*Ammodramus bairdii*) is the focus of an assessment because it was a candidate for the USFS Region 2 Sensitive Species list during the Region's extensive revision effort of that list in 2003. Ultimately, the species was not included because there was no evidence at the time that the species maintained significant breeding or overwintering territory in Region 2 (G. Patton personal communication 2004). Within the National Forest System, a sensitive species is a plant or animal whose population viability is identified as a concern by the Regional Forester because of significant current or predicted downward trends in abundance or significant current or predicted downward trends in habitat capability that would reduce its distribution

[FSM 2670.5 (19)]. A sensitive species may require special management, so knowledge of its biology and ecology is critical. This assessment addresses the biology, ecology, status, conservation, and management of the Baird's sparrow. This introduction defines the goal of the assessment, outlines its scope, and describes the process used in its production.

Goal

Species conservation assessments produced as part of the Species Conservation Project are designed to provide land managers, biologists, and the public with a thorough presentation of the biology, ecology, conservation status, and management of certain species based on current scientific knowledge. The assessment goals limit the scope of the work to critical summaries of scientific knowledge, discussion of broad implications of that knowledge, and outlines of information needs. The assessment does not seek to develop prescriptive

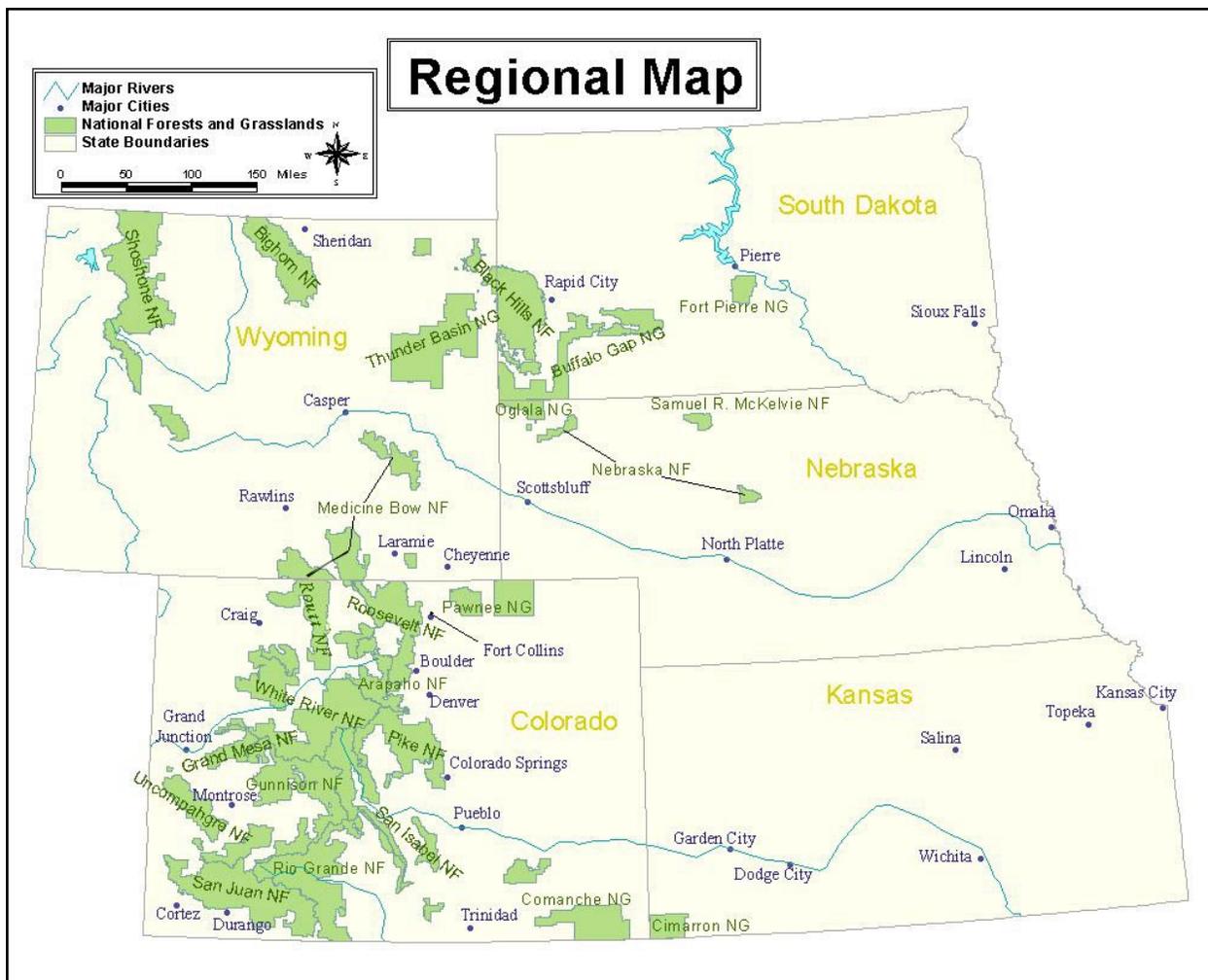


Figure 1. Map of national forests and grasslands within USDA Forest Service Region 2.

management. Rather, it provides the ecological background upon which management must be based and focuses on the consequences of changes in the environment that result from management (i.e., management implications). Furthermore, it cites management recommendations proposed elsewhere, as well as considerations essential to understanding the conservation needs and management of the species. When management recommendations have been implemented, the assessment examines the outcome.

Scope and Limitations of Assessment

The Baird's sparrow assessment examines the ecology, status, conservation, and management of this species with specific reference to the geographic and ecological characteristics of the USFS Rocky Mountain Region (**Figure 1**). Although all of the literature on the species originated from field investigations outside the region (primarily in North Dakota, Montana, and Saskatchewan), this document places that literature in the ecological and social context of the central Great Plains. Consequently, this assessment summarizes the available information under the assumption that patterns observed elsewhere will also pertain to Region 2. Although there is some uncertainty in doing so, making such an assumption seems reasonable given the close proximity of known or potential breeding areas in Region 2, and those just to the north in Montana and North Dakota where much previous research has been conducted.

Similarly, this assessment is concerned with characteristics of Baird's sparrows in the context of the current environment. The evolutionary environment of the species is considered in conducting the synthesis, but placed in current context.

In producing the assessment, the author reviewed refereed literature, non-refereed publications, research reports, and data accumulated by resource management agencies. Not all publications on Baird's sparrows are referenced in the assessment, nor were all published materials considered equally reliable. The assessment emphasizes refereed literature because this is the accepted standard in science. Non-refereed publications or reports were regarded with greater skepticism, but I chose to use some non-refereed literature when refereed information was unavailable.

Baird's sparrows have only recently been studied in detail, and several key components of their life history remain unknown. Consequently, writing this

assessment required reliance on a relatively small set of publications (as well as some unpublished information) covering a limited geographic area, which is outside of Region 2. Conclusions and recommendations are therefore tentative.

Treatment of Uncertainty

In this assessment, the strength of evidence for particular ideas is noted, and when appropriate, alternative explanations are described. While well-executed experiments represent a strong approach to developing knowledge, alternative approaches such as modeling, critical assessment of observations, and inference are accepted as sound approaches to understanding and used in synthesis for this assessment.

The primary challenge in attempting to summarize the status and range of Baird's sparrows is a lack of information on occurrence and habitat use during migration and on the wintering grounds. In addition, there remains a lack of information on the species' breeding distribution and habitat in Region 2. Nearly all studies of Baird's sparrow breeding ecology have been conducted north of Region 2, in Montana, North Dakota, and southern Canada. Consequently, this assessment relies heavily on studies from outside Region 2, with the assumption that the results of such studies will apply to some extent to Region 2.

Publication of Assessment on the World Wide Web

To facilitate the use of species conservation assessments, they are being published on the Region 2 World Wide Web site. Placing the documents on the Web makes them available to agency biologists, land managers, and the public more rapidly than publishing them as reports. More important, Web publication facilitates their revision, which will be accomplished based on guidelines established in Region 2.

Peer Review

Species conservation assessments developed for the Species Conservation Project have been peer reviewed prior to their release on the Web. This assessment was reviewed through a process administered by the Society for Conservation Biology, employing two recognized experts on Baird's sparrows. Peer review was designed to improve the quality of communication and to increase the rigor of the assessment.

MANAGEMENT STATUS AND NATURAL HISTORY

Management Status

The Nature Conservancy's Natural Heritage Network has assigned the Baird's sparrow a rank of G4 (apparently secure; on a scale of G1 to G5, from highest to lowest priority, respectively). The Baird's sparrow was formerly listed as threatened in Canada (Goossen et al. 1993), but following the development of a recovery plan (Goossen et al. 1993) and a review of its status within Canada, it was removed from the list in 1996, primarily because populations appeared to be stable in Saskatchewan (Skeel et al. 1995, COSEWIC 1996, Jones and Green 1997). In the United States, Baird's sparrows are a Species of Conservation Concern in U.S. Fish and Wildlife Service Regions 2 and 6 (U.S. Fish and Wildlife Service 2002a). Within USFS Region 2, the Baird's sparrow is not listed as a sensitive species or as a Management Indicator Species.

A summary of the management status of the Baird's sparrow within state Partners in Flight plans is presented in **Table 1**. It is listed as a PIF Highest Priority Species in New Mexico and a Priority Species in Arizona and Montana. In Wyoming, the Baird's sparrow is listed as a Priority Species, but the authors chose to defer further comment on the species because of its peripheral and limited breeding range in Wyoming (Cervoski et al. 2001). The species's status in Wyoming is unclear, as reflected in the conflicting management ranks given by the PIF Bird Conservation Plan ("limited breeding range in Wyoming"; Cervoski et al. 2001) and the state Natural Heritage Program ("non-

breeding"; **Table 2**). However, to date, there has been no documented nesting attempt by Baird's sparrows in Wyoming (D. Faulkner personal communication 2006). The state of South Dakota lists the Baird's sparrow as Threatened (**Table 2**), and in states surrounding Region 2 it is listed as Endangered in Minnesota, Threatened in New Mexico and Montana, and Accidental in Oklahoma. Baird's sparrows have not been given any federal status in Mexico.

Existing Regulatory Mechanisms, Management Plans, and Conservation Strategies

One of the first management-oriented papers on Baird's sparrows was published in 1994 (Drilling et al. 1992), at a time when the species had not been well studied. Nonetheless, this study foresaw many of the currently recognized management recommendations, such as an elimination of or reduction in grazing intensity, a seasonal delay of mowing activities in haylands and croplands, an initiation of a prescribed burning scheme (albeit on an infrequent basis and depending on mean annual rainfall), and maintenance/restoration of native grassland habitats. For the purposes of this assessment, native grasslands are considered those that have retained species compositions similar to grasslands that existed prior to European settlement of the Great Plains. That is, grasslands typified by native Great Plains flora and excluding areas dominated or heavily influenced by alien grasses and agricultural crops.

In a later study that incorporated much of the research carried out in the 1990's, Dechant et al. (2003)

Table 1. Management status of Baird's sparrows according to Partners-in-Flight (PIF) state Bird Conservation Plans from states within and surrounding USDA Forest Service Region 2. Bold font indicates Region 2 states.

State	Status	Citation
Colorado	Not a Priority Species	Beidleman 2000
Kansas	State PIF plan not published	
Wyoming	Level I* Priority Species	Cervoski et al. 2001
Nebraska	State PIF plan not published	
South Dakota	State PIF plan not published	
North Dakota	State PIF plan not published	
Montana	Priority Species (Level I*; Mixed-grass prairie)	Casey 2000
New Mexico	Highest Priority Species	Rustay 2001
Oklahoma	State PIF plan not published	
Texas	State PIF plan not published	
Arizona	Priority Species (desert grasslands)	Latta et al. 1999

* Level I priority species are the highest priority - those for which conservation action is urgently needed.

Table 2. State-based management status of Baird’s sparrows within Region 2 and surrounding states. State ranks are typically determined by state Natural Heritage Programs. Bold font indicates Region 2 states.

State	State Rank	Reference
Wyoming	S1B? ¹ , SZN ²	www.uwyo.edu/wyndd
South Dakota	S2B ³ , SZN	http://www.sdgifp.info/Wildlife/Diversity/RareAnimal.htm
Colorado	Not listed	ftp://ftp.cnhp.colostate.edu/99Handbook.pdf
Nebraska	Not listed	http://www.natureserve.org/nhp/us/ne/birds.html
Kansas	Not listed	http://www.ksnhi.ku.edu/data/html/avail.htm
North Dakota	Under review	www.natureserve.org
Minnesota	Endangered	http://www.dnr.state.mn.us/ets/birds.html
Oklahoma	SA ⁴	http://www.biosurvey.ou.edu/pub/animals01.pdf
Montana	S2B	http://mtnhp.org/SpeciesOfConcern/Default.aspx
Texas	Not listed	http://www.tpwd.state.tx.us/huntwild/wild/species/endang/animals/birds/
Arizona	S2N ⁵	http://www.azgfd.gov/w_c/edits/hdms_species_lists.shtml
New Mexico	Threatened	http://www.wildlife.state.nm.us/conservation/index.htm

¹S1B = As a breeding species, critically imperiled because of extreme rarity (often <5 extant occurrences) or because some factor makes it highly vulnerable to extinction.

