U.S. Fish & Wildlife Service and Prairie Pothole Joint Venture

A Full Annual-Cycle Conservation Strategy for Sprague's Pipit, Chestnut-collared and McCown's Longspurs, and Baird's Sparrow

Brian Sullivan

Scott Somershoe

Scott Somershoe

Scott Somershoe

Sprague's Pipit (top, left); Chestnut-collared Longspur (bottom, left); McCown's Longspur (top, right); Baird's Sparrow (bottom, right)

Acknowledgments

The strategy was developed by the Grassland Bird Technical Subcommittee of the Prairie Pothole Joint Venture, led by Scott Somershoe, Land Bird Coordinator, Division of Bird Habitat Conservation, Migratory Bird Program, Region 6, U.S. Fish and Wildlife Service.

Grassland Bird Technical Subcommittee members

Scott Somershoe, Migratory Bird Program, U.S. Fish and Wildlife Service, (lead); Sean P. Fields, Prairie Pothole Joint Venture, U.S. Fish and Wildlife Service, (co-lead); Allison J. P. Begley, Montana Fish, Wildlife and Parks; Corrie C. Borgman, Migratory Bird Program, U.S. Fish and Wildlife Service; Daniel Casey, Northern Great Plains Joint Venture; Maureen D. Correll, Bird Conservancy of the Rockies; Eileen Dowd Stukel, South Dakota Department of Game, Fish, and Parks; Kevin S. Ellison, Northern Great Plains Program, World Wildlife Fund; Robert P. Ford, Partners in Flight Coordinator, U.S. Fish and Wildlife Service; Sarah D. Hewitt, National Audubon Society; Lawrence D. Igl, U.S. Geological Survey, Northern Prairie Wildlife Research Center; Sandy K. Johnson, North Dakota Game and Fish Department; Jessica A. Larson, Refuges Program, U.S. Fish and Wildlife Service; Cheryl A. Mandich, American Bird Conservancy; Neal D. Niemuth, Habitat and Population Evaluation Team, U.S. Fish and Wildlife Service; Arvind O. Panjabi, Bird Conservancy of the Rockies; Barry G. Robinson, Canadian Wildlife Service, Environment and Climate Change Canada; Marisa K. Sather, Partners for Fish and Wildlife Program, U.S. Fish and Wildlife Service; Catherine A. Wightman, Montana Fish, Wildlife and Parks.

Additional Contributors

Jeff Ball, Environment and Climate Change Canada; Anne Bartuszevige, Playa Lakes Joint Venture; Michael Borgreen, U.S. Fish and Wildlife Service; David Borre, Pronatura Noroeste; Curtis Bradbury, North Dakota Natural Resources Conservation Service; Katherine R. Conkin, Government of Saskatchewan, Fish, Wildlife and Lands Branch, Ministry of Environment; Ian Davidson, National Fish and Wildlife Foundation; Stephen K. Davis, Canadian Wildlife Service; Erin Duvuvuei, New Mexico Game and Fish; Seth Gallagher, National Fish and Wildlife Foundation; Cara Joos, Central Hardwoods Joint Venture; Joel Jorgensen, Nebraska Parks and Game Commission; Edwin Juarez, Arizona Game and Fish Department; Bonnie McKinney, El Carmen Land & Conservation Co.; Rodolfa Garcí a Morales, CONANP Mapimí; Karen Newlon, U.S. Fish and Wildlife Service; Aimee M. Roberson, Rio Grande Joint Venture; Alfredo Rodriguez, World Wildlife Fund Mexico; Cliff Shackelford, Texas Parks and Wildlife Department; Maggi Sliwinski, Parks Canada, Grasslands National Park; Samantha Song, Environment and Climate Change Canada; Erin Strasser, Bird Conservancy of the Rockies; Bill Van Pelt, Western Association of Fish and Wildlife Agencies; and Emily Jo Williams, American Bird Conservancy.

Chapter Authorship

Chapter 1, Range and Distribution - Scott Somershoe (lead), Lawrence D. Igl, Jessica A. Larson, Cheryl A. Mandich, Neal D. Niemuth, and Marisa K. Sather

Chapter 2, Population Estimates and Trends - Scott Somershoe (lead), Lawrence D. Igl, Jessica A. Larson, Cheryl A. Mandich, Neal D. Niemuth, and Marisa K. Sather

Chapter 3, Grasslands of the Great Plains and Chihuahuan Desert - Sean P. Fields (lead), and Barry G. Robinson

Chapter 4, Life History - Scott Somershoe (lead), Corrie C. Borgman, Maureen D. Correll, Kevin S. Ellison, Robert P. Ford, Arvind O. Panjabi, and Marisa K. Sather

Chapter 5, Implementation Strategies and Conservation Actions - Sean P. Fields (lead), Daniel Casey, Robert P. Ford, Sarah D. Hewitt, Lawrence D. Igl, Sandy K. Johnson, Neal D. Niemuth, Arvind O. Panjabi, and Catherine A. Wightman

Chapter 6, Monitoring and Assessment - Sean P. Fields (lead), Allison J. P. Begley, Maureen D. Correll, Sarah D. Hewitt, and Neal D. Niemuth

Chapter 7, Information Gaps - Scott Somershoe (lead), Maureen D. Correll, Jessica A. Larson, Arvind O. Panjabi, and Barry G. Robinson

Appendices - all completed by Scott Somershoe, except where noted below.

Appendix A. - Scott Somershoe, Allison J. P. Begley, Corrie C. Borgman, Daniel Casey, Maureen D. Correll, Kevin S. Ellison, Sean P. Fields, Robert P. Ford, Lawrence D. Igl, Sandy K. Johnson, Jessica A. Larson, Cheryl A. Mandich, Neal D. Niemuth, Arvind O. Panjabi, Barry G. Robinson, and Marisa K. Sather

Appendix F. - Scott Somershoe and Barry G. Robinson

Appendices O-R. - Scott Somershoe, Maureen D. Correll, Kevin S. Ellison, Cheryl A. Mandich, Arvind O. Panjabi, and Marisa K. Sather

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Author contact information:

Scott Somershoe
Land Bird Coordinator,
Migratory Bird Program, Region 6

U.S. Fish and Wildlife Service
P.O. Box 25486, DFC
Denver, CO 80225-0486

Phone: 303-236-4201

Email: Scott_Somershoe@fws.gov

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Conversions

1 hectare (ha) = 2.47 acres (ac.)

1 square kilometer (km2) = 247.1 acres (ac.)

1 meter (m) = 3.28 feet (ft.)

1 centimeter (cm) = 0.39 inches (in.)

1 gram (g) = 0.035 ounces (oz.)

Glossary

Apparent Nest Success – Estimate of nest success that does not consider the length of time since eggs were laid and that the nest has been vulnerable to predation.

Beneficial Management Practices – Any management practices or actions that positively impact the viability of the focal species and their habitats.

Breeding Area/Season – Areas used by a grassland bird species during the primary breeding season.

Degradation - Changes in grassland vegetation structure, composition, or ecological processes that result in losses of biodiversity and ecosystem functions.

Demographic Parameters or Vital Rates – Characteristics that influence the dynamics of a population, including age structure, sex ratio, fecundity, mortality and survival, immigration and emigration, population size, and population rate of change.

Disturbance – Types of management that result in different grassland conditions.

Fragmentation – Reduced grassland patch sizes as a result of land cover changes, e.g., road development, agricultural practices.

Grassland Bird Conservation Areas (GBCAs) – Priority areas for grassland protection and enhancement that are thought to provide suitable habitat for many priority grassland bird species in portions of the U.S. Northern Great Plains. GBCAs identify habitat based on sensitivity of many species of grassland birds to patch size and landscape structure.

Grassland Enhancement – Management actions aimed at improving grassland habitat condition, e.g., prescribed fire, livestock grazing, and control of invasive and woody species.

Grassland Protection – Management actions aimed at conserving and protecting grasslands, rangelands, and related cover from conversion to cropland and other uses, e.g., through easements and leases, fee title acquisition, and agricultural programs.

Grassland Restoration or Grassland/Prairie Reconstruction – Replanting of grasses and forbs to simulate former native prairies; grassland restoration also has been used in the literature in reference to reverting cropland to perennial grass cover

Grassland Priority Conservation Areas (GPCAs) – Grassland areas of tri-national importance due to their ecological significance and threatened nature that are in need of international cooperation for their successful conservation.