²SZN = Rank not applicable: indicates that a migratory species is essentially absent or unrankable during migration.

³S2B = Imperiled because of rarity or because of some other factor(s) making it vulnerable throughout its range; SZN = Migratory populations not ranked.

⁴SA = Accidental occurrence in state.

⁵S2N = Imperiled because of rarity or because of some other factor(s) making it vulnerable. Winter range.

summarized the effects of management practices on Baird’s sparrows. They noted that disturbance to native grasslands was and is a natural phenomenon, and that disturbance such as fire, grazing, and/or mowing may improve habitat, depending on local conditions. They also stressed that prescribed burns should mimic historical patterns, and that while Baird’s sparrow populations typically decreased the first year after prescribed burns (presumably due to combination of a lack of vegetative litter and a lack of sufficient grass density for nesting and foraging), populations recovered or exceeded pre-fire levels within one to five years. Two studies suggested prescribed burns every four to six years (Madden et al. 1999, Winter 1999), but these studies were carried out in relatively mesic grasslands in North Dakota and likely are not directly applicable to the more arid grasslands found in Region 2. **Table 3** and **Table 4** provide summaries of the major habitat management recommendations in Dechant et al. (2003) and state Partners in Flight Bird Conservation Plans, respectively.

The U.S. Fish and Wildlife Service Region 6 recently prepared a conservation plan for the Baird’s sparrow (Jones and Green 1997; www.r6.fws.gov/bairdsparrow/planfinl.htm). The plan did not recommend any change in the Federal status of this

species as the authors concluded that despite local variability in population size, the overall population was stable. However, they noted that there is still relatively little knowledge concerning the effects of different grassland management strategies on Baird’s sparrow populations. In addition, they noted an almost total lack of information on habitat use and population trends on the migratory route and wintering grounds of this species. Both of these problems were raised as research priorities within the USFWS conservation plan (Jones and Green 1997). These problems are echoed in this report and will continue to pose challenges to land managers seeking habitat policies that will benefit Baird’s sparrows.

In Canada, concern about local declines in the numbers of Baird’s sparrows led to the species being listed as Threatened in 1989. In turn, this led to the formation of the Baird’s Sparrow Recovery Team (in 1990) and the preparation of a recovery plan (Goossen et al. 1993) for the Canadian portion of the species’ range. The priority action recommended was to collect baseline data on population sizes, trends, and distribution, including on the wintering grounds. The second priority action was to document the security and availability of Baird’s sparrow habitat. A subsequent review of the status of Baird’s sparrows in 1996

Table 3. A summary of published habitat management recommendations for Baird’s sparrows.

Recommendations	Presumed benefits	Citation(s)
Avoid heavy and/or continuous grazing; use rotational rather than continuous grazing	Maintains moderate vegetative and litter cover, both of which are preferred substrates for nesting and foraging	Owens and Myres 1973, Kantrud 1981, Dale 1983, Messmer 1990, De Smet and Conrad 1991, Davis 1994, Anstey et al. 1995, Sutter et al. 1995
Prescribed burns every 4 to 6 years in mixed- or tallgrass prairie; much less frequently (if ever) in western shortgrass prairie habitat	Maintains optimal litter and vegetative cover	Johnson 1997, Madden et al. 1999
Protect and expand native grasslands	Maintains preferred breeding habitat	Anstey et al. 1995, Mahon 1995
Encourage vegetative diversity	Maintains preferred breeding habitat	Mahon 1995, Winter 1999
Provide large areas of grassland	Reduces cowbird parasitism	Johnson and Temple 1990, Davis and Sealy 1998
Delay mowing of hayfields until mid-July or August	Reduce nestling/fledgling mortality and decreases disturbance at nests	Dale et al. 1997

Table 4. Summary of published management recommendations for Baird’s sparrows within Partners-in-Flight State Bird Conservation Plans.

State	Recommendations	Presumed benefits	Citation(s)
Montana	Protect large blocks of grassland on a region-wide basis	Provide numerous potential breeding territories and buffer against variation in local environmental conditions	Casey 2000
	Prescribed burning of grasslands on a rotational basis to mimic historic fire regime	Prevent shrub/tree encroachment and rejuvenate overly-dense grasslands	
	Delay mowing until late July or August	Decrease disturbance and avoid nest destruction	
	Use light, rotational grazing schemes, with little or no grazing during the breeding season (May-July)	Maintain grassland quality and decrease disturbance and nest destruction	
	Seed CRP lands with native grasses	Improve habitat quality	
	Maintain or enhance vegetative structural and species diversity	Improve habitat quality	
Arizona	Maintain minimum 2.5 ha (6 ac) plots of dense <i>Grama</i> spp. and bunchgrass within 16 ha blocks of mixed grasses; maintain at least 250 such blocks per 4045 ha of contiguous grassland	Provide winter foraging and roosting cover	Latta et al. 1999
	Avoid heavy and long-duration grazing	Improve winter habitat	

resulted in the species being removed from the list of Threatened and Endangered species in Canada. The primary reason for de-listing was the apparently stable population in Saskatchewan, in the core of the species’ breeding range.

Recent attempts to improve grassland habitats, either by allowing croplands to go fallow (e.g., the

Conservation Reserve Program [CRP] in the United States and the Permanent Cover Program in Canada) or by direct re-seeding of grasslands, have the potential to benefit Baird’s sparrows (e.g., Johnson and Igl 1995, Johnson 2000). However, re-seeding grassland with exotic grass species (a common practice in many areas of the Great Plains) will likely have little impact since Baird’s sparrows largely avoid exotic grasslands. The

effectiveness of CRP lands in providing breeding and migratory habitat for Baird's sparrows is in need for further study.

Biology and Ecology

Systematics

No subspecies are recognized (American Ornithologists' Union 1957).

Nominate race: *Ammodramus bairdii* Audubon.

Distribution and abundance

Global perspective

Baird's sparrows were historically noted as common or abundant within their limited breeding range on the northern Great Plains (e.g., Coues 1874). Although typically common, their status varied from year-to-year depending on the extent of local rainfall (in some areas, densities appear to be higher during normal or above-average rainfall years; e.g., Roy 1996). Despite their abundance on the breeding grounds, there are relatively few historical records of Baird's sparrows on migratory routes in the central and southern Great Plains, and their winter range is still poorly delineated. The difficulty in documenting their presence during migration and on wintering grounds stems from their secretive habits and problems with identification (especially in relation to savannah sparrows [*Passerculus sandwichensis*] and grasshopper sparrows [*Ammodramus savannarum*]; see discussion in Seyffert 2001). Identification problems have resulted in at least one historical account of breeding Baird's sparrows far from their current known breeding range – a breeding record from the Texas panhandle (McCauley 1877) that was probably a misidentified grasshopper sparrow (Seyffert 2001).

The historical breeding distribution of the Baird's sparrow includes:

Southeastern Alberta – The species is found in south-central and southeastern Alberta, but its historical breeding distribution was not clearly outlined by either Taverner (1926) or Rand (1948). More recent work shows the primary range in southeastern Alberta, with a patchy distribution west to Calgary and north into Elk Island National Park (Semenchuk 1992).

Southern and central Saskatchewan – Historically, Baird's sparrow has been listed as follows: a

common breeder in grasslands around Last Mountain Lake and Davidson (Todd 1947); common in native grasslands in and around Regina from the 1930's to the 1960's (Belcher 1980); a common breeder in grasslands along the Qu'Appelle River valley in southeastern Saskatchewan (Arnold 1895, Callin 1986); a common summer resident in the Rosetown-Biggar District in west-central Saskatchewan (Renaud and Renaud 1975); uncommon during the summer in the Cypress Hills and Flotten Lake region (southwestern Saskatchewan; Godfrey 1950); a fairly common to common summer resident in southwestern Saskatchewan (Roy 1996). There are additional breeding season records, including singing males, for east-central Saskatchewan (Nipawin), but breeding has not been confirmed there (Houston and Street 1959). Davis et al. (1996) recorded individuals breeding in grassland remnants north into the periphery of the Aspen Parklands.

South-central and southwestern Manitoba

– The Baird's sparrow was listed as abundant in the Assiniboine River valley and the Souris River plains (Thompson 1891). During the early 1930's, they were known to have bred around Winnipeg, east to the Pinawa/Lac du Bonnet region (Taylor 1983), and north to the Lake St. Martin region (Shortt and Waller 1937), but they are now restricted to the southwestern corner of the province (Knapton 1979, Taylor 1983). The eastward breeding range extension during the 1930's may have been a temporary response to the severe drought conditions on the Canadian prairies (Taylor 1983).

Montana – The Baird's sparrow was noted as a common breeder in the central and eastern part of the state by Saunders (1921) and the Montana Bird Distribution Committee (1996).

North Dakota – Baird's sparrows have been reported as common to uncommon breeders nearly statewide, but rare to absent in the extreme southeast (Stewart 1975).

Western Minnesota – Although formerly reported in the summer along the western tier of counties (from Traverse to Kittson counties), the only confirmed records of Baird's sparrows are from Pennington and Polk counties in the 1930's (Janssen 1987). More recently, Baird's sparrows have been found during the summer in remnant native prairie in Clay County, but there are no confirmed nesting records from that area (Janssen 1987).

Most early historical works suggest that Baird's sparrows were common to abundant within their breeding range. For example, Coues (1874) considered it "extremely abundant" and "sometimes outnumbering all other bird species combined" in the Dakota Territory. Thompson (1891) considered it common to abundant in southwestern Manitoba. However, it has always been noted as rare during migration and on the wintering grounds.

Migratory pathways are very poorly known. Although Baird's sparrows are often presumed to migrate primarily along the central and western Great Plains, confirmed records are scarce. Other authors have suggested that migration may occur at higher altitudes (Bailey 1928, Green et al. 2002) and at night (Thompson and Ely 1992), which may help explain the paucity of records on the Great Plains.

Figure 2 shows the current known distribution of Baird's sparrows on their breeding and wintering grounds. During the winter, Baird's sparrows are found in western (collected in winter north to Bailey County; Seyffert 2001) and southwestern (Trans-Pecos; most records in Brewster, Presidio, and Jeff Davis counties; Peterson and Zimmer 1998) Texas, southern New Mexico (previously noted as exceedingly rare in winter, with only a single documented record: Hubbard 1978), southeastern Arizona (Phillips et al. 1964, Monson and Phillips 1981, Holt 1989), extreme north-central and northeastern Sonora (only four definite records; Van Rossem 1945, Russell and Monson 2000), northern, central and eastern Chihuahua, western Coahuila, northern Durango, and extreme northwestern Zacatecas (Howell and Webb 1995). The species's wintering range in Mexico is poorly understood, largely based upon a few old specimen records (e.g., Friedmann et al. 1957). Recent unpublished work has documented wintering Baird's sparrows on the northern portion of the Mexican Plateau in north-central Chihuahua (Nocedal et al. 2001).

Regional distribution and abundance

Within Region 2 states, Baird's sparrows breed in northwestern and north-central South Dakota, an area that represents the southern periphery of their breeding range (South Dakota Ornithologists' Union 1991, Tallman et al. 2002). During migration they are rare in prairie grassland habitat throughout South Dakota, Nebraska, southeastern Wyoming, western and central Kansas, and the eastern plains of Colorado.

However, it should be noted that most such records are undocumented and given identification problems, their status during migration is still unclear.

The current status of Baird's sparrow in Region 2 is as follows:

South Dakota – The species is an uncommon breeder in northwestern (Harding, Perkins, Corson, Zwieback, and Dewey counties) and north-central (Campbell, McPherson, Walworth, Edmunds, Potter, and Faulk counties) South Dakota (Tallman et al. 2002). Confirmed and predicted (based on GAP analysis) breeding areas in South Dakota are mapped in **Figure 3**. It apparently once bred southeastward to Hand and Beadle counties (Cartwright et al. 1937). Singing males have been found in late May in areas south of the main breeding range, but breeding has not been confirmed there (Tallman et al. 2002; see similar records of singing males under Wyoming account below).

Nebraska – The Baird's sparrow is a casual migrant statewide (but mainly in the west) in spring and fall, but not known to breed in the state (Molhoff 2001, Sharpe et al. 2001). There is a report of three males "on territory" in late June in extreme northwestern Nebraska (Sioux County), but the record is questioned by Sharpe et al. (2001).

Wyoming – There are no documented nesting records of Baird's sparrows in Wyoming, but singing males have been found near Cheyenne in July (Scott 1993), which is very late for migrating individuals. However, males found singing in suitable habitat in late May and early June have not been found on subsequent visits during the breeding season (Scott 1993, D. Faulkner personal communication 2006). Recent atlas work by the Wyoming Game and Fish Department has produced "suspected" breeding records in three atlas blocks (Luce et al. 1999). Presumed suitable breeding areas in Wyoming, based upon GAP analysis, are mapped on **Figure 4**. Migrating birds are found in grasslands in the southeastern corner of the state, from Laramie and Cheyenne north to Van Tassel and the Black Hills area (Scott 1993). Historically, the species was not mentioned by Knight (1902).

Colorado – The Baird's sparrow is a rare spring and fall migrant on the eastern plains of Colorado, with no recorded breeding (Andrews and Righter 1992, Kingery 1998). As in other areas within Region

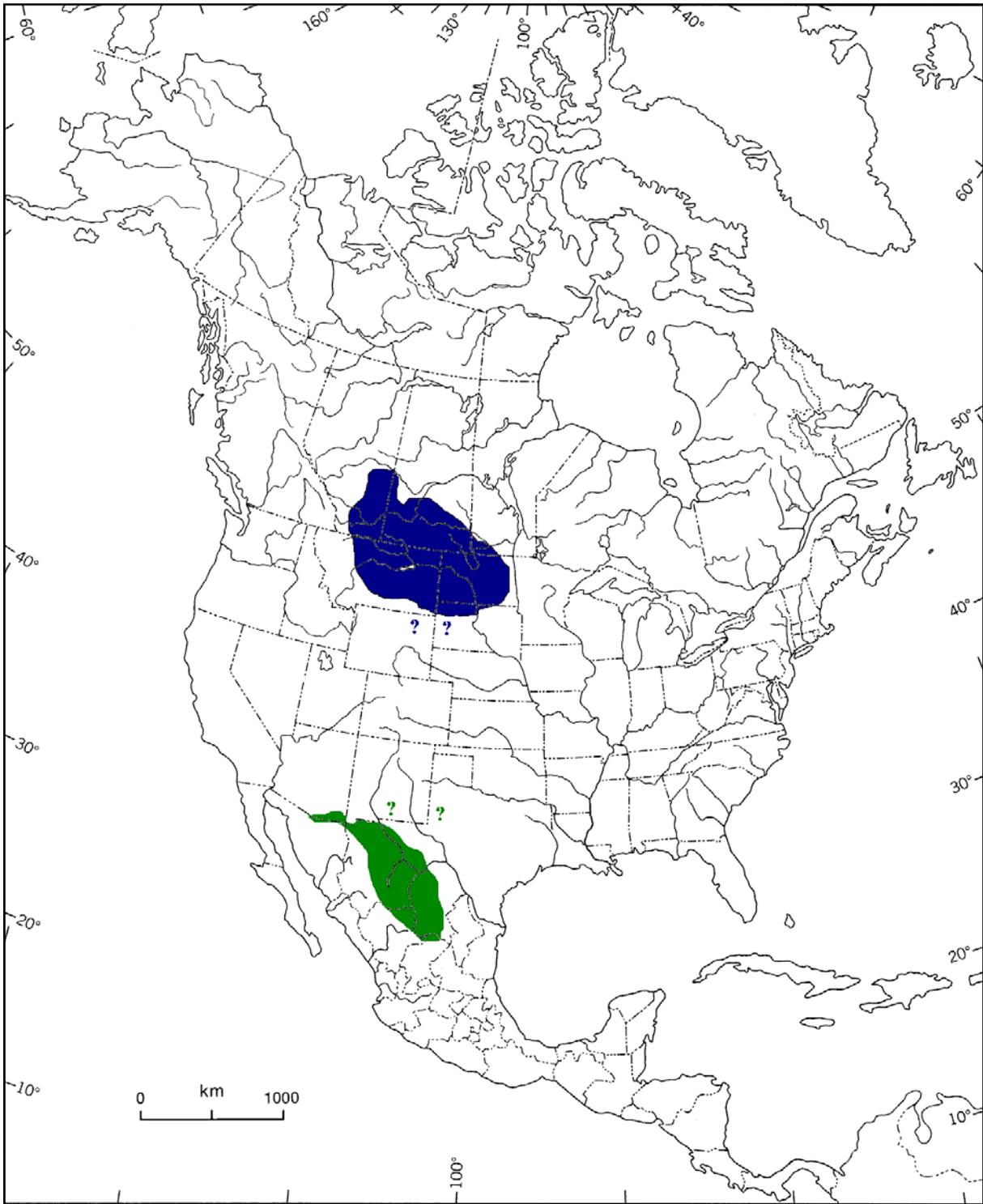


Figure 2. Current breeding and wintering distribution of Baird's sparrows, redrawn from Green et al. (2002).

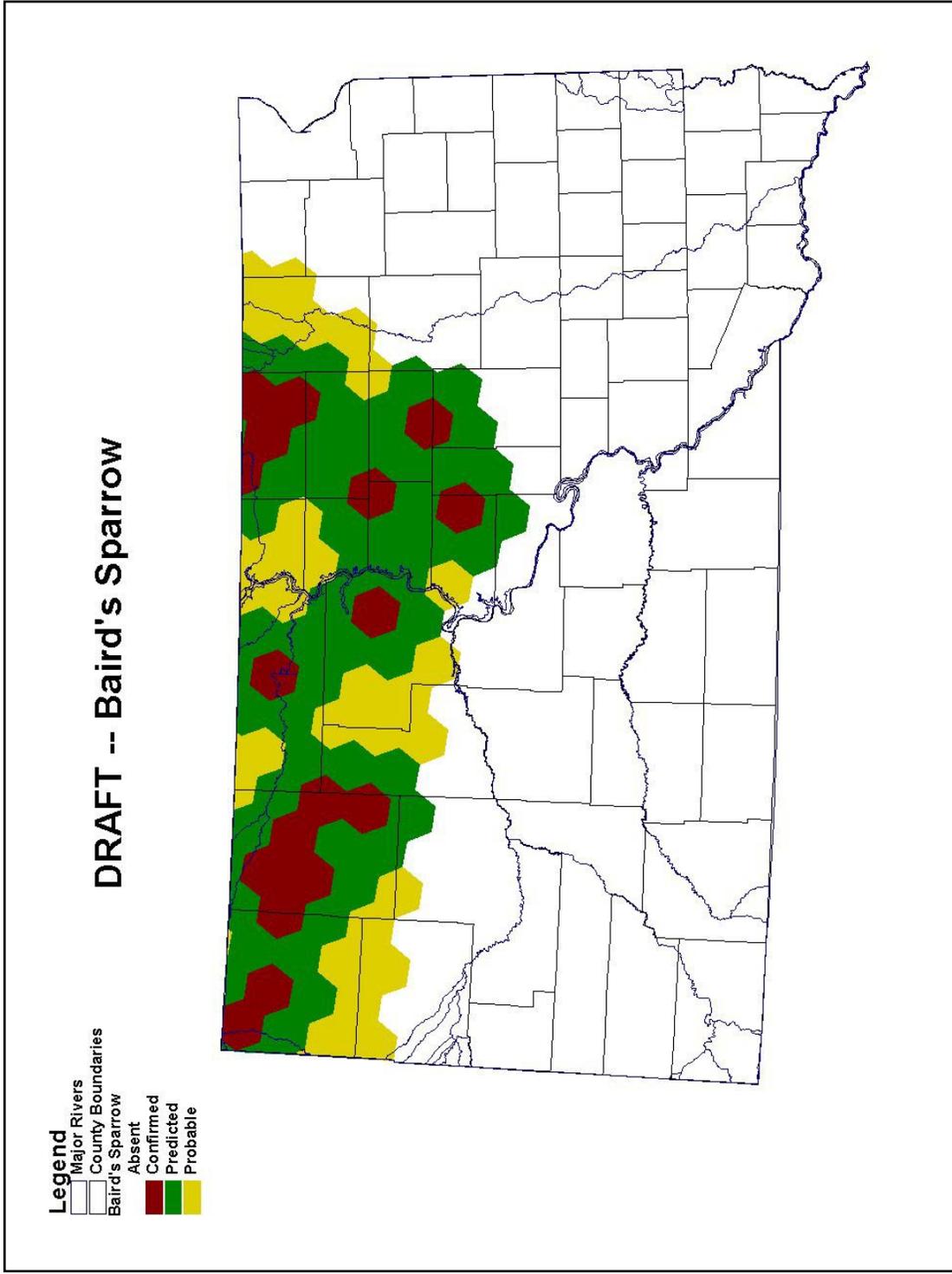


Figure 3. Areas of confirmed (red), predicted (green), and probable (yellow) suitable habitat for breeding Baird's sparrows in South Dakota. For details of the habitat suitability analyses, see the South Dakota Gap Analysis Project (www.wfs.sdstate.edu/sdgap/sdgap.htm).

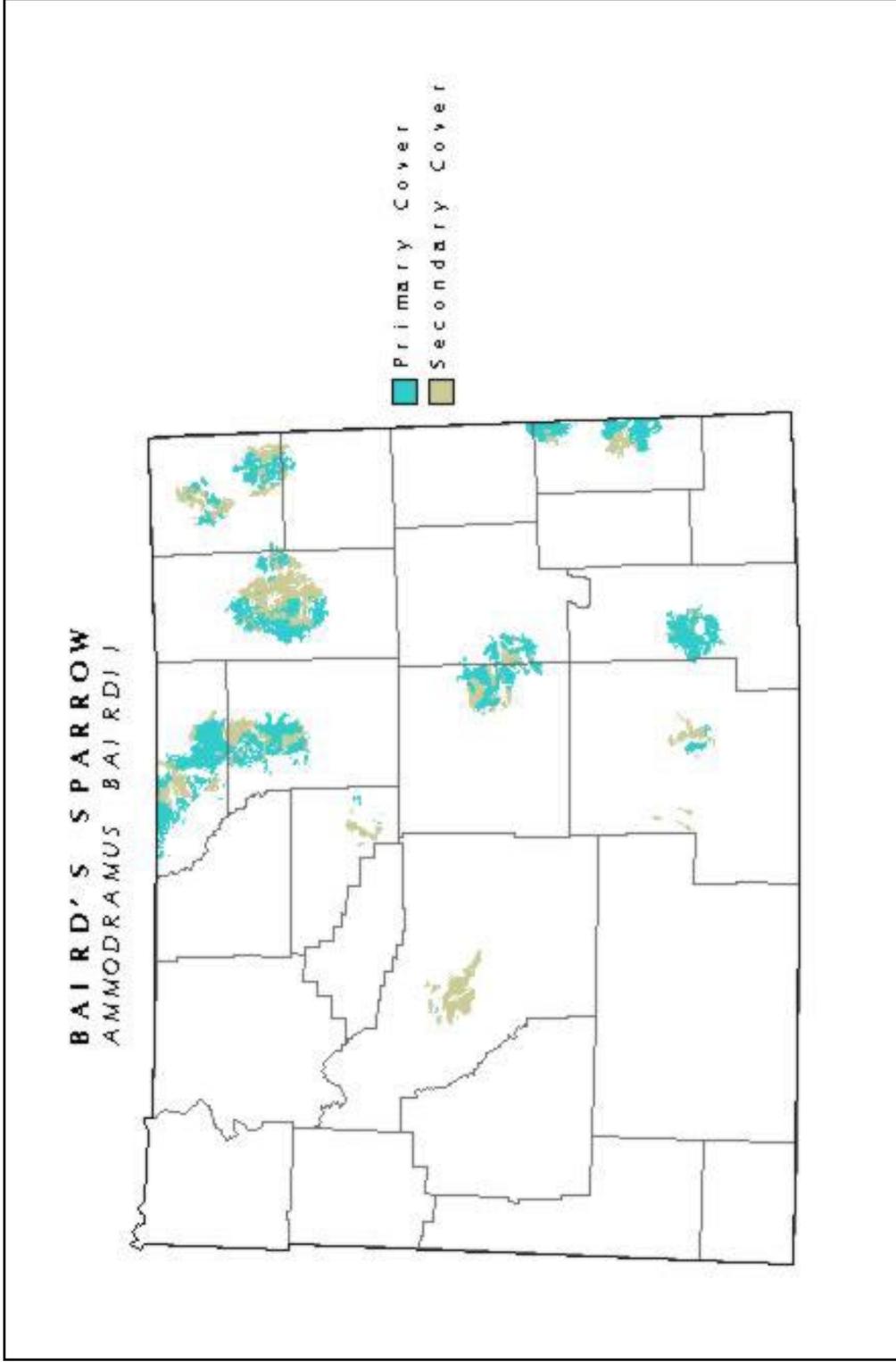


Figure 4. Presumed areas of suitable habitat for breeding and migrating Baird's sparrows in Wyoming. For details on the criteria used in assessing habitat suitability, see the Wyoming Gap Analysis Project (www.wygis.uwyo.edu).

2, the status of the species during migration is difficult to measure given their secretive habits and difficulties in identification (see discussion in Andrews and Righter 1992).

Kansas – The Baird’s sparrows is a rare migrant statewide in spring and fall, with no breeding records (Thompson and Ely 1989, Busby and Zimmerman 2001).