Limiting Factors – Environmental conditions or factors that constrain population growth, abundance, or distribution of a bird species.

Native, Unbroken Prairie – Grasslands that have not been cultivated/broken or anthropogenically disturbed (e.g., cropland, urban or developed areas), and in an original or natural state, but may be invaded with non-native vegetation.

Non-breeding Area/Season – Areas used by a grassland bird species during the migration and winter seasons. Note that migration and wintering areas may overlap for some species.

Non-native Grassland – Broken prairie that has been converted to perennial grasslands and planted to non-native grass and forb species.

Normalized Difference Vegetation Index (NDVI) – A measure of annual net primary productivity for herbaceous vegetation.

Protected Lands – Lands under some level of conservation protection, i.e., federal, state, private organization ownership, or conservation easement, preventing conversion of grasslands to other land cover types.

Threats – Natural disturbances or human actions that result in the loss of habitat, use of habitat, or otherwise negatively affect a species, e.g., resulting in higher mortality or lower nest survival.

Wintering Area/Ground – Areas used by a grassland bird species during the primary winter season.

Acronyms

BBS – Breeding Bird Survey

BCC – Birds of Conservation Concern

BCR – Bird Conservation Region

BLM – Bureau of Land Management

CBC – Christmas Bird Count

CEC – Committee for Environmental Cooperation

COSEWIC – Committee on the Status of Endangered Wildlife in Canada

CRI – Credible Interval

CRP – Conservation Reserve Program (United States)

CWS – Canadian Wildlife Service, Environment and Climate Change Canada

ESA – Endangered Species Act (United States)

EQIP – Environmental Quality Incentives Program

GBCA – Grassland Bird Conservation Area

GPCA - Grassland Priority Conservation Area

IMBCR – Integrated Monitoring of Bird Conservation Regions

IUCN – International Union for Conservation of Nature

JV – Joint Venture

MBCA – Migratory Bird Convention Act

MBTA – Migratory Bird Treaty Act

NABCI – North American Bird Conservation Initiative

NALCP – North American Landbird Conservation Plan

NDVI - Normalized Difference Vegetation Index

NGPJV - Northern Great Plains Joint Venture (United States)

PCP – Permanent Cover Program (Canada)

PFW – Partners for Fish and Wildlife Program, U.S. Fish and Wildlife Service

PHJV – Prairie Habitat Joint Venture (Canada)

PIF – Partners in Flight

PIF NALCP – Partners in Flight North American Landbird Conservation Plan

PPJV – Prairie Pothole Joint Venture (United States)

RGJV – Rio Grande Joint Venture

SARA – Species at Risk Act (Canada)

SGCN – Species of Greatest Conservation Need

SHC – Strategic Habitat Conservation

SOTB – State of the Birds

U.S. – United States

USDA – United States Department of Agriculture

USFWS – U.S. Fish and Wildlife Service

Executive Summary

Sprague's Pipit *(Anthus spragueii)*, Chestnut-collared Longspur *(Calcarius ornatus)*, McCown's Longspur *(Rhynchophanes mccownii)*, and Baird's Sparrow *(Centronyx bairdii)* [hereafter, "the Species"] are North American grassland-obligate songbirds whose populations have experienced significant annual population declines and are the focus of increasing conservation concern. The purpose of this strategy is to summarize current knowledge of the Species and identify priority research, monitoring and conservation actions required to improve their population status.

Grasslands are among the most threatened ecosystems in the world with historic losses of 61-70% converted to other land uses, primarily cropland agriculture. Losses continue, with current conversion in the northern Great Plains occurring several times faster than grasslands can be protected. The Partners in Flight North American Landbird Conservation Plan (PIF NALCP) estimates current global populations of 900,000, 3,000,000, 600,000, and 2,000,000 for Sprague's Pipit, Chestnut-collared Longspur, McCown's Longspur, and Baird's Sparrow, respectively. Over the period of 1967-2015, these populations have declined at -3.1, -4.2, -5.9 and -2.2% annually for estimated total losses of 78, 87, 94 and 65%, respectively.

Habitat associations of breeding birds, especially at the local scale, represent the majority of the existing scientific literature on the Species' biology. Landscape-scale associations are more poorly understood, and few studies have linked habitat, at any scale, to population vital rates. Increasing effort is focused on nonbreeding season and very little is known about migration. Current knowledge identifies three primary threats: 1) loss of native grasslands, 2) degradation and fragmentation of remaining native grasslands, and 3) disturbance inconsistent with needs of the Species. Top priorities for future research include: identification of population limiting factors, links between breeding habitat and demographics, identification of migratory habitat requirements, and identification of conditions promoting winter survival.

Implementation strategies must focus on the protection, restoration, and enhancement (i.e., management) of grassland communities. Most imperative is the protection of remaining native grasslands from conversion to other uses. Actions supporting grass-based agriculture on privately-owned, native grasslands are paramount. These include incentive-based tools to support livestock grazing that benefits both priority birds and healthy ranching communities, which in turn prevent the conversion of native grasslands to cropland. Where cropland conversion has already taken place, conservation partners should work to continue and improve programs such as the Conservation Reserve Program (CRP) to restore and maintain permanent native cover.

This strategy adopts the PIF NALCP objective, which is to reduce the rate of the Species' decline in the first 10 years, then stabilize and ultimately increase the 2016 population by 5-15% over the subsequent 20 years. Ongoing monitoring programs such as the Breeding Bird Survey, Integrated Monitoring of Bird Conservation Regions, and eBird are critical for informing broad-scale demographic and geographic trends for the Species. However, to achieve PIF NALCP goals, there is additional need for monitoring that links habitat conservation accomplishments to population performance within a strategic habitat conservation framework.

Introduction

Sprague's Pipit *(Anthus spragueii)*, Chestnut-collared Longspur *(Calcarius ornatus)*, McCown's Longspur *(Rhynchophanes mccownii)*, and Baird's Sparrow *(Centronyx bairdii)*, hereafter "the Species," are grassland-dependent songbirds of the Great Plains of Canada, the United States, and Mexico. The Species breed primarily in the northern Great Plains and overwinter in the Chihuahuan and Sonoran deserts of the southwestern United States and northern Mexico. All have experienced significant population declines on their breeding grounds since the late-1960s, with annual population declines ranging from -2.1 to -5.9% per year from 1967-2015 and an overall population loss of 65-95% since 1970 (Sauer et al. 2017). Although the species are locally abundant in suitable habitat, overall population declines and range contractions have resulted in these species being designated as species of high conservation concern at national, state, and provincial levels in both the United States and Canada. The primary drivers of population losses are generally attributed to widespread conversion, both historical and contemporary, of native grasslands to agricultural production and other land uses. Degradation and fragmentation of remaining grasslands and management that is inconsistent with the needs of each species have also likely contributed to declines. Each of these drivers affects habitat at local and landscape scales, impacting the distribution, abundance, and reproduction of the Species and ultimately resulting in consistent, long-term, and steep population declines.

Each of the Species has been considered for federal protections in the United States and/or Canada. Sprague's Pipit was petitioned for potential listing in the U.S. under the Endangered Species Act (ESA) in 2008, but the U.S. Fish and Wildlife Service (USFWS) determined listing was not warranted in 2015. Baird's Sparrow was proposed for listing as Threatened in 1997, but the 90-day finding issued in 1999 noted the petition did not present substantial information to warrant listing (Jones and Green 1998, Green et al. 2002). In Canada, Sprague's Pipit was officially listed as "threatened" under Schedule 1 of the Species at Risk Act (SARA) in 2003. In 2012, Chestnut-collared Longspur was officially listed as "Threatened" under Schedule 1 of SARA. McCown's Longspur is currently listed as Special Concern under SARA. Most recently, Baird's Sparrow was officially listed as a species of "Special Concern" under SARA in 2017. The Species are protected as migratory birds in Mexico under the U.S. Migratory Bird Treaty Act (MBTA), but none of the Species are currently included in the federal "NORMA Oficial Mexicana NOM-059-SEMARNAT" (NOM-059) species-at-risk list in Mexico.

The Species also have been identified by the USFWS as Birds of Management Concern, which is a subset of species protected under the MBTA that pose special management challenges due to declining populations, small or restricted populations, and/or dependence on restricted or vulnerable habitats. Sprague's Pipit is designated as a focal species in the USFWS's "Focal Species Strategy for Migratory Birds," which was initiated to provide explicit, strategic, and adaptive sets of conservation actions required to return or maintain species of concern at healthy and sustainable population levels.

For more information on the Focal Species Strategy, visit https://www.fws.gov/birds/management/managed-species/focal-species.php.

The USFWS, Canadian Wildlife Service (CWS), and many state and provincial governments recognize the concerns for the Species and have identified them as conservation priorities. This conservation strategy was developed in collaboration with diverse partners who have jurisdiction and/or are stakeholders in management and conservation of these species throughout their annual cycle. The strategy provides a comprehensive assessment of the state of the knowledge of the Species and identifies priority research needs and conservation actions. It is intended as a guiding document for researchers, conservation planners, resource managers, and funding organizations to facilitate effective and efficient conservation of the Species at a continental scale.

Our overarching purpose is to summarize the current knowledge of the life history and demographic parameters across the full annual cycle of the Species in order to improve their population status. We use this information to identify gaps in our knowledge and prioritize monitoring and research needs that can help fill these gaps. Based on our current knowledge, we identify and prioritize critical conservation action required to reduce and reverse population declines with an additional goal that landscapes can support sustainable populations at desired levels.

Action proposed in this strategy can help prevent additional federal level listings under the ESA in the United States, SARA in Canada, and NOM-059 in Mexico, and ultimately remove species from lists of species of conservation concern due to recovery or improved status.

The Goal, Objectives and Sub-Objectives for this strategy are summarized here. See Appendix A for a full presentation of the Goal, Objectives, Sub-objectives, and Actions.

Goal and Objectives

The goal is to improve the population status of Sprague's Pipit, Chestnut-collared Longspur, McCown's Longspur, and Baird's Sparrow by identifying priority research, inventory, monitoring and conservation actions for implementation by landowners and managers, researchers, biologists, and policy/decision makers.

Objective 1: Develop population and habitat targets.

Sub-objective 1.1 – Evaluate current population status, trends and distribution.

Sub-objective 1.2 – Optimize inventory and monitoring activities to inform status, trends, population estimates, and management actions.

Objective 2: Synthesize existing information and identify key knowledge gaps.

Sub-objective 2.1 – Compile and summarize current information.

Sub-objective 2.2 – Prioritize research to inform conservation delivery.

Objective 3: Prioritize conservation and outreach actions.

Sub-objective 3.1 – Improve the delivery of grassland conservation programs.

Sub-objective 3.2 – Improve outreach and partnership opportunities.

Sub-objective 3.3 – Inform policy development.

Chapter 1. Range and Distributions

1.1 Breeding Ranges

Combined, the four Species historically bred across the prairies of the northern Great Plains of the United States and Canada from the boreal transition zone in central Saskatchewan and Alberta and east through North and South Dakota with the longspurs extending south to eastern Colorado and western Kansas. The current breeding ranges for each Species are reduced from their historical distributions, with the majority of the current breeding distribution occurring in the Prairie Potholes Bird Conservation Region (BCR) of the United States and Canada, the Badlands and Prairies BCR, and northern end of the Shortgrass Prairie BCR (Sauer et al. 2013). Although each species has a different overall breeding range, all four species overlap and generally have the highest densities in southeastern Alberta, southern Saskatchewan, and north-central and northeastern Montana (Sauer et al. 2013, M. K. Sather, U.S. Fish and Wildlife Service, unpubl. data).

The Species breed across a relatively small geography, thus a limited number of states and provincial agencies have significant jurisdiction over the majority of the breeding populations (Blancher et al. 2013). Only four states and provinces support the majority of breeding Sprague's Pipits, including Alberta, Saskatchewan, Montana, and North Dakota. Similarly, Chestnut-collared Longspur, McCown's Longspur, and Baird's Sparrow are primarily limited to breeding in seven, five, and four states and provinces, respectively. See Appendices B, C, D, and E for information on population estimates and percentage of breeding population at country, BCR, and state and province levels.

Sprague's Pipit

Sprague's Pipit has the northernmost breeding distribution of the four Species and is found north into the southern end of the boreal transition zone in Alberta, Saskatchewan, and Manitoba (Figure 1). Sprague's Pipit occurs very locally in northern and central South Dakota, as per recent Breeding Bird Atlas surveys (Davis et al. 2014, Drilling et al. 2016). Its breeding range also extends east into southwestern Manitoba and west to the Rocky Mountain foothills, although it is only locally common in central and western Montana.

The Sprague's Pipits breeding range in Alberta, Manitoba, and Saskatchewan has contracted significantly (COSEWIC 2002); however, it may never have been very abundant in these areas (Carey et al. 2003). The species formerly bred across North Dakota except the southeastern-most counties and east to northwest Minnesota (Stewart 1975). It bred in north-central and northwestern South Dakota, but no nests have been found in the state since 1907 (Davis et al. 2014), although evidence of breeding was reported in 1996 and 2010 (Drilling et al. 2016).

The majority of the breeding population occurs in Canada (60%) (Lipsey et al. 2015). The majority of the U.S. population breeds in Montana (63%). Populations are highly clumped, with 75% of breeding birds predicted in 25% of the range of occurrence. About 20% of the population is on protected lands, and approximately 25% are at risk due to predicted tillage expansion in the future. Range wide, most of the population (70%) occurs on private land (Lipsey et al. 2015).

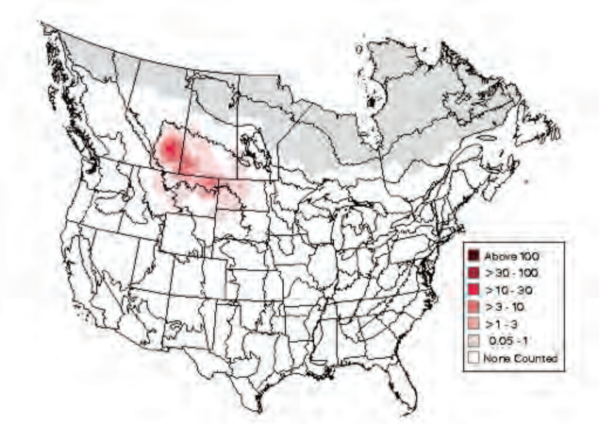


Figure 1. Relative abundance of breeding Sprague's Pipits (average number of birds per BBS route) based on North American Breeding Bird Survey (BBS) data 2011-2015 (Sauer et al. 2017). Map depicts state boundaries in the conterminous United States and provincial boundaries in Canada as well as BCR boundaries.

Chestnut-collared Longspur

Chestnut-collared Longspur breeding population is concentrated in southern Saskatchewan and Alberta, north-central and eastern Montana, the western two-thirds of North Dakota, and most of north and central South Dakota. A nearly disjunct population occurs in southeastern Wyoming and extends into north-central Colorado; however, this population is ~1% of the global population and has declined significantly in recent decades (Partners in Flight Science Committee 2013). Small numbers are found in western Nebraska and scattered locations in east-central and northeast Wyoming. A few birds are occasionally reported during the breeding season in the species' historic range in western Minnesota (Roberts 1936; Wyckoff 1986a, 1986b; MDNR 2014).

Chestnut-collared Longspur breeding range has contracted significantly since at least the early 1900s (Figure 2). Significant population declines have been documented by the North American Breeding Bird Survey (BBS) since the late 1960s, although this trend likely began long before the initiation of the BBS. The species formerly bred across much of North Dakota, except the extreme southeast corner, but has largely disappeared from the eastern third of the state. Similarly, it also formerly bred across South Dakota except in the Black Hills, but have been largely extirpated from the eastern third of the state. Chestnut-collared Longspur was formerly reported as an "abundant" breeder in Kansas (Allen 1872 in Baird et al. 1874), but it no longer breeds in that state (Thompson and Ely 1992), and is now absent from all but western Nebraska (Sharpe et al. 2001, Mollhoff 2016). The species was common in Manitoba until the mid-1980s, but is now restricted to the southwest corner of the province (Cleveland et al. 1988, Sauer et al. 2017). Chestnut-collared Longspur is also increasingly restricted to extreme southern Saskatchewan and southeastern Alberta (Davis et al. 1999).