Regional discontinuities in distribution and abundance

There appear to be no large discontinuities in the breeding range of Baird’s sparrows (Green et al. 2002). However, shifts in abundance and, to some extent in distribution, occur from year-to-year given the stochastic nature of precipitation in the northern Great Plains. Monson (cited in Lane 1968) has speculated that in normally dry areas, the local abundance of Baird’s sparrows tends to increase in years with normal to above-average rainfall while in normally wetter areas, abundance decreases in years of increased rainfall. The breeding distribution is thought to shift away from dry areas during drought conditions (e.g., see discussion in Taylor 1983). It should be noted however that all of these conclusions are speculative, and there is no quantitative evidence correlating distribution or abundance with rainfall patterns. The available data are not sufficient to make conclusions regarding discontinuities in abundance and distribution on the wintering grounds.

Population trend

Data from the North American Breeding Bird Survey (BBS; Sauer et al. 2005) are summarized in

Table 5. The general pattern is that the abundance of Baird’s sparrow has decreased in all areas except Saskatchewan, with a clear negative trend across the species’ range. The results for South Dakota are difficult to interpret for two reasons. First, sample sizes (routes on which the species was detected) are small, rendering statistical analysis problematical. In addition, it is not clear to what extent detections of singing birds in May (for example) are indicative of local breeding. As noted under the regional status analysis for Wyoming, Baird’s sparrows may sing during migration, thus complicating analysis of the Wyoming and South Dakota BBS data. In addition, BBS survey techniques (i.e., roadside surveys) are not well-suited for Baird’s sparrows given that the species occurs at greater densities away from roadways (Sutter et al. 2000). Overall, BBS results suggest that Baird’s sparrows have declined over a large portion of the breeding range.

Henshaw (1874, 1875) described Baird’s sparrows as abundant in the early 1870’s in southeastern Arizona and southwestern New Mexico. In Arizona, abundance apparently declined rapidly thereafter as the species was listed as “uncommon” in the 1920’s, and more recently as sparsely distributed and very rare (Phillips et al. 1964, Monson and Phillips 1981, Holt 1989). This decline is similar to that noted for many species of grassland birds in southern Arizona and New Mexico, and it has been attributed to overgrazing in these areas, as well as to conversion of (Great Plains) breeding habitat to cropland (Phillips et al. 1964). In New Mexico, Bailey (1928) noted Baird’s sparrows as “common” almost statewide (and at many altitudes) during migration, but more recent summaries list them as rare or casual during migration (primarily on the eastern plains) and largely absent during winter (Ligon 1961, Hubbard 1978).

Table 5. Long-term trends in the abundance of Baird’s sparrows on Breeding Bird Survey routes in the United States and Canada. Trend values indicate the percentage change per year during the period. Data are from Sauer et al. (2005). Underlined P values indicate statistically significant trends.

Region	1966-1979			1980-2004		
	N	Trend	P	N	Trend	P
South Dakota	3	97.8	0.42	5	6.6	0.47
North Dakota	12	- 3.4	0.10	26	- 6.4	<u>0.00</u>
Alberta	11	- 14.0	0.12	32	- 6.4	<u>0.02</u>
Saskatchewan	14	- 0.7	0.93	30	2.3	0.6
Manitoba	2	- 0.1	0.99	6	- 29.5	<u>0.03</u>
Montana	5	- 2.2	0.93	18	- 4.5	0.19
FWS Region 6	20	- 3.2	0.11	52	- 6.0	<u>0.00</u>
Canada	27	- 8.0	0.13	68	- 1.5	0.60
Survey-wide	47	- 4.5	<u>0.03</u>	121	- 4.0	<u>0.02</u>

Oberholser (1974) concluded that the abundance of Baird's sparrows in Texas had declined greatly since the 1880's due to overgrazing and plowing of habitat.

Activity pattern and movements

Baird's sparrows migrate from their breeding grounds on the northern Great Plains to wintering areas in the southwestern United States and northern Mexico. Little is known of their migratory behavior, presumably as a result of their secretive habits. Migration is assumed to occur over the central and western Great Plains, but there is so little information available that mapping important migration routes is not possible. Little is known of Baird's sparrow activity away from their nest sites. They forage on the ground in grasses, generally avoiding bare areas (Green et al. 2002). There are no data on sex or age-related differences in migration or dispersal patterns.

The degree to which populations in the northern Great Plains are linked is unclear as there is little information on dispersal and movement among populations. However, given their tendency to shift breeding sites from year to year, depending on local environmental conditions (Lane 1968, Kantrud and Faanes 1979, De Smet and Conrad 1991), there is likely a good deal of gene flow among populations and thus relatively little genetic sub-structuring among populations. Baird's sparrows occasionally show a low level of site fidelity as approximately 5 percent of color-banded males returned to breed at previous breeding sites in North Dakota and Montana (Green et al. 2002).

Habitat

Nesting habitat

During the breeding season, Baird's sparrows prefer native grasslands and lightly grazed pastures for both nesting and foraging (Sousa and McDonald 1983, Davis et al. 1999, Sutter et al. 1999, Green et al. 2002, Dechant et al. 2003). They will also utilize non-native grasslands (Davis et al. 1996), as well as a variety of dense grass habitats such as dry wetland basins (Lane 1968). In their northern Great Plains breeding range, Baird's sparrows breed largely within the mixed-grass prairie biome (Dechant et al. 2003). Baird's sparrows are area-sensitive, favoring large blocks (Johnson and Igl 2001, McMaster and Davis 2001) of habitat and generally avoiding areas in close proximity to roads (Sutter et al. 2000). Dechant et al. (2003) typified preferred nesting habitat as:

- ❖ moderately deep litter cover (>0 cm, <2 cm; less than 0.8 inches)
- ❖ vegetation height varying between 20 to 100 cm (8 to 40 inches)
- ❖ moderately high, but patchy, forb coverage
- ❖ areas composed of patchy grass and litter cover, with some bare soil (i.e., heterogeneous grasslands)
- ❖ minimal or no woody vegetation

Although singing males have been found using croplands (e.g., Green et al. 2002), whether nests are actually located in such habitats is unclear. This uncertainty regarding the territories of singing males, and whether they contain nests and foraging areas, has led to problems in delineating the distribution and habitat affinities of this species.

Baird's sparrows appear to show a shift in nesting habitat choice depending on the local environmental conditions. In dry years, they prefer relatively mesic areas while in wet years they prefer drier areas (Lane 1968, Kantrud and Faanes 1979, De Smet and Conrad 1991). In Saskatchewan, Baird's sparrows showed a preference for nesting in grasslands dominated by native vegetation (100 percent of plots occupied), relative to grasslands dominated by *Poa pratensis* (Kentucky bluegrass; 60 to 75 percent of plots occupied) and *Bromus inermis* (smooth brome; 28 to 38 percent of plots occupied) (Dale et al. In prep). **Table 6** summarizes the vegetative characteristics at Baird's sparrow nest sites.

While nearly all early breeding records were in habitats such as native grassland and dry marshes (Coues 1874, Thompson 1891), several publications have reported singing males in croplands (e.g., Belcher 1980, Callin 1986, Roy 1996). Although it appears that Baird's sparrows may breed in such fields, there remain no confirmed accounts of nesting in cultivated croplands (Roy 1996). Lane (1968) reported finding an active Baird's sparrow nest in a tame grass (*Bromus inermis*) field, but the field had been abandoned 10 years earlier and the ground cover had reverted to largely native grassland. In a Saskatchewan study, Davis et al. (1999) found that singing males occurred in nearly equal densities in native pasture, seeded pasture, and hayland. Again, however, the presence of singing males does not constitute evidence of nesting. Davis (cited in Green et

Table 6. Vegetative cover around Baird’s sparrow nest sites. In most cases, vegetative cover was that which typified the surrounding habitat, rather than the immediate nest microhabitat. See individual studies for details.

Region	Primary vegetative cover in nest area	References
Southern Alberta	Rough fescue (<i>Festuca scabrella</i>) Sedge (<i>Carex obtusata</i>) Porcupine grass (<i>Stipa spartea</i>) Club moss (<i>Selaginella densa</i>) Spike oat (<i>Helictotrichon hookeri</i>)	Owens and Myres 1973
Southern Saskatchewan	Canby’s bluegrass (<i>Poa canbyi</i>) Graceful sedge (<i>Carex praegracilis</i>) Foxtail barley (<i>Hordeum jubatum</i>) Needle grass (<i>Stipa</i> spp.) June grass (<i>Koeleria cristata</i>) Northern wheatgrass (<i>Agropyron dasystachyum</i>) Pasture sage (<i>Artemisia frigida</i>) Western snowberry (<i>Symphoricarpos occidentalis</i>)	Dale 1983, Sutter et al. 1995, Davis and Duncan 1999, Davis et al. 1999
Southwestern Manitoba	Smooth brome (<i>Bromus inermis</i>) Porcupine grass (<i>Stipa spartea</i>) Bluegrass (<i>Poa</i> spp.) June grass (<i>Koeleria gracilis</i>) Pasture sage (<i>Artemisia frigida</i>) Western snowberry (<i>Symphoricarpos occidentlis</i>) Wolf willow (<i>Eleagnus commutata</i>) Mat muhly (<i>Muhlenbergia richardsonis</i>)	Davis and Sealy 1998
North Dakota	Club moss (<i>Selaginella densa</i>) Pasture sage (<i>Artemisia frigida</i>) June grass (<i>Koeleria pyramidata</i>) Needle grass (<i>Stipa comata</i>)	Kantrud and Kologiski 1982

al. 2002) reported that only 6 percent of territorial males in hay fields were mated. Thus, considerable caution must be used when equating the presence of singing males with active, local nesting activity (cf. S. K. Davis personal communication 2003) .

Foraging habitat

Foraging habitat of Baird’s sparrows has typically been inferred from indirect observations (e.g., singing) of birds using different habitat types, rather than from direct observations of foraging birds. Consequently, as with the section on nesting habitat, there is some degree of uncertainty in the data. Under the assumption that breeding Baird’s sparrows forage mostly within their nesting territory, foraging habitats include native grassland/pasture, fallow cultivated fields, hay, and seeded pastures (Davis et al. 2002). During the winter, the few available data suggest that Baird’s sparrows occur in relatively dense (i.e., lightly grazed or ungrazed) grasslands typified by bunchgrasses (e.g., *Bouteloua* spp., *Eragostris* spp.; Gordon 2000).

Food habits

The food habits of Baird’s sparrows have not been well-studied. During the breeding season, Baird’s sparrows feed mainly on invertebrates including beetles, caterpillars, flies, grasshoppers, leafhoppers, and spiders (Cartwright et al. 1937, Lane 1968). On the wintering grounds, they consume seeds including sorghum, pigweed, green bristlegrass, lamb’s quarters, Russian thistle, ragweed, plantain, brome grass, and bluestem (Lane 1968, Oberholser 1974). Lane (1968) noted that in Manitoba, their diet in spring and fall includes a substantial number of seeds, including those of lamb’s quarters, Russian pigweed, Russian thistle, redroot pigweed, false flax, tumbling mustard, and especially green foxtail. A summary of Baird’s sparrow food items is presented in **Table 7**.

In the 1930’s in southern Manitoba, young were fed almost exclusively large grasshoppers (Cartwright et al. 1937) while adults consumed smaller insect prey (e.g., beetles, leafhoppers). Thirty years later,

Table 7. Summer and winter diets of Baird’s sparrows, as well as vegetative cover in fields used by foraging Baird’s sparrows during spring migration.

Time of year	Area	Food	Citation
Summer	Manitoba	Grasshoppers (<i>Orthoptera</i>) Beetles (<i>Coleoptera</i>) Caterpillars (Lepidoptera larvae) Leafhoppers (<i>Homoptera</i>) Flies (<i>Diptera</i>) Spiders (<i>Araneae</i>) Moths (<i>Lepidoptera</i>) seeds (<i>Phleum pratense</i> ?)	Cartwright et al. 1937
Migration (April)*	central Oklahoma	red three-awn (<i>Aristida</i>) little bluestem (<i>Adropogon scoparius</i>) brome (<i>Bromus</i>) six weeks’ fescue (<i>Festuca octoflora</i>) yellow sweet clover (<i>Melilotus officinalis</i>) perennial ragweed (<i>Ambrosia psilostachya</i>) plantain (<i>Plantago virginica</i>) blazing-star (<i>Liatris</i>) evening primrose (<i>Oenothera laciniata</i>)	Graber cited in Lane 1968
Winter	southwest Texas	sorghum <i>Amaranthus</i> spp. pigweed green bristlegrass lambquarter Russian thistle plantain bromegrass bluestem	Lane 1968, Oberholser 1974

*Graber’s study in central Oklahoma was not a diet study. The plant species listed were found in fields where Baird’s sparrows were observed foraging and are thus best viewed as foraging habitat.

Lane (1968) found that small green caterpillars were the primary diet of nestlings up to 5 days of age. Thus, nestling diets are probably greatly affected by local environmental conditions and their effects on prey availability.

Breeding biology

Courtship and pair formation

Males typically arrive on the breeding grounds 3 to 7 days before females (Cartwright et al. 1937), with pairs forming after males have settled into territories (Lane 1968). The timing of arrival on the breeding grounds varies from late April to late May (**Table 8**). There is little information on daily and seasonal variation in singing, but males appear to sing throughout the day, with a second seasonal singing peak (corresponding to initiation of second broods) in late June and early July (Cartwright et al. 1937). It is unclear to what extent song functions in territorial establishment

versus female attraction. Males typically sing from the highest perch within their territory, and they may make presumed courtship flights (i.e., shallow, rapid wing-beats) between display sites on the territory (Green et al. 2002).