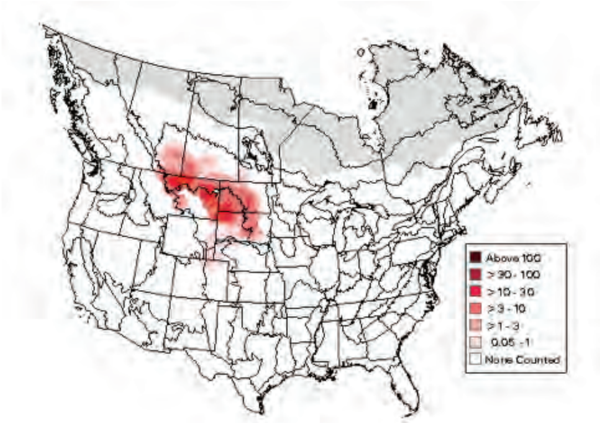


Figure 2. Relative abundance of breeding Chestnut-collared Longspur (average number of birds per BBS route) based on North American Breeding Bird Survey (BBS) data 2011-2015 (Sauer et al. 2017). Map depicts state boundaries in the conterminous United States and provincial boundaries in Canada as well as BCR boundaries.

McCown's Longspur

McCown's Longspur has shown significant range contractions since the early 1900s. It formerly bred from southwest Minnesota across North and South Dakota and south through Nebraska, Kansas, and into the panhandle of Oklahoma. The current breeding range is divided into two disjunct populations: one population is in Montana and southern Alberta and Saskatchewan, and the other population in north-central Colorado, extending into southern and eastern Wyoming, and extreme western Nebraska (Figure 3). The species was only detected twice in the most recent South Dakota Breeding Bird Atlas (Drilling et al. 2016). Small numbers were found in several counties in east-central Colorado during the second Breeding Bird Atlas (Wickersham 2016). McCown's Longspur was not found in these areas during the state's first Atlas (Kingery 1998). In contrast to the other species, McCown's Longspur is generally absent from the Dakotas (Drilling et al. 2016). In recent years in North Dakota, the species was only reported on one legal section of State School Land in southwestern North Dakota (Svingen and Martin 2003), although historically the species once nested in the western two-thirds of the state (Stewart 1975).

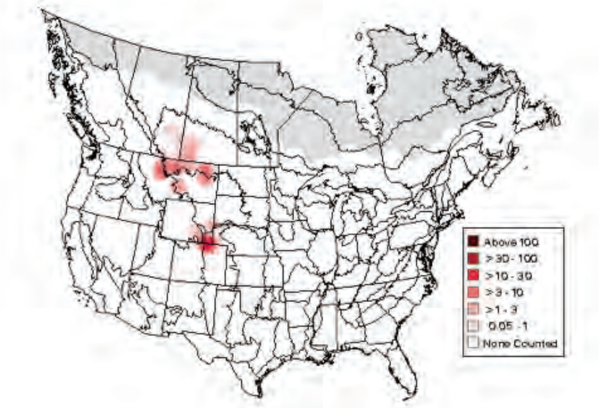


Figure 3. Relative abundance of breeding McCown's Longspur (average number of birds per BBS route) based on North American Breeding Bird Survey (BBS) data 2011-2015 (Sauer et al. 2017). Map depicts state boundaries in the conterminous United States and provincial boundaries in Canada as well as BCR boundaries.

Baird's Sparrow

Baird's Sparrow breeding range is centered in southern Alberta and Saskatchewan and extends east from the Rocky Mountain foothills in northern Montana through eastern Montana and into western North and South Dakota (Figure 4). Confirmed breeding records were documented in eastern Wyoming, including Laramie, Platte, Albany, Converse, and Campbell counties (Luce et al. 1999). Although up to 15 singing males have been documented in one location in north-central Colorado in 2015-2018 with nesting confirmed in July 2018 (Youngberg and Panjabi 2016, M. Correll, pers. comm. eBird.org). The species formerly bred farther east into western Minnesota, but its range has contracted significantly westward as native grasslands were lost to cultivation (Stewart 1975).

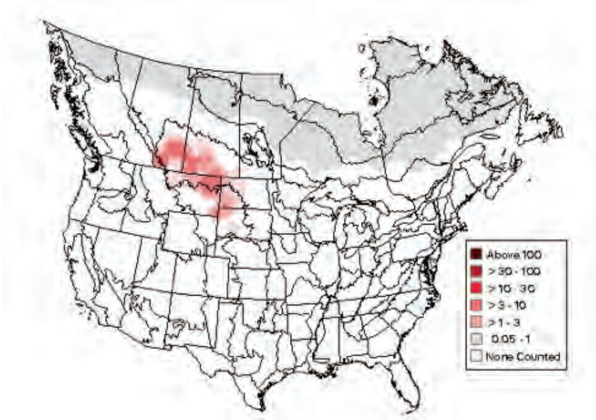


Figure 4. Relative abundance of breeding Baird's Sparrow (average number of birds per BBS route) based on North American Breeding Bird Survey (BBS) data 2011-2015 (Sauer et al. 2017). Map depicts state boundaries in the conterminous United States and provincial boundaries in Canada as well as BCR boundaries.

1.2 Non-breeding Area (Migration)

In migration, these species are typically found in Nebraska, Colorado, Kansas, Oklahoma, Texas, Arizona and New Mexico. Records of Sprague's Pipit and Baird's Sparrow are especially scarce during migration as they are particularly cryptic and difficult to detect. As a result, little is known about specific migration routes, timing of occurrence, and habitat preferences. In a study in multiple habitats in southern Texas during the nonbreeding season, 98% of Sprague's Pipit observations were recorded during winter (1 January to 15 February), but only 2% were recorded during peak spring migration (1 April to 15 May) and none were recorded during peak fall migration (1 September to 15 October) (Igl and Ballard 1999).

1.3 Wintering Area (U.S. and Mexico)

As with the migration period, data on winter distributions are generally limited because the Species are cryptic, may be difficult to identify in winter, and are not easily detected. The Species have much broader wintering ranges than their breeding ranges (Figure 5). Relative abundance data from the Christmas Bird Count (CBC) may cover the basic winter range in the United States but does not represent an assessment of abundance. In addition, detections may have increased in some areas of the United States, likely due to CBC observers shifting effort to target these species, especially Sprague's Pipit. Bird Conservancy of the Rockies conducted winter grassland bird surveys on Grassland Priority Conservation Areas (GPCAs) designated by the Commission for Environmental Cooperation (CEC) in northern Mexico, western Texas, and southern New Mexico from 2007 to 2013 (Macías-Duarte et al. 2011), thus providing the largest and most comprehensive assessment of winter abundance and distribution for Sprague's Pipit, Chestnut-collared Longspur, and Baird's Sparrow. See Appendices B, C, D, and E for regulatory and conservation status for the Species at federal, state, and provincial scales, including states within the winter range of the Species.

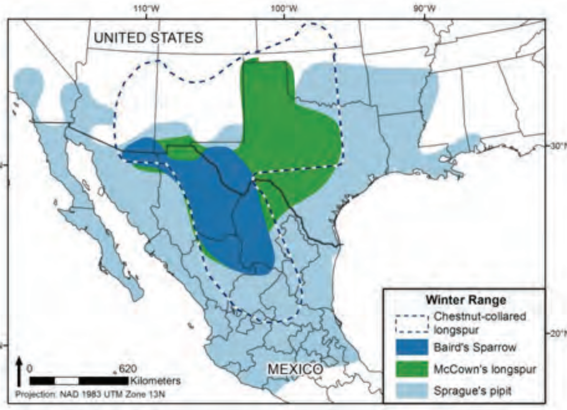


Figure 5. Estimated winter ranges for Sprague's Pipit, Chestnut-collared and McCown's longspur, and Baird's Sparrow combined (BirdLife International and NatureServe 2013).

Sprague's Pipit

Sprague's Pipit has the broadest wintering range of the Species with small numbers of birds wintering from southern California to much of Arkansas and the Red River valley and coast of Louisiana, with small numbers found annually as far east as southern Alabama and northwest Florida (Figure 6). It also has the most southerly wintering range which extends south to the Mexican states of Michoacán, Puebla, and Veracruz (Davis et al. 2014). Sprague's Pipit is widely distributed but is relatively uniform in distribution across the Chihuahuan Desert, tending to be most abundant in the southeastern portion and least abundant in the north (Pool et al. 2012).

Figure 6. Sprague's Pipit estimated winter range (BirdLife International and NatureServe 2013).

Chestnut-collared Longspur

Chestnut-collared Longspur may overwinter farther north than the other species with birds found periodically as far north as east-central Colorado, central Kansas, and north-central Arizona (Figure 7). The species is occasionally found in small numbers in large flocks of Lapland Longspurs *(Calcarius lapponicus)* or Horned Larks *(Eremophila alpestris)* in eastern and north-central Colorado (eBird.org). The primary winter range extends west through New Mexico to southeastern Arizona and south through western Texas to northern Mexico, the desert grasslands of northern Sonora, and on the Central Plateau from Chihuahua and Coahuila south to Zacatecas, Aguascalientes, and San Luis Potosí (Bleho et al. 2014).

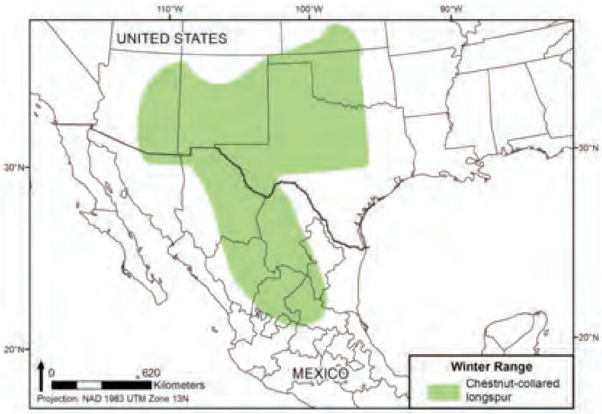


Figure 7. Chestnut-collared Longspur estimated winter range (BirdLife International and NatureServe 2013).

McCown's Longspur

McCown's Longspur is found relatively far north in winter with birds occurring as far north as southwestern Kansas and east-central Colorado (Figure 8). The western edge of its winter range includes northeast New Mexico and southeast Arizona, while it generally does not occur further south than Durango and southern Coahuila states in Mexico. The highest winter abundance generally occurs in northwestern and south-central Texas, the panhandle of Oklahoma, and eastern New Mexico (With 2010).

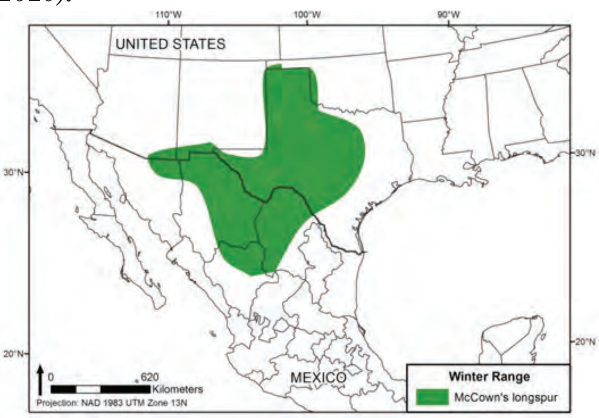


Figure 8. McCown's Longspur estimated winter range (BirdLife International and NatureServe 2013).

Baird's Sparrow

Baird's Sparrow has the narrowest winter range of the Species. The range overlap with the other Species is significant; however, they are limited to the grasslands of southeastern Arizona, southwestern New Mexico, southwestern Texas (Green et al. 2002), and north-central Mexico from extreme northeastern Sonora, northern Chihuahua and northern Coahuila, south to Durango, and possibly adjacent Zacatecas (Figure 9).

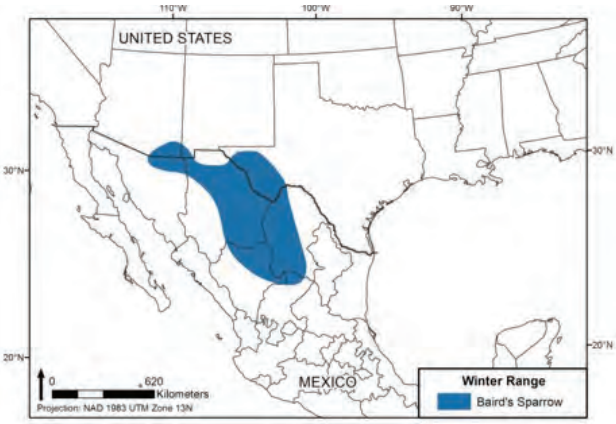


Figure 9. Baird's Sparrow estimated winter range (BirdLife International and NatureServe 2013).

Chapter 2. Population Estimates and Trends

2.1 Population Estimates

The Partners in Flight North American Landbird Conservation Plan (PIF NALCP) provides global and regional population estimates for the Species based on North American BBS data. The methodology explaining how population estimates are calculated is available in the Handbook to the Partners in Flight Population Estimates Database, Version 2.0 (Blancher et al. 2013). Global population estimates are 900,000 for Sprague's Pipit, 3,000,000 for Chestnut-collared Longspur, 600,000 for McCown's Longspur, and 2,000,000 for Baird's Sparrow and are largely based on BBS data from 1998-2007 (Blancher et al. 2013).

See Appendices B, C, D, and E for regulatory and conservation status for the Species at federal, state, and provincial scales, population trends, population estimates, and percentage of breeding population at country, BCR, and state/province levels based on Blancher et al. (2013). Appendix F further describes regulatory and conservation status for the Species at federal, state, and provincial levels.

2.2 Population Trends

Trends from Breeding Season Surveys

The BBS is the primary source of data used to estimate population changes for many migratory birds in North America (Sauer et al. 2017). The majority of trend scores for all scales of jurisdiction received moderate or high credibility scores, which indicate sufficient sample sizes and precision in analyses to calculate reliable population trends. A small number of states and BCRs on the periphery of individual species breeding ranges have insufficient sample sizes to provide reliable trend data. Trend information is presented at all scales, noting data reliability due to small sample sizes, thus providing a complete perspective of species distribution and knowledge of trends. Population trends were estimated using hierarchical model methods described by Sauer and Link (2011).

Sprague's Pipit

Sprague's Pipit has shown a range wide, long-term (1967-2015) significant decline of -3.1% per year (Figs. 10 and 11) with an overall population index loss of approximately 78.1% during this period (Sauer et al. 2017). The decline of Sprague's Pipit has been generally consistent across the entire period of the BBS. However, the recent, short-term range-wide trend (2005-2015) suggests a steeper, significant decline of -4.27% per year. The steepest and most consistent long- and short-term regional declines were recorded in Canada and in the Prairie Pothole BCR (-3.1% to -5.0% per year). Alberta, Manitoba, Saskatchewan, and North Dakota show significant long-term declines, with Alberta and North Dakota showing more recent steep, short-term declines (-6.4% and -10.3% per year, respectively). These results should be evaluated in the context of the area of importance (i.e., percentage of the global population) and survey effort (Appendix B).

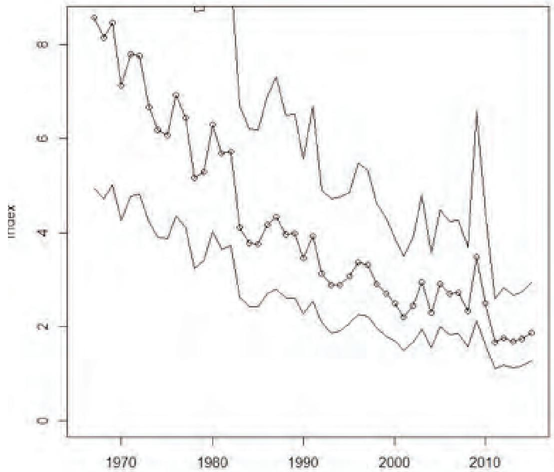


Figure 10. Annual range-wide indices of Sprague's Pipit relative abundance (mean birds/route) from BBS data collected from 1967-2015 (Sauer et al. 2017). Open circles show annual indices of relative abundance lines; above and below represent credible intervals (2.5% and 97.5%).