Pairs are generally monogamous, but there has been one observation of a male with two females nesting within a territory (Green et al. 2002). Of three pairs followed through first and second broods in Manitoba, two pairs remained together and one pair split up after the first brood fledged (Cartwright et al. 1937). There is no information on year-to-year pair bonds, as few birds return to breed at the same sites (Green et al. 2002).

Nest-site selection

Baird’s sparrows place their nests in shallow depressions on the ground, typically beside or within a tuft of grass (Cartwright et al. 1937, Davis and Sealy 1998). Multivariate analysis of nest site choice in a

Table 8. Timing of Baird’s sparrow arrival on and departure from the breeding grounds.

Area	Spring arrival date	Fall departure date	Citation
Alberta	3rd week of May	unknown	Semenchuk 1992
Saskatchewan	early May	August to early September	Belcher 1980, Green et al. 2002
Manitoba	early May	latest 23 September	Seton 1885
Montana	26 April to 3 May	mid September	Green et al. 2002
North Dakota	early May (?)	unknown	Stewart 1975
South Dakota	late April to early May	September to early October	Tallman et al. 2002

Saskatchewan native grassland showed that, relative to random sites, nest sites were typified by less bare ground, greater litter depth, a greater density of standing dead vegetation, and a lower density of live (< 10 cm) grasses (S. K. Davis, cited in Green et al. 2002). A study of nest sites in north-central Montana revealed similar results, with nest sites usually located in patches of western wheatgrass and typified by greater litter depth, greater vegetation height and density, and less bare rock, bare ground cover, and clubmoss (S.L. Jones, cited in Green et al. 2002). Nests are composed of two layers, a coarse outer layer of grass, stems, and leaves, and a finer inner cup of narrow-leaf grasses and rootlets, fur, string, and hairlike moss setae (Cartwright et al. 1937, Lane 1968, Davis and Sealy 1998). In a Saskatchewan study, most nests were exposed on the south and east sides and protected by vegetation on the north and west sides (S. K. Davis, cited in Green et al. 2002). There is no information on whether the nest is built only by the female, or whether the male contributes to nest construction.

Clutch and brood size

The average Baird’s sparrow clutch contains four or five eggs, with a range of two to six (**Table 9**). Clutch size declines significantly over the course of the breeding season (Davis and Sealy 1998). No data are available to assess whether the seasonal decline in clutch size is due to a reduction in clutch size among females laying their first clutch, and/or whether

females laying a second clutch (later in the season) are laying fewer eggs. However, studies from other passerines suggest that both factors likely contribute to the seasonal clutch size decline. Second broods are sometimes raised, but the frequency of second broods is unknown. Cartwright et al. (1937) suggested that raising two broods per season was typical for Baird’s sparrows in Manitoba, but Green et al. (2002) stated that only one brood is typically raised per season. Second clutches have also been observed in Minnesota and Montana (Green et al. 2002).

Davis and Sealy (1998) summarized data from the Canadian Prairie Nest Record Scheme and found that among 15 successful nests, mean brood size was 3.8 (SE = 0.3) young. Similar data from their study in southwestern Manitoba yielded a mean of 2.8 (n = 40, SE = 0.2) young per nest.

Parental care and offspring behavior

The female Baird’s sparrow incubates the eggs (Cartwright et al. 1937). Both Lane (1968) and Davis and Sealy (1998) report an incubation period of 11 to 12 days. Although males have not been observed to feed the female on the nest during incubation, such behavior would likely occur away from the nest site in a species (such as Baird’s sparrow) that is susceptible to nest depredation and brown-headed cowbird (*Molothrus ater*) parasitism. There is no information available on the length of incubation bouts.

Table 9. Clutch size and reproductive success of Baird’s sparrows.

Study area	Clutch size			Range	Daily survival rate during incubation/nestling stage	Fledging success*	Citation
	N	Mean	SE				
Manitoba	61	4.6	0.78	3-6	0.958/0.948	1.4 yg/nest	Davis and Sealy 1998
Montana	52	4.3	0.8	2-6	0.964/0.931	—	Jones unpubl., cited in Green et al. 2002
North Dakota	15	4.7	—	4-5	—	—	Stewart 1975
Saskatchewan	144	4.6	0.57	3-5	0.948/0.904	1.5 yg/nest	Davis unpubl., cited in Green et al. 2002

*Number of young fledged per nest initiated.

The female broods the young for short periods (up to three minutes) after returning to the nest with food (Cartwright et al. 1937). This behavior continues until the young are 5 days old. Females also brood the young at night (Cartwright et al. 1937). The pattern of post-hatching feeding behavior has not been closely studied. During the first few days, the female provides the majority of food, with the male providing the majority of food thereafter (Cartwright et al. 1937). In 881 minutes of observation at three nests containing a total of 11 young, Cartwright et al. (1937) observed a total of 157 feeding visits. During these observations, the average interval between feeding visits was 6.3 minutes.

Anecdotal observations suggest that males provide all of the post-fledging care of first broods while females may contribute to post-fledging care of second broods (Cartwright et al. 1937). Adults have been observed shading fledglings from the heat, up to 11 days post fledging (S. L. Jones, cited in Green et al. 2002). Young leave the nest 8 to 11 days after hatching, usually still incapable of flight (Cartwright et al. 1937, Davis and Sealy 1998).

Timing of breeding and breeding success

Table 10 provides a summary of the timing of major reproductive events. Baird’s sparrows arrive on the breeding grounds from late April to late May, initiate first clutches from late May to late June, and second clutches (if any) from late June to early August. Studies quantifying reproductive success are summarized in **Table 9**. At nests not depredated during incubation, Davis and Sealy (1998) reported 81 percent hatching success. Reproductive success (at least one young fledged) in southwestern Manitoba was

54 percent (n = 74 nests), with losses attributed to nest predators (39 percent of nests depredated) and various effects of brood-parasitic brown-headed cowbirds (see Demography section below; Davis and Sealy 1998).

Demography

Genetic characteristics and concerns

The distribution of Baird’s sparrows across the northern Great Plains is relatively contiguous, with a few isolated breeding populations in patches of grassland within aspen parkland in central Alberta and Saskatchewan. Breeding site fidelity appears to be relatively low (Green 1992, Green et al. 2002). In addition, studies of vocalizations across the breeding range suggest that there is little if any regional variation in song types (Green 1992). All of these factors suggest a low degree of genetic isolation among populations. However, given the increasing fragmentation of suitable breeding habitat, the extent to which nearby populations may be mixing is likely decreasing. Breeding populations are almost certainly much more isolated today than they were in the mid to late 1800’s, when grasslands were relatively unaffected by cropland conversion and overgrazing. A study of population divergence (e.g., a mtDNA study) from within known breeding areas (e.g., Alberta, Manitoba, South Dakota, Montana) together with information on the dispersal of young birds would be particularly informative in understanding the genetic structuring of Baird’s sparrow populations.

Life history characteristics

Baird’s sparrows typically lay a clutch of four or five eggs, and some pairs may raise two broods in a single season. Although studies of marked individuals

Table 10. Approximate timing of breeding of Baird’s sparrows based on known nesting attempts.

Study area	N	Nest building	1st clutch date	Hatch date	Fledge date	Citation
Saskatchewan	3	—	23-28 June	late July-early August	early-mid September	Lane 1968
Saskatchewan	174	3rd week May	7 June (median date)	mid June	late June	Davis cited in Green et al. 2002
Manitoba	76	—	29 May-4 June (peak)	mid June	late June	Davis and Sealy 1998
Montana	52	earliest 23 May	11 June (median date)	July-August	2 August	Green et al. 2002
South Dakota	13	—	June - 24 July	—	—	Tallman et al. 2002
North Dakota	23	—	5 June - 21 July	4 August	30 June - 18 August	Stewart 1975

are lacking, Baird's sparrows (like most other temperate-zone passerines) likely breed first when one year old (Green et al. 2002).

There are no available data on post-fledging survival, adult survival, or age-related variation in reproductive success. Given the lack of these critical life history data, analyses of life cycle diagrams and associated demographic matrices (Caswell 1989, McDonald and Caswell 1993) were not carried out in this review. While such analyses can provide valuable insights into which life-history stages may be most critical to population growth, constructing models based on incomplete and/or poor quality data may have little relevance (Reed et al. 2002). Not surprisingly, population viability analyses (PVA) have not been published for Baird's sparrows.

Social patterns and spacing

Baird's sparrows are territorial during the breeding season, but apparently non-territorial during winter (Green et al. 2002) when they are relatively sedentary and do not join flocks. In a North Dakota study, males defended breeding territories varying in size from an average of 1.2 (n = 19) to 1.5 (n = 11) hectares, with larger territories in the study area that had been burned less frequently (Winter 1999). Lane (1968) reported breeding territories ranging from 0.4 to 0.8 ha in southern Manitoba. During winter in Arizona, Gordon (2000) mist-netted Baird's sparrows and found that they appear to remain within a local winter home range.

Factors limiting population growth

On the breeding grounds, availability of large tracts of suitable nesting habitat is likely the strongest factor limiting the growth of Baird's sparrow populations. Suitable habitat is degraded by intensive grazing, fragmentation, mowing (e.g., hayfields), and either a lack of or a high frequency of grassland fires. In some portions of the range, brood-parasitism by brown-headed cowbirds has significant negative effects on the reproductive success of Baird's sparrows and can affect up to 36 percent of nests; cowbird parasitism is likely negatively correlated with the size of nesting habitat patches (Davis and Sealy 1998; see Community ecology section below). Although there are no quantitative data available, several authors have stressed that degradation and direct loss of wintering habitat may also be posing a serious problem for Baird's sparrow populations.

Community ecology

Predators and relationship to habitat use

Predation on adults has rarely been recorded; a single adult male near its nest was apparently taken by a weasel (*Mustela* spp; Green et al. 2002). Presumed predators of eggs and nestlings include striped skunks (*Mephitis mephitis*), thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*), mice (*Peromyscus* spp.), badgers (*Taxidea taxa*), red fox (*Vulpes vulpes*), and coyotes (*Canis latrans*) (Lane 1968). Young birds have been taken by northern harriers (*Circus cyaneus*) and merlins (*Falco columbarius*) (Lane 1968). There are insufficient data to assess whether habitat variation affects nest predation.

Competitors

On both the breeding and wintering grounds, there is significant territorial overlap with potentially competing species (e.g., grasshopper and savannah sparrows; Cartwright et al. 1937, Green et al. 2002). However, there have been no studies of interspecific competition involving Baird's sparrows and other grassland passerines.

Effects of brood-parasitic brown-headed cowbirds

Historical records indicate that Baird's sparrows were a very infrequent host of the brown-headed cowbird (e.g., see summary in Lane 1968). However, recent studies have shown parasitism rates of 6 to 36 percent, often with more than one cowbird egg in each parasitized nest (**Table 11**). When at the nest, female sparrows respond aggressively to cowbirds (Green et al. 2002).

Cowbird brood parasitism typically has significant negative effects on Baird's sparrow reproductive success. For example, clutch size in parasitized nests is significantly smaller than in non-parasitized nests (3.1 vs. 4.5, respectively, in Manitoba; Davis and Sealy 1998). Whether this is due to egg destruction by female cowbirds, or to a reduction in clutch size by laying sparrows is not known. In addition, the number of fledged sparrows was lower in parasitized nests than in non-parasitized nests in Manitoba (1.9 vs. 2.1; Davis and Sealy 1998) and Saskatchewan (3.0 and 3.9; S. K. Davis, cited in Green et al. 2002). Davis and Sealy (2000) found that nests that were parasitized by cowbirds fledged 1.4 fewer Baird's sparrow young than nests with no parasitism.

Table 11. Frequency of parasitism by brown-headed cowbirds on Baird’s sparrows.

Region	N	% parasitized by cowbirds	Mean number of cowbird eggs laid/parasitized nest	Reference
Manitoba	74	36	2.0	Davis and Sealy 1998
Saskatchewan	182	21	1.7	Davis, cited in Green et al. 2002
Canadian prairie provinces	27	11	2.3	Davis and Sealy 1998
Montana	52	6	—	Davis, cited in Green et al. 2002

Interactions between Baird’s sparrows, their habitat, disturbances, and other species are shown in **Figure 5**. The primary factors positively affecting the local abundance and reproductive success of Baird’s sparrows is the presence of large tracts of undisturbed, native grassland. Several studies have shown that Baird’s sparrows are more common and achieve better reproductive success in areas typified by native grassland (Sousa and McDonal 1983, Sutter et al. 1995, Johnson and Igl 2001, Dechant et al. 2003). However, some form of occasional disturbance (e.g., fire, grazing, mowing; Dechant et al. 2003) is typically beneficial as it creates suitable conditions for nesting and foraging. Heavy, continuous livestock grazing has been shown to negatively affect both the density and reproductive success of Baird’s sparrows (Owens and Myres 1973, Kantrud 1981, Dale 1983, De Smet and Conrad 1991, Anstey et al. 1995, Sutter et al. 1995). However, in areas with relatively moist grasslands (i.e., the eastern half of the species’ range), sporadic, light grazing may act to improve habitat for Baird’s sparrows (Anstey et al. 1995, Mahon 1995). In addition to the availability and quality of habitat, a primary threat to Baird’s sparrows is brood parasitism by brown-headed cowbirds.