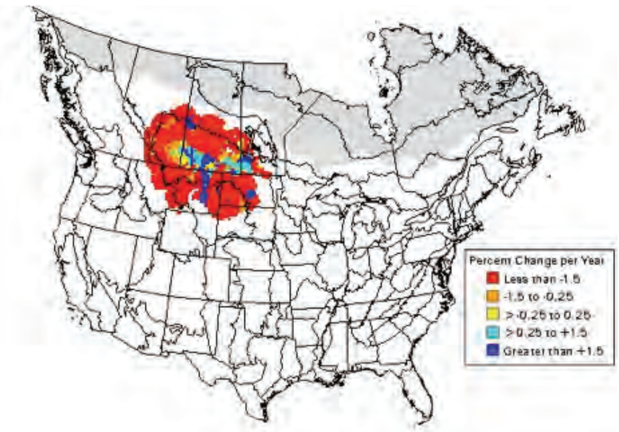


Figure 11. Geographic patterns in population change for Sprague's Pipit from 1967-2015 based on point estimates of trends using BBS data (Sauer et al. 2017). Map depicts state boundaries in the conterminous United States and provincial boundaries in Canada as well as BCR boundaries.

Chestnut-collared Longspur

Chestnut-collared Longspur has shown a range wide, long-term (1967-2015) significant decline of -4.2% per year (Figs. 12 and 13) with an overall population loss of approximately 87.3% during this period (Sauer et al. 2017). The steepest period of decline of Chestnut-collared Longspur occurred between 1967 and approximately 1990. Although the more recent decline is less steep, a continual annual decline persists through 2015 with a short-term (2005-2015) significant decline of -2.9% per year. A significant declining trend is evident for the long-term (1967-2015) and/or short-term (2005-2015) periods for all spatial scales with sufficient sample sizes. Sample sizes in Colorado and Wyoming were insufficient to calculate reliable trend analyses (Appendix C).

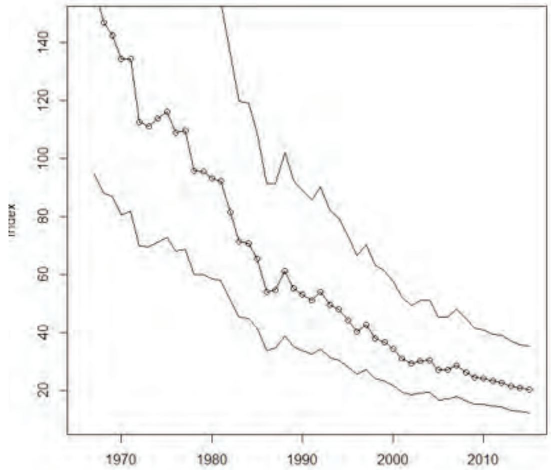


Figure 12. Annual range-wide indices of Chestnut-collared Longspur relative abundance (mean birds/route) from BBS data collected from 1967-2015 (Sauer et al. 2017). Open circles show annual indices of relative abundance; lines above and below represent credible intervals (2.5% and 97.5%).

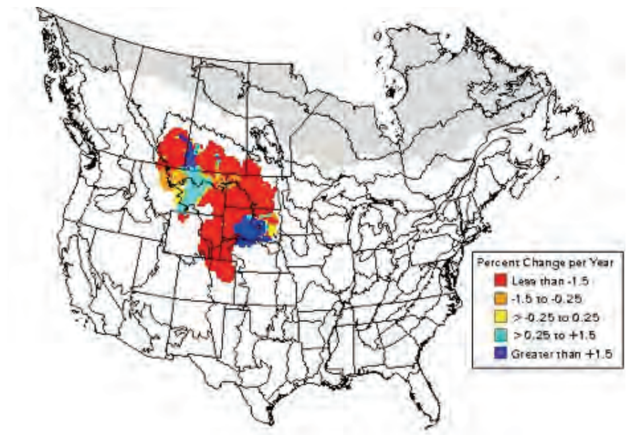


Figure 13. Geographic patterns in population change for Chestnut-collared Longspur from 1967-2015 based on point estimates of trends using BBS data (Sauer et al. 2017). Map depicts state boundaries in the conterminous United States and provincial boundaries in Canada as well as BCR boundaries.

McCown's Longspur

McCown's Longspur has shown the steepest survey-wide, long-term (1967-2015) declines of the four Species (-5.9% per year) (Figs. 14 and 15) and also has the greatest overall population loss of approximately 94.2% during this period (Sauer et al. 2017). The steepest period of decline of McCown's Longspur occurred between 1967 and 1981. However, the species has shown a continual annual decline through 2015. In contrast to observed trends in the other species, McCown's Longspur primarily shows only long-term (1967-2015) significant declines with one short-term (2005-2015) decline, e.g., Alberta (-9.6% per year) (Appendix D). The majority of the global population loss appears to have occurred in the early years of the BBS, while trends have subsequently slowed with apparently significant range retraction resulting in two distant, disconnected core breeding populations (With 2010).

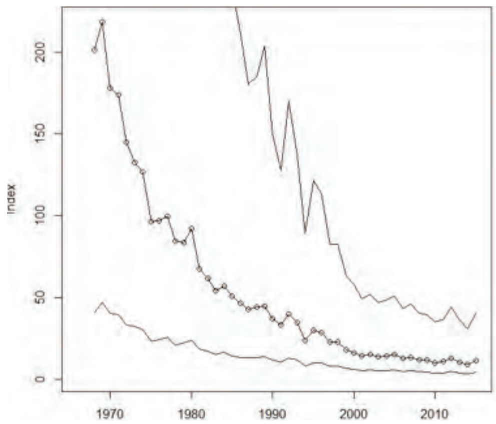


Figure 14. Annual range-wide indices of McCown's Longspur relative abundance (mean birds/route) from BBS data collected from 1967-2015 (Sauer et al. 2017). Open circles show annual indices of relative abundance; lines above and below represent credible intervals (2.5% and 97.5%).

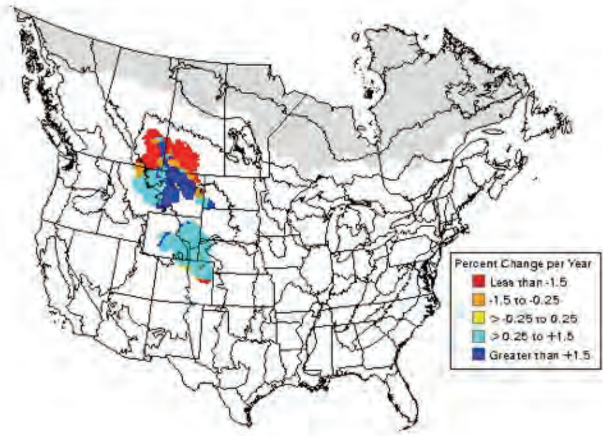


Figure 15. Geographic patterns in population change for McCown's Longspur from 1967-2015 based on point estimates of trends using BBS data (Sauer et al. 2017). Map depicts state boundaries in the conterminous United States and provincial boundaries in Canada as well as BCR boundaries.

Baird's Sparrow

Baird's Sparrow has shown a survey-wide long-term (1967-2015) declining trend of -2.2% per year (Figs. 16 and 17) with an overall population loss of approximately 65.2% during this period (Sauer et al. 2017). Baird's Sparrow has generally declined throughout the entire period of the BBS with some notable significant declines between approximately 1975-1983 and 1997-2001. The majority of significant declining trends are at the largest spatial scales, e.g., range-wide and national scales, with the only other significant long-term trends observed in the Prairie Pothole BCR and North Dakota. There are no apparent recent short-term (2005-2015) significant declines (Appendix E), and the population appears to have largely stabilized at a relatively low population since 2000 (Figure 16).

Figure 16. Annual range-wide indices of Baird's Sparrow relative abundance (mean birds/route) from BBS data collected from 1967-2015 (Sauer et al. 2017). Open circles show annual indices of relative abundance; lines above and below represent credible intervals (2.5% and 97.5%).