CONSERVATION

Threats

Historically, Baird’s sparrows were one of the most common species of birds on the northern Great Plains (Coues 1874). The subsequent decline in their abundance was likely due to two principal factors: 1) the conversion of native grassland to agricultural use on the northern plains breeding grounds, and 2) habitat degradation, primarily due to overgrazing by livestock. Even within recent years, Baird’s sparrow has continued to decline in abundance, with statistically significant declines since 1980 in the United States and range-wide (**Table 5**). Clearly, the species is facing continuing problems and the following section considers potential causes of recent population declines.

Grassland conversion

It is clear that the large-scale conversion of native prairie to agricultural use significantly affected Baird’s sparrows both on their breeding grounds to the north and on their migratory route across the southern Great Plains. Although it is not clear to what extent such grassland conversion is still being carried out, large-scale programs aimed at restoring grassland habitat are now in place in the United States and Canada. However, as these programs sometimes “restore” grasslands by planting exotic grasses, it is not clear to what extent such programs may be benefiting Baird’s sparrows. On the breeding grounds, Baird’s sparrows reach significantly higher densities in native grasslands relative to both fallow fields (such as CRP land) and croplands. In fact, although singing males have been observed in active agricultural fields, no firm evidence of breeding exists for that habitat type. Consequently, conversion of remaining native grasslands would represent a significant threat to local population viability of Baird’s sparrows.

Overgrazing

In areas with relatively moist grasslands, limited livestock grazing may benefit Baird’s sparrows by reducing the density and height of grasses, and promoting new grass growth. However, in drier areas, including most grasslands in Region 2, livestock grazing is often carried out at levels that are reducing the density and height of grasses to less than optimal for Baird’s sparrows. In addition, heavy overgrazing in the species’ wintering range has been cited as a potential problem (Phillips et al. 1964, Jones and Green 1997), and this is a concern that is in need of further study (see the Information Needs section).

Lack of habitat disturbance

Although Baird’s sparrows occur at high densities in idle grassland, some form of occasional disturbance

is known to be beneficial in the long-term. Thus, grasslands that are carefully controlled such that little to no disturbance occurs over long (multi-year) periods may eventually prove unsuitable for Baird's sparrows. However, in reality most areas are subject to a range of disturbances including natural and prescribed burns, as well as livestock grazing. As a consequence, a lack of habitat disturbance should be viewed more as a potential (rather than actual) threat to Baird's sparrows. More commonly, intensive disturbance is the norm throughout most of the Great Plains, as relatively dense grasslands are those most highly desired by the livestock industry.

Elimination of landowner incentives

Federal programs in the United States and Canada have created a large increase in grassland cover on the Great Plains. However, such programs have limited tenure, and their elimination would likely lead to a sharp decrease in the quantity of habitat available to Baird's sparrows on the breeding grounds and along their major migratory route.

Brood parasitism

Although reported brood parasitism rates are relatively low (**Table 11**), brood parasitism by brown-headed cowbirds may represent a serious threat to Baird's sparrows. Reproductive success is significantly reduced when nests are parasitized by cowbirds, and such parasitism is likely increasing as grassland habitats become smaller and more fragmented, and as shrubs encroach on grasslands (Brittingham and Temple 1983, O'Connor and Faaborg 1992). Davis and Sealy (2000) found that among three sites in southwestern Manitoba, the frequency of cowbird parasitism was significantly higher at the smallest site, despite lower host (sparrow) density at that site. The small site contained the largest number of shrubs, which are used as perch/observation sites by cowbirds, and this was thought to have led to the higher abundance of cowbirds at the site. Although further data are needed to assess the generality of this result, the implications are clearly negative for a species faced with habitat fragmentation.

Other disturbances

The primary natural disturbance that may have negative impacts on the Baird's sparrow is drought. In exceedingly dry years, the species may seek more favorable (i.e., wetter) nesting conditions in nearby areas. Invasion of native grasslands by exotic grasses

(e.g., smooth brome) may create habitat that is unsuitable for Baird's sparrows.

In summary, the current threats for Baird's sparrows are likely (in rank order): 1) overgrazing of grassland habitat; 2) establishment of alien (instead of native) grasses in Conservation Reserve Program (and other habitat conservation plan) plots; 3) the potential elimination of the CRP, the Grassland Reserve Program, and other landowner incentive programs; and 4) conversion of native grassland to agricultural use.

Conservation Status of Baird's Sparrows in Region 2

The status of Baird's sparrows in Region 2 is difficult to assess with the information currently available. First, there is conflicting evidence as to the species' breeding status in Wyoming (e.g., BBS data, Cervoski et al. 2001), but the species has never been confirmed breeding in the state (D. Faulkner personal communication 2006). Second, Baird's sparrows are rarely observed during migration, and there has been very limited study of habitat use at that time. Consequently, assessing the conservation status of this species in Region 2 requires making assumptions based on information from studies north of the region.

Two factors appear to be critical to sustaining viable populations of Baird's sparrows: 1) the intensity of grazing pressure, and 2) the nature (native instead of exotic grass species) and size (large, contiguous instead of small, fragmented) of the available grasslands. The ideal habitat for this species is lightly grazed or ungrazed mixed-grass prairie. In the central and eastern portions of the range, occasional fires may cause Baird's sparrows to abandon breeding areas for one or two years, but they may also help to improve habitat over the long term by reducing the density of litter. However, prescribed fire would likely not improve habitat conditions for breeding in the relatively arid grasslands of Region 2. We still have too few data to assess the effects of habitat variation on migrating and wintering Baird's sparrows – this largely stems from the difficulty in observing the species during migration, as well as a lack of information on their habitat use during winter.

Baird's sparrows appear to be vulnerable to subtle changes in local environmental conditions (e.g., rainfall) and habitat in that they have relatively specialized breeding site requirements. In some areas, they may shift breeding areas readily, depending on the condition of local grasslands (Taylor 1983, Roy

1996). This is probably especially true around the periphery of the range (e.g., northern South Dakota and possibly northern and eastern Wyoming), where suitable breeding habitat may be patchily distributed. Unfortunately, there are too few data available to assess whether reproductive success also varies with certain habitat characteristics.

The percentage of native prairie remaining in the northern Great Plains is small and apparently declining (Knopf and Samson 1997). This has likely had significant negative impacts on the abundance of Baird's sparrows on the breeding grounds. However, there have been recent management attempts to establish conservation easements, re-seed grasslands with native grass species, and allow grasslands to recover following agricultural use (e.g., CRP). Given that the percentage of native grasslands has declined precipitously throughout the southern Great Plains (one of the presumed migratory pathways) as well (see Knopf and Samson 1997), there is likely a lack of suitable foraging/cover habitat along the species' migratory routes. In addition, heavy grazing pressure on remaining native grasslands is likely having a significant negative impact on Baird's sparrows, not only on the breeding grounds, but also along migratory routes and on the wintering grounds.

There is currently too little information available to assess whether Baird's sparrows are currently at risk in Region 2. Given this lack of information, land management strategies that aim to support a diversity of grassland structural characteristics (see below) are likely the best to follow until further data become available on the ecology of the Baird's sparrow in Region 2.

Management of Baird's Sparrows in Region 2

Implications and potential conservation elements

Stochastic environmental phenomena, such as drought and fire, may have significant impacts on the local distribution and abundance of Baird's sparrows in Region 2. These factors are especially significant in the western portion of the species' range, where rainfall and fire have greater impacts on the grasslands. In these semi-arid western areas, fires should generally be avoided, and grazing should be minimized within suitable breeding and migratory habitat.

Current land management practices may be having significant negative effects on Baird's

sparrow populations. Overgrazing by livestock and conversion of native grasslands to exotic grasslands and crops eliminate or severely degrade nesting and foraging habitat. When suitable habitat is fragmented, reproductive success is lowered, the probability of brood parasitism by brown-headed cowbirds increases, and the overall abundance of breeding birds decreases (Johnson and Igl 2001, McMaster and Davis 2001). Recent studies (e.g., Sousa and McDonal 1983, U.S. Fish and Wildlife Service 2002b, Dechant et al. 2003) have provided a number of management strategies (see below as well as **Table 3** and **Table 4**) that can assist in providing optimal nesting and foraging habitat for Baird's sparrows. Such practices should also contribute to improving the quality of habitat on the migration and wintering grounds although no studies of the species' ecology in those areas has yet been carried out.

Altering grazing regimes to eliminate continuous, heavy grazing is probably the single most effective tool in improving grasslands for Baird's sparrows. This is especially true for areas of shortgrass prairie on the migration route in southeastern Wyoming, eastern Colorado, western Nebraska, and western Kansas as these grasslands are more easily prone to, and more difficult to recover from, overgrazing. When grazing is carried out in potential or known Baird's sparrow habitat, it should be carried out in a rotational manner so that grasslands are allowed to recover. As grassland habitats become available for conservation easements or other non-agricultural usage (e.g., CRP), any re-seeding should be carried out with native species.

On the breeding grounds in South Dakota, initiation of a prescribed fire regime, at relatively long intervals (e.g., every 8 to 10 years), may also improve breeding habitat. However, prescribed fire needs to be carefully considered as it may be detrimental in areas where grasslands recover more slowly. Studies in North Dakota suggest that, in areas with good rainfall, a grassland fire every 4 to 6 years provided optimal long-term habitat conditions for Baird's sparrows (Madden et al. 1999, Winter 1999).

Preserving large blocks, rather than small, fragmented patches of native grassland may improve the reproductive success of Baird's sparrows by lowering the frequency of brood parasitism by brown-headed cowbirds. Large habitat blocks are also known to attract higher densities of breeding sparrows, both within native grasslands and conservation easements (McMaster and Davis 1998, Johnson and Igl 2001).

Tools and practices

Habitat management

At present, habitat management practices have only been developed for Baird's sparrows on the breeding grounds in south-central Canada and the northern United States. These management plans have been formulated based largely on observations of Baird's sparrow abundance in grasslands that were exposed to different treatments in earlier years. That is, to date there have been no direct tests of such management practices on the abundance and reproductive success of Baird's sparrows. Ideally, grassland plots with similar numbers of breeding Baird's sparrows should be exposed to different treatments (e.g., variable grazing regimes), and the resulting abundance and reproductive success compared to assess treatment effects.

The primary habitat management goal for breeding Baird's sparrows is to provide a mosaic of relatively dense, native grassland, with moderate litter cover, in relatively large patches. However, grasslands that are allowed to grow too dense, with excessive litter depth and grass cover, become unsuitable for Baird's sparrows. The considerable data gathered since 1990 suggests that the following land management activities should improve habitat conditions for Baird's sparrows:

Maintain or increase land set-aside programs:

Although there has not yet been a detectable population-level effect of land set-aside programs on Baird's sparrow abundance, small-scale studies of breeding density and success suggest that such programs will lead to improved population viability.

Limit heavy grazing in grassland areas: Heavy livestock grazing likely remains a serious threat to Baird's sparrows throughout much of the species' range, particularly in drier portions. Within Region 2 and neighboring areas, livestock grazing on the relatively dense grasslands preferred by Baird's sparrows would be detrimental during the breeding season. Light grazing outside the breeding season may provide the subtle regeneration needed for optimal density of grasses during the breeding season (Dale 1984).

Utilize prescribed fire: As an alternative to light, periodic grazing, prescribed fire may show long-term benefits in areas where grasslands recover relatively quickly (i.e., the eastern portion of the Baird's sparrow breeding range). For example, in northwestern North

Dakota, Baird's sparrow density was highest 2 to 4 years after local burns, with declining populations in unburned areas due to the development of overly-dense grass cover (Winter 1994, Madden 1996). Prior to initiating prescribed fire regimes in Region 2, small-scale studies of vegetation recovery should be carried out to assess how quickly such areas recover to conditions (e.g., litter depth, vegetation height) that are suitable as Baird's sparrow breeding habitat.

Reduce brood parasitism by brown-headed cowbirds: A few studies have shown significant negative effects of brown-headed cowbirds on Baird's sparrow reproductive success (Davis and Sealy 1998, 2000). In areas where cowbird parasitism is a problem, reducing the number of trees and shrubs, either with prescribed fire or by selective removal of individual trees and shrubs, may reduce this threat.

Inventory and monitoring

In Canada, population monitoring of grassland birds is currently carried out as a pilot program under the Grassland Bird Monitoring (GBM) program (Dale et al. in prep). The GBM program is an attempt to more accurately assess trends in the abundance of grassland specialists, relative to the BBS. Dale et al. (In prep) found that target species were detected on a significantly greater number of GBM routes than in the BBS program. They also found that trends based on the GBM scheme were generally more positive than those from BBS data, but that GBM data for four grassland specialists (including Baird's sparrow) showed significantly stronger negative trends. These data suggest that dedicated surveys for grassland specialists such as Baird's sparrows may give a more accurate picture of population trends.

Inventory methods used for Baird's sparrows in Region 2 should consider the following (based largely on suggestions in Sutter et al. 2000):

- ❖ surveying should take place in June, when singing males are easily detected
- ❖ survey routes should be approximately 10 km (6.4 miles) in length, with stops every 800 m (0.5 miles)
- ❖ survey routes should be focused on areas with a high concentration of grasslands if the study is aimed at deriving accurate local population estimates

- ❖ survey routes should be in areas representative of local habitat types if the goal of the study is to assess general habitat associations
- ❖ although for logistical reasons most surveys are carried out along roadways, Sutter et al. (2000) found significantly higher densities when surveying from crude vehicle trails in grassland, rather than graded roadways.

Information Needs

While the breeding range in northern South Dakota is more-or-less well known, there is considerable uncertainty about whether and where the species may be breeding in Wyoming and to what extent it may breed on USFS Region 2 grasslands units (e.g., Buffalo Gap National Grassland) in South Dakota. Consequently, there is a clear need for dedicated surveying for breeding Baird's sparrows in northeastern and eastern Wyoming, as well as western South Dakota. These surveys should not be directed only at locating singing males, but should include follow-up observations to verify adults carrying food, nests, or adults feeding recently fledged young.

The timing of migration of Baird's sparrows, as well as their spatial distribution during migration, is poorly known. Occasional sight records are often disregarded due to the difficulty in separating Baird's from savannah sparrows and juvenile grasshopper sparrows. In addition, Baird's sparrows are known to be secretive away from the breeding grounds, contributing to difficulties in identification and to the lack information about migratory routes. Surveys should be undertaken in native grasslands by experienced observers who are familiar with flight patterns, behavior, and vocalizations of Baird's sparrows. Such surveys should be carried out in August and early September in southeastern Wyoming, western South Dakota, and western Nebraska, and in September and October in eastern Colorado and western Kansas. During the spring, surveys for migrating sparrows should be carried out in April in Colorado and Kansas and in early May in Wyoming, Nebraska, and South Dakota.

While Baird's sparrow reproductive success has been relatively well-studied in Canada, there is little information for U.S. populations and no published information for Region 2 populations. There is very little information on juvenile or adult survival, site fidelity, or patterns of age-related reproduction. All of these data are needed to carry out population viability analyses. In addition, there have been no published

accounts of long-term local population dynamics or reproductive success. Such data are needed to assess the viability of local populations, especially with respect to local and regional habitat conditions.

Baird's sparrows are relatively well-suited to BBS survey methodology as males are conspicuous when singing on territory. However, since BBS routes are typically along roads and Baird's sparrows show some aversion to habitat edges such as roads (e.g., Sutter et al. 2000), BBS-type surveys may not be well-suited to Baird's sparrows. Surveys that are more focused on grassland specialists (e.g., the GBM scheme in Canada; see Tools and practices section above) may provide more accurate data on population trends. Another problem in assessing Baird's sparrow population trends is that nests are difficult to find and must be monitored carefully in order to avoid inducing predation (a common problem among ground-nesting passerines). Finally, there are very few data on the species' status on the wintering grounds. This lack of information complicates any assessment of which factors may be driving variation in population viability.

It is known that Baird's sparrows respond positively to reducing grazing pressure, to increasing the size of native grassland patches, and in some parts of the range, to periodic prescribed burns. These management techniques can therefore be used to improve local habitat quality and to increase both the abundance and reproductive success of Baird's sparrows. Similar management practices along the western and central Great Plains should also provide improved habitat quality along the main (presumed) migratory pathway. However, a better understanding of its distribution and abundance in the southwestern U.S. and northern Mexico is needed. If, for example, population trends are being negatively affected by poor habitat quality on the wintering grounds, such a problem may marginalize any benefits of habitat restoration on the breeding grounds.

Research priorities should include:

- 1) Study of the breeding success and habitat use in South Dakota (and Wyoming, if possible). The majority of the available information on the reproductive success and breeding habitat choice of Baird's sparrows comes from studies in Canada. Thus, there is a clear need to study these same factors in other areas.
- 2) Long-term analysis of site occupancy and reproductive success. This would help to clarify the roles of environmental variation

- (e.g., drought) and habitat management (e.g., grazing pressure) on population viability. There is some indication of recent declines in Baird's sparrow abundance in South Dakota, but such data are difficult to interpret given the low sample sizes and the tendency for the species to shift breeding areas depending on local environmental conditions.
- 3) Information on Baird's sparrow food habits and the ecology of their main prey species. Current data on food items are few and based largely on casual observations at a few nests.
 - 4) Experimental confirmation of the observational data on the relationship between habitat characteristics and Baird's sparrow abundance, reproductive success, and cowbird parasitism.
 - 5) Surveys for nesting Baird's sparrows in eastern Wyoming. At the moment, there are no documented nesting records in Wyoming, despite the presence of singing males during the summer at various locations in the eastern portion of the state.

REFERENCES

- American Ornithologists' Union. 1957. Checklist of North American Birds. Fifth edition. American Ornithologists' Union, Washington, D.C.
- Andrews, R. and R. Righter. 1992. Colorado Birds. Denver Museum of Natural History, Denver, CO.
- Anstey, D.A., S.K. Davis, D.C. Duncan, and M.A. Skeel. 1995. Distribution and habitat requirements of eight grassland songbird species in southern Saskatchewan. Unpublished report. Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan, Canada.
- Arnold, E. 1895. An outing in Assiniboia. *Oologist* 12:150-151, 161-163, 168-170.
- Bailey, F.M. 1928. Birds of New Mexico. New Mexico Department of Game and Fish.
- Beidleman, C.A. 2000. Colorado Partners in Flight Land Bird Conservation Plan. Version 1.0. Estes Park, CO.
- Belcher, M. 1980. Birds of Regina. Revised edition. Saskatchewan Natural History Society, Special Publication No. 12, Regina, Saskatchewan, Canada.
- Brittingham, M.C. and S.A. Temple. 1983. Have cowbirds caused forest songbirds to decline? *BioScience* 33:31-35.
- Brown, J.H. and M.V. Lomolino. 1998. Biogeography. Second edition. Sinauer Associates, Inc., Sunderland, MA.
- Busby, W.H. and J.L. Zimmerman. 2001. Kansas Breeding Bird Atlas. University Press of Kansas, Lawrence, KS.
- Callin, E.M. 1986. Birds of the Qu'Appelle, 1857-1979. Saskatchewan Natural History Society, Special Publication No. 13, Regina, Saskatchewan, Canada.
- Cartwright, B.W., T.M. Shortt, and R.D. Harris. 1937. Baird's Sparrow. *Transactions Royal Canadian Institute* 21: 153-198.
- Casey, D. 2001. Montana Partners in Flight Bird Conservation Plan. Version 1.0. American Bird Conservancy, Kalispell, MT.
- Caswell, H. 1989. Matrix population methods. Sinauer Associates, Inc. Sunderland, MA.
- Cerovski, A., M. Gorges, T. Byer, K. Duffy, and D. Felley. 2001. Wyoming Bird Conservation Plan, Version 1.0. Wyoming Partners in Flight. Wyoming Fish and Game Department, Laramie, WY.
- Committee on the Status of Endangered Wildlife in Canada. 1996. Canadian species at risk. COSEWIC Publication, Ottawa, Ontario, Canada.
- Coues, E. 1874. Birds of the Northwest. A handbook of the Ornithology of the region drained by the Missouri River and its tributaries. Government Printing Office, Washington, D.C.
- Dale, B.C. 1983. Habitat relationships of seven species of passerine birds at Last Mountain Lake, Saskatchewan. M.S. Thesis, University of Regina, Regina, Saskatchewan, Canada.
- Dale, B.C. and G. McKeating. 1997. Finding common ground – the nongame evaluation of the North American waterfowl management plan in Canada. Pages 258-265 *in* Proceedings of the 7th International Waterfowl Symposium, Memphis, TN.
- Dale, B.C., P.A. Martin, and P.S. Taylor. In prep. The impacts of two exotic grasses on the avian community in native mixed grass prairie habitat.
- Davis, S.K. 2003. Biologist. Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan. Personal communication.
- Davis, S.K. 1994. Cowbird parasitism, predation and host selection in fragmented grassland of southwestern Manitoba. M.S. Thesis, University of Manitoba, Winnipeg, Manitoba, Canada.
- Davis, S.K. and D.C. Duncan. 1999. Grassland songbird occurrence in native and crested wheatgrass pastures of southern Saskatchewan. *Studies in Avian Biology* 19:211-218.

- Davis, S.K. and S.G. Sealy. 1998. Nesting biology of the Baird's Sparrow in southwestern Manitoba. *Wilson Bulletin* 110:262-270.
- Davis, S.K. and S.G. Sealy. 2000. Cowbird parasitism and nest predation in fragmented grasslands of southwestern Manitoba. Pages 220-228 *in* J.N.M. Smith, T.L. Cook, S.L. Rothstein, S.K. Robinson, and S.G. Sealy, editors. *Ecology and management of cowbirds and their hosts*. University of Texas Press, Austin, TX.
- Davis, S.K., D.C. Duncan, and M.A. Skeel. 1996. The Baird's Sparrow: status resolved. *Blue Jay*: 54: 185-191.
- Davis, S.K., D.C. Duncan, and M.A. Skeel. 1999. Distribution and habitat associations of three endemic grassland songbirds in southern Saskatchewan. *Wilson Bulletin* 111:389-396.
- Dechant, J.A., M.L. Sondreal, D.H. Johnson, L.D. Igl, C.M. Goldade, M.P. Nenneman, and B.R. Euliss. 2003. Effects of management practices on grassland birds: Baird's Sparrow. Northern Prairie Wildlife Research Center, Jamestown, ND. Available online at: <http://www.npwrc.usgs.gov/resource/literatr/grasbird/bais/bais.htm> (Version 12 Aug 2004).
- De Smet, K.D. and M.P. Conrad. 1991. Management and research needs for Baird's Sparrows and other grassland species in Manitoba. Pages 83-86 *in* G.L. Holroyd, G. Burns, and H.C. Smith, editors. *Proceedings of the second endangered species and prairie conservation workshop*. Natural History Occasional Paper 15. Provincial Museum of Alberta, Edmonton, Alberta, Canada.
- Drilling, N.E., R.L. Henson, and J.D. Reichel. 1992. Baird's Sparrow. Species Management Abstract. The Nature Conservancy, Arlington, VA.
- Faulkner, D. 2006. Biologist, Department of Zoology and Physiology, University of Wyoming, Laramie, Wyoming. Personal communication.
- Friedmann, H., L. Griscom, and R.T. Moore. 1957. A Distributional Check-List of the Birds of Mexico. Part II. Pacific Coast Avifauna 33, Cooper Ornithological Society, Berkeley, CA.
- Godfrey, W.E. 1950. Birds of the Cypress Hills and Flotten Lake Regions, Saskatchewan. National Museum of Canada, Bulletin no. 120, Biological Series No. 40. Ottawa, Ontario, Canada.
- Goossen, J.P., S. Brechtel, K.D. DeSmet, D. Hjertaas, and C. Werschler. 1993. Canadian Baird's Sparrow Recovery Plan. Recovery of Nationally Endangered Wildlife Report No. 3. Canadian Wildlife Federation, Ottawa, Ontario, Canada. Available online at http://www.speciesatrisk.gc.ca/publications/plans/baispa_e.cfm.
- Gordon, C.E. 2000. Movement patterns of wintering grassland sparrows in Arizona. *Auk* 117:748-759.
- Green, M.T. 1992. Adaptations of Baird's Sparrows (*Ammodramus bairdii*) to grasslands: Acoustic communication and nomadism. Ph.D. Dissertation, University of North Carolina, Chapel Hill, NC.
- Green, M.T., P.E. Lowther, S.L. Jones, S.K. Davis, and B.C. Dale. 2002. Baird's Sparrow, (*Ammodramus bairdii*). *In*: A. Poole and F. Gill, editors. *The Birds of North America*, No. 638. The Birds of North America, Inc., Philadelphia, PA.
- Henshaw, H.W. 1874. Report upon ornithological specimens collected in the years 1871, 1872, and 1873. Geographical and geological exploration and survey west of the 100th meridian.
- Henshaw, H.W. 1875. Report upon ornithological collections made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona, during the years 1871, 1872, 1873, and 1874. Wheeler's report Geographical and geological exploration and survey west of the 100th meridian, vol. 5, zoology, chap. 3, pp. 133-507.
- Holt, H.R. 1989. *A Birder's Guide to Southeastern Arizona*. American Birding Association, Inc., Colorado Springs, CO.
- Houston, C.S. and M.G. Street. 1959. *The Birds of the Saskatchewan River, Carlton to Cumberland*. Saskatchewan Natural History Society Special Publication No. 2, Regina, Saskatchewan, Canada.
- Howell, S.N.G. and S. Webb. 1995. *A guide to the birds of Mexico and northern Central America*. Oxford University Press, Oxford, UK.