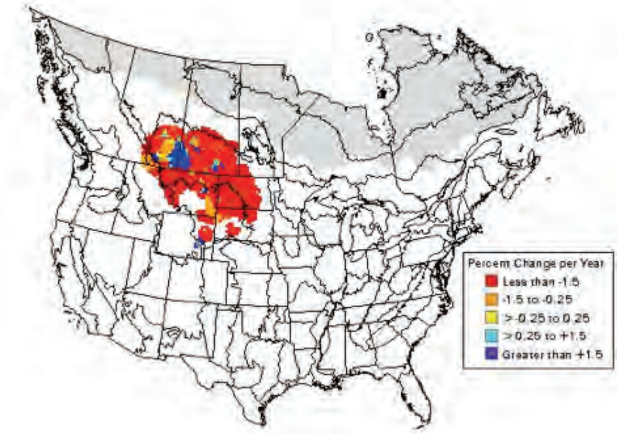


Figure 17. Geographic patterns in population change for Baird's Sparrow from 1967-2015 based on point estimates of trends using BBS data (Sauer et al. 2017). Map depicts state boundaries in the conterminous United States and provincial boundaries in Canada as well as BCR boundaries.

Trends from Non-breeding Area (Winter) Surveys

The Christmas Bird Count (CBC) provides limited information on early winter populations for many of the Species due to their low detectability on the wintering grounds. The CBC data may provide potentially representative information on winter ranges, but does not provide much information on abundance and assessment of population trend is limited. The variation in survey effort among count circles and across years, in addition to non-random selection of the count circle locations, makes inferences of the data complicated without appropriate methods to control for these biases (Dunn et al. 2005, Link et al. 2006, Hochachka et al. 2012, Soykan et al. 2016).

CBC data do not provide reliable trend information for Sprague's Pipit (Davis et al. 2014) or Baird's Sparrows (Green et al. 2002). Chestnut-collared Longspur abundance varies greatly on CBCs, but declining trends are apparent in Arizona and Texas (Bleho et al. 2015).

Numbers of McCown's Longspurs have varied widely across the CBC period from 1961 to 2009 with notable declines and short-term increases; however the number of McCown's Longspurs have declined by 50% from 1977-1993 to 1994-2009 in spite of a 25% increase in the number of observers (With 2010). Although not as reliable as BBS data, CBC data provide another measure of abundance and support the declines observed on the breeding grounds.

Chapter 3. Grasslands of the Great Plains and Chihuahuan Desert

Figure 18. The primary annual cycle geography for the Sprague's Pipit, Chestnut-collared and McCown's longspurs, and Baird's Sparrow in the North American Great Plains and Chihuahuan Desert.

The Species' annual life-cycle is concentrated in the North American Great Plains spanning from Canada to Texas and extending south through the Chihuahuan Desert in Mexico (Figure 18). These passerines breed in the mixed-grass prairies of southern Canada and northern U.S., and migrate through the central mixed-grass prairie and shortgrass prairie of the midwestern and southern U.S., and winter in the semi-desert grasslands of the southwestern U.S. and northern Mexico.

The Great Plains and Chihuahuan Desert cover approximately 285 million ha and exhibit considerable variation in climatic, topographic, edaphic, and geologic conditions, as well as wide ranging land uses. Historically, periods of drought and deluge, huge roaming herds of American bison *(Bison bison)*, and periodic wildfires were the main forces of change on the grassland landscape. Those forces shifted with the arrival of early Euro-American settlers who were attracted to the

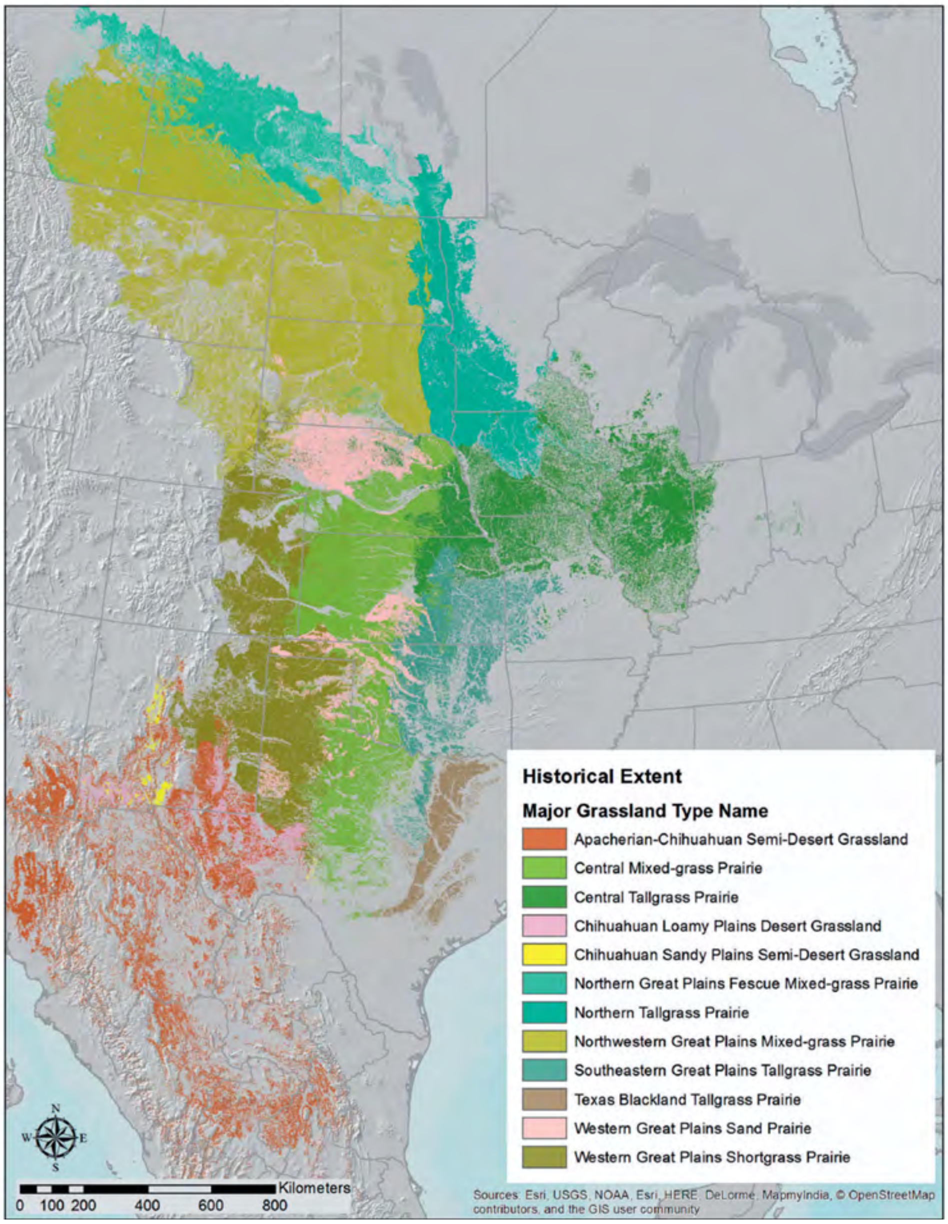


Figure 19. Approximate historical extent of 12 major temperate grasslands in the Great Plains and Chihuahuan desert (Comer et al. 2018).

grasslands of the Great Plains for farming due to the area's flatter topography and nutrient-rich soils.

Increasing settlement of the region encouraged in the United States by the Homestead Act of 1862 and in Canada by the Dominion Lands Act of 1908, accelerated settlement in the area as well as the loss of native prairie (Ostlie et al. 1997). Since then, the Great Plains and Chihuahuan Desert have sustained extensive grassland loss and degradation mostly due to agricultural conversion.

Today, the temperate grasslands of the Great Plains and Chihuahuan Desert are among the most threatened ecosystems in the world (Hoekstra et al. 2005). Significant portions of the region contain some of the most productive and intensively cultivated croplands and pasture lands on the planet (Gauthier et al. 2003, Ramankutty et al. 2008). Recent high commodity prices, exacerbated by demand for biofuels and by an increase in genetically modified crops, have accelerated cropland agriculture expansion, especially in the northern Great Plains (Fargione et al. 2009, Wright and Wimberly 2013, Lark et al. 2015). Historic grassland loss estimates across the Great Plains and Chihuahuan Desert range from approximately 61% (Comer et al. 2018) to 70% (Samson et al. 2004) including near complete conversion of the most productive areas (e.g., tallgrass prairie) where only remnant tracts remain. In the northern regions where relatively large tracts of mixed-grass prairie remain, agricultural conversion is occurring five times faster than grasslands can be protected (Doherty et al. 2013, Walker et al. 2013). Land-use intensification and eroded ecosystem integrity has resulted in consistent declines in Great Plains plants and animals (Samson and Knopf 1994), with grassland birds being among the species of highest conservation concern (Peterjohn and Sauer 1999, Hill et al. 2014, North American Bird Conservation Initiative 2016). Many grassland birds breeding in the Great Plains, including the Species, are considered area sensitive and thus are positively associated with the amount of grasslands in the landscape (Bakker et al. 2002, Davis 2004, Ribic et al. 2009, Greer et al. 2016, Lipsey et al. 2017). Understanding the extent of grassland loss and the drivers associated with these losses is an important step to stemming population declines for these species.