- Hubbard, J.P. 1978. Revised check-list of the birds of New Mexico. New Mexico Ornithological Society Publication no. 6. McCleod Printing Co, Albuquerque, NM.
- Janssen, R.B. 1987. Birds in Minnesota. University of Minnesota Press, Minneapolis, MN.
- Johnsgard, P.A. 2001. Prairie Birds: fragile splendor in the Great Plains. University Press of Kansas, Lawrence, KS.
- Johnson, D.H. 1997. Effects of fire on bird populations in mixed-grass prairie. Pages 182-205 in F.L. Knopf and F.B. Sampson, editors. Ecology and Conservation of Great Plains Vertebrates. Springer-Verlag, New York, NY.
- Johnson, D.H. 2000. Grassland bird use of Conservation Reserve Program fields in the Great Plains. Pages 19-33 in L.P. Heard, A.W. Allen, L.B. Best, S.J. Brady, W. Burger, A.J. Esser, E. Hackett, D.H. Johnson, R.L. Pederson, R.E. Reynolds, C. Rewa, M.R. Ryan, R.T. Molleur, and P. Buck. A comprehensive review of farm bill contributions to wildlife conservation, 1985-2000. W.L. Hohman and D.J. Halloum, editors. U.S. Department of Agriculture, Natural Resources Conservation Service, Wildlife Habitat Management Institute, Technical Report, USDA/NRCS/WHMI-2000. Northern Prairie Wildlife Research Center, Jamestown, ND.
- Johnson, D.H. and S.A. Temple. 1990. Nest predation and brood parasitism of tallgrass prairie birds. Journal of Wildlife Management 54:106-111.
- Johnson, D.H. and L.D. Igl. 1995. Contributions of the Conservation Reserve Program to Populations of Breeding Birds in North Dakota. Wilson Bulletin 107:709-718.
- Johnson, D.H. and L.D. Igl. 2001. Area requirements of grassland birds: a regional perspective. Auk 118:24-34.
- Jones, S.L. and M.T. Green. 1997. Baird's Sparrow status assessment and conservation plan. Admin. Rep., U. S. Fish and Wildlife Service, Denver, CO. Available online at www.r6.fws.gov/bairdssparrow.
- Kantrud, H.A. 1981. Grazing intensity effects on the breeding avifauna of North Dakota grasslands. Canadian Field-Naturalist 95:404-417.
- Kantrud, H.A. and C.A. Faanes. 1979. Range expansion of Baird's Sparrow in South Dakota. Prairie Naturalist 11: 111-112.
- Kantrud, H.A. and R.L. Kologiski. 1983. Avian associations of the northern Great Plains grasslands. Journal of Biogeography 10: 331-350.
- Kingery, H. 1998. Colorado Breeding Bird Atlas. Colorado Bird Atlas Partnership and Colorado Division of Wildlife, Denver, CO.
- Knapton, R.C. 1979. Birds of the Gainsborough-Lyleton Area, Saskatchewan-Manitoba. Nature Saskatchewan Special Publication 9. Regina, Saskatchewan, Canada.
- Knight, W.C. 1902. The birds of Wyoming. University of Wyoming Agricultural Experiment Station Bulletin Number 55, Laramie, WY.
- Knopf, F.L. and F.B. Samson. 1997. Conservation of grassland vertebrates. Pages 273-289 in F.L. Knopf and F.B. Samson, editors. Ecology and Conservation of Great Plains Vertebrates. Springer-Verlag, New York, NY.
- Lane, J. 1968. *Ammodramus bairdii* (Audubon). Baird's Sparrow. Pages 745-765 in O.L. Austin, Jr., editor. Life Histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows and their allies. United States National Museum Bulletin 237, part 2. Washington, D.C.
- Latta, M.J., C.J. Beardmore, and T.E. Corman. 1999. Arizona Partners in Flight Bird Conservation Plan. Version 1.0. Nongame and Endangered Wildlife Program Technical Report 142. Arizona Game and Fish Department, Phoenix, AZ.
- Ligon, J.S. 1961. New Mexico birds and where to find them. University of New Mexico Press, Albuquerque, NM.
- Luce, B., A. Cerovski, B. Oakleaf, J. Priday, and L. Van Fleet. 1999. Atlas of Birds, Mammals, Reptiles, and Amphibians in Wyoming. Wyoming Game and Fish Department, Lander, WY.
- Madden, E.M. 1996. Passerine communities and bird-habitat relationships on prescribe-burned, mixed grass prairie in North Dakota. M.S. Thesis, Montana State University, Bozeman, MT.

- Madden, E.M., A.J. Hansen, and R.K. Murphy. 1999. Influence of prescribed fire history on habitat and abundance of passerine birds in northern mixed-grass prairie. *Canadian Field-Naturalist* 113: 627-640.
- Mahon, C.L. 1995. Habitat selection and detectability of Baird's Sparrow in southwestern Alberta. M.S. Thesis. University of Alberta, Edmonton, Alberta, Canada.
- McCauley, C.A.H. 1877. Notes on the ornithology of the region about the source of the Red River of Texas, from observations made during the exploration conducted by Lieut. E. H. Ruffner, Corps of Engineers, U.S.A. *Bull. U.S. Geol. and Geog. Surv. Terr.* 3, no. 3. (K.D. Seyffert and T.L. Baker, editors, *Panhandle Plains Historical Review* 61:25-88).
- McDonald, D.B. and H. Caswell. 1993. Matrix methods for avian demography. Pages 139-185 in D. Power, editor. *Current Ornithology*, Volume 10. Plenum Press, New York, NY.
- McMaster, D.G., and S.K. Davis. 1998. Non-game evaluation of the Permanent Cover Program. Unpublished report. Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan, Canada.
- McMaster, D.G. and S.K. Davis. 2001. An evaluation of Canada's permanent cover program: habitat for grassland birds? *Journal of Field Ornithology* 72:195-210.
- Messmer, T.A. 1990. Influence of grazing treatments on nongame birds and vegetation structure in south central North Dakota. Ph.D. dissertation. North Dakota State University, Fargo, ND.
- Molhoff, W.J. 2001. The Nebraska Breeding Bird Atlas 1984-1989. Nebraska Ornithologists' Union, Occasional Papers No. 7, Lincoln, NE.
- Monson, G. and A.R. Phillips. 1981. Annotated Checklist of the Birds of Arizona. Second edition. University of Arizona, Tucson, AZ.
- Montana Bird Distribution Committee. 1996. P. D. Skaar's Montana Bird Distribution. Fifth edition. Special Publication No. 3, Montana Natural Heritage Program, Helena, MT.
- Nocedal, J., M.R. Carter and T. Leukering. 2001. Winter habitat segregation of bird species in the grasslands of the northern Mexican Plateau. Abstract of paper presented at the Cooper Ornithological Society 71st annual meeting, Albuquerque, NM.
- Oberholser, H.C. 1974. *The Bird Life of Texas*. Volume 2. University of Texas Press, Austin, TX.
- O'Connor, R.J. and J. Faaborg. 1992. The relative abundance of the Brown-headed Cowbird (*Molothrus ater*) in relation to exterior and interior edges in forests in Missouri. *Trans. Missouri Academy of Sciences* 26:1-9.
- Owens, R.A. and M.T. Myres. 1973. Effects of agriculture upon populations of native passerine birds of an Alberta fescue grassland. *Canadian Journal of Zoology* 51:697-713.
- Patton, Gary. 2004. USDA Forest Service, Rocky Mountain Region, Lakewood, CO. Personal communication.
- Peterson, J., and B.R. Zimmer. 1998. *Birds of the Trans-Pecos*. University of Texas Press, Austin, TX.
- Phillips, A.R., J.T. Marshall and G. Monson. 1964. *The Birds of Arizona*. University of Arizona Press, Tucson, AZ.
- Rand, A.L. 1948. *Birds of southern Alberta*. National Museum of Canada Bulletin 111. Ottawa, Ontario, Canada.
- Reed, J.M., L.S. Mills, J.B. Dunning Jr., E.S. Menges, K.S. McKelvey, R. Frye, S.R. Beissinger, M-C. Anstett, and P. Miller. 2002. Emerging issues in population viability analysis. *Conservation Biology* 16:7-19.
- Renaud, W.E. and D.H. Renaud. 1975. *Birds of Rosetown-Biggar District, Saskatchewan*. Natural History Society, Special Publication No. 9. Regina, Saskatchewan.
- Roy, J.F. 1996. *Birds of the Elbow*. Saskatchewan Natural History Society, Special Publication No. 21. Regina, Saskatchewan, Canada.
- Russell, S.M. and G. Monson. 1998. *The Birds of Sonora*. University of Arizona Press, Tucson, AZ.
- Rustay, C.M. 2001. *New Mexico Bird Conservation Plan, Version 1.1*. Hawks Aloft Inc., Albuquerque, NM.

- Sauer, J.R., J.E. Hines, and J. Fallon. 2005. The North American Breeding Bird Survey, Results and Analysis 1966 - 2004. Version 2005.1, USGS Patuxent Wildlife Research Center, Laurel, MD. Available online at www.mp2-pwrc.usgs.gov/bbs/.
- Saunders, A.A. 1921. A distributional list of the birds of Montana. Pacific Coast Avifauna no. 14. Cooper Ornithological Club, Berkeley, CA.
- Scott, O.K. 1993. A birder's guide to Wyoming. American Birding Association, Colorado Springs, CO.
- Semenchuk, G.P. 1992. The Atlas of Breeding Birds of Alberta. Federation of Alberta Naturalists, Edmonton, Alberta, Canada.
- Seyffert, K.A. 2001. Birds of the Texas Panhandle. Texas A&M University Press, College Station, TX.
- Sharpe, R.S., W.R. Silcock and J.G. Jorgensen. 2001. Birds of Nebraska. University of Nebraska Press, Lincoln, NE.
- Shortt, T.M., and S. Waller. 1937. Birds of the Lake St. Martin Region, Manitoba. Contributions of the Royal Ontario Museum of Zoology. No. 10., Toronto, Ontario, Canada.
- Skeel, M.A., D.C. Duncan, and S.K. Davis. 1995. Abundance and distribution of Baird's sparrows in Saskatchewan in 1994. Revised report. Saskatchewan Watershed Conservation Corporation. Unpublished report. Regina, Saskatchewan, Canada.
- Sousa, P.J. and W.N. McDonal. 1983. Habitat suitability index models: Baird's Sparrow. U. S. Department of the Interior, Fish and Wildlife Service report FWS/OBS-82/10.44.
- South Dakota Ornithologists' Union. 1991. The birds of South Dakota. Second edition. South Dakota Ornithologists' Union, Aberdeen, SD.
- Stewart, R.E. 1975. Breeding birds of North Dakota. Tri-College Center for Environmental Studies, Fargo, ND.
- Sutter, G.C., S.K. Davis, and D.C. Duncan. 2000. Grassland songbird abundance along roads and trails in southern Saskatchewan. *Journal of Field Ornithology* 71:110-116.
- Sutter, G.C., M. Forbes, and T. Troupe. 1995. Abundance of Baird's Sparrows, *Ammodramus bairdii*, in native prairie and introduced vegetation. *Ecoscience* 2:344-348.
- Tallman, D. A., D. L. Swanson, and J. S. Palmer. 2002. Birds of South Dakota. South Dakota Ornithologists' Union, Aberdeen, SD.
- Taverner, P.A. 1926 Birds of Western Canada. Victoria Memorial Museum, Bulletin No. 41, Ottawa.
- Taylor, P. 1983. Wings along the Winnipeg. The birds of the Pinawa-Lac du Bonnet region, Manitoba. Manitoba Naturalists Society Eco Series No. 2. Winnipeg, Manitoba, Canada.
- Thompson, E.E. 1891. The birds of Manitoba. *Proceedings of the U.S. National Museum*, 13:457-613.
- Thompson, M.C. and C. Ely. 1989. Birds in Kansas. Volume II. University of Kansas Museum of Natural History, Lawrence, KS.
- Todd, W.E.C. 1947. Notes on the birds of southern Saskatchewan. *Annals of the Carnegie Museum* 30:383-421.
- U.S. Fish and Wildlife Service. 2002a. Birds of conservation concern 2002. Division of Migratory Bird Management, Arlington, VA. Available online at <http://migratorybirds.fws.gov/reports/bcc2002.pdf>.
- U.S. Fish and Wildlife Service. 2002b. Baird's Sparrow Status Assessment and Conservation Plan. Available online at <http://www.r6.fws.gov/bairdssparrow/planfinl.htm>.
- van Rossem, A.J. 1945. A distributional survey of the birds of Sonora, Mexico. Occasional Paper No. 21, Museum of Zoology, Louisiana State University, Louisiana State University Press, Baton Rouge, LA.
- Winter, M. 1994. Habitat selection of Baird's Sparrows in the northern mixed-grass prairie. Diplomarbeit der Fakultät für Biologie der Universität Tübingen, Tübingen, Germany.
- Winter, M. 1999. Relationship of fire history to territory size, breeding density, and habitat of Baird's Sparrows in North Dakota. *Studies Avian Biology* 19:171-177.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, DC 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.