Recently, 12 major grassland types in the region have been mapped and assessed for trends in area loss by type (Comer et al. 2018; Figure 19 and Table 1). These temperate grasslands fall into four main biomes: tallgrass prairie (86% historic loss), mixed-grass prairie (60% historic loss), shortgrass prairie (38% historic loss), and semi-desert to desert grasslands found throughout the Chihuahuan Desert (43% historic loss). Although historic losses provide general context for continental grassland assessments, annual rates of grassland loss at the regional scale are more informative for conservation planning in migratory bird Joint Ventures. Relatively recent trends in agricultural intensification, energy development, and biofuel production have influenced regionally-specific change rates across the Great Plains and Chihuahuan Desert (Table 2).

The future of the Great Plains and Chihuahuan Desert grasslands is expected to be shaped by a changing climate and an increasing global demand for food to feed a projected world population of 11 billion people by 2050 (Foley et al. 2011, Ray et al. 2013). These stressors will result in the increased risk of grassland conversion to agriculture, intensified land use, and degradation of remaining grasslands (e.g., tree encroachment, desertification), highlighting the need to strategically protect remaining grasslands, enhance deteriorated grasslands, and restore or replant grasslands previously lost to conversion.

Table 1. Long-term trends in extent of 12 major grassland types (Comer et al. 2018).

Major Temperate Grassland Type	*Historical Extent Estimate (km²)*	*Current Extent Estimate (km²)*	*Percent Loss to Conversion*
Texas Blackland Tallgrass Prairie	41,400	670	98
Northern Tallgrass Prairie	157,200	6,500	96
Central Tallgrass Prairie	242,000	20,100	92
Northern Great Plains Mixed-grass Prairie	137,000	18,000	87
Chihuahuan Sandy Plains Semi-Desert Grassland	8,100	1,600	80
Southeastern Great Plains Tallgrass Prairie	108,000	31,400	71
Central Mixed-grass Prairie	259,000	77,000	70
Western Great Plains Sand Prairie	107,300	38,000	65
Chihuahuan Loamy Plains Desert Grassland	38,300	14,400	62
Northwestern Great Plains Mixed-grass Prairie	620,900	307,500	50
Apacherian-Chihuahuan Semi-Desert Grassland and Steppe	249,400	152,200	39
Western Great Plains Shortgrass Prairie	259,000	188,000	27
Total	2,227,600	855,370	62

Table 2. Regional grassland losses and conversion rates in the Northern American Great Plains.

Region	*Grass type*	*Time period*	*Annual Loss Rate/ Total Acres Lost*	*Reference*
Contiguous U.S.	All grass Undisturbed	2008-2012	2.3 million ha (all grass), 650,000 ha (undisturbed)	Lark et al. (2015)
Contiguous U.S.	All grass Undisturbed	2008-2012	1.7 million ha (all grass), 1.5 million ha (undisturbed)	Wright et al. (2017)
Great Plains	All grass	2009-2015	2%	Gage et al. (2016)
Western Corn Belt	All grass	2006-2011	1.0-5.4%	Wright and Wimberly (2013)
Northern Great Plains	Undisturbed	1997-2007	0.10%	Claassen et al. (2011)
U.S. PPR	All grass	1997-2009	0.22%	Dahl (2014)
North Dakota and South Dakota	Undisturbed	1979-1997	1.30%	Rashford et al. (2010)
Eastern Dakotas	All grass	2004-2014	0.43%	Wimberly et al. (2017)
North Dakota	Undisturbed	1989-2003	0.4%	Stephens et al. (2008)

Table 2. Regional grassland losses and conversion rates in the Northern American Great Plains. *(continued)*

Region	*Grass type*	*Time period*	*Annual Loss Rate/ Total Acres Lost*	*Reference*
Chihuahua	All grass	2006-2011	1.22%	Pool et al. (2014)
Canada	Moist mixed grassland	2001-2011	0.44%	Watmough et al. (2017)
Canadian PPR	All grass	2001-2011	0.23%	
Alberta	Mixed-grass	2001-2011	0.37%	
Saskatchewan	Moist mixed-grass	2001-2011	0.07%	Watmough et al. (2017)
Saskatchewan	Mixed-grass	2001-2011	0.10%	Watmough et al. (2017)

Chapter 4. Life History

The majority of information on biology, habitat, demographics, and potential limiting factors and threats for the Species comes from research conducted on the breeding grounds. A limited, but increasing, effort is focused on the wintering grounds and there is relatively little known about these Species during migration. Habitat associations with occurrence and abundance of breeding birds, especially at the local scale, represent the vast majority of the existing scientific literature. Landscape-scale associations are more poorly understood, and few studies have linked habitat, at any scale, to measures of survival or reproductive success. Information on vital rates is largely unknown or understudied for the Species, limiting our ability to evaluate population limiting factors in the absence of further research. And without knowing limiting factors, it is challenging to recommend appropriate conservation actions.

This chapter provides a broad overview of the life histories, habitat associations, and demographic parameters for each Species. As a supplement to this chapter, Appendices G through J summarize information on demographic parameters for the Species. In addition, Appendices K through N summarize information on Species' responses to management, specifically grazing, fire, and mowing/haying. The content of this chapter demonstrates the general scarcity of demographic and vital rate information and their relation to management prescriptions in all parts of the annual cycle. In addition to the effect of specific threats, interactions among multiple threats are likely significant, complex, and largely unknown. Isolating and studying bird response to individual threats, especially with respect to demographic parameters and vital rates, will be critical to identifying population limiting factors and addressing observed population declines.

4.1 Threats

Based on information currently available, there are three primary threats to populations of the Species: 1) loss of native grasslands, 2) degradation and fragmentation of remaining native grasslands, and 3) disturbance inconsistent with needs of the Species. For example, the timing, frequency, or intensity of a disturbance (e.g., grazing, fire, or mowing and haying) may be incompatible with the habitat needs of the Species. Perhaps the greatest threat is loss of grasslands to other land uses, especially to agricultural production via cropland. Insecticide use, although rarely considered, may be a significant driver of population declines of grassland birds.

4.2 Life History and Phenology

Breeding Phenology

Sprague's Pipits typically arrive on the breeding grounds from mid-April through early May, with first eggs laid in mid- to late May (Jones 2010). Nest initiation dates for pipits may vary greatly among years and do not appear to be influenced by arrival dates (Davis 2003b).

Chestnut-collared Longspurs arrive from early to mid-April, but nest initiation does not occur until early to mid-May and varies greatly among years and geographically (Bleho et al. 2015).

McCown's Longspurs arrive from late March to early April in Colorado and southern Wyoming, to late April to early May in Saskatchewan and Alberta (With 2010). Although McCown's Longspurs may arrive early, nest initiation does not generally begin until early May or later with increasing latitude.

Baird's Sparrows arrive as early as late April with peak arrival in early to mid-May (Maher 1973, De Smet 1992, Davis and Sealy 1998, Green et al. 2002). Nest initiation for Baird's Sparrows occurs in late May and early June (Maher 1973, Davis and Sealy 1998, Green et al. 2002, Jones et al. 2010).

Breeding Territory Size and Densities

Observed territory sizes are 0.4-6.4 ha for Sprague's Pipit (Fisher and Davis 2011a, Jones 2011, Davis et al. 2014), 0.2-1 ha for Chestnut-collared Longspur (Harris 1944, Fairfield 1968, Bleho et al. 2015), 0.5-1.5 ha for McCown's Longspur (Felske 1971, Greer 1988, Greer and Anderson 1989, Wiens 1970, 1971, With 2010), and 0.3-0.8 ha for Baird's Sparrow (Lane 1968, Lein 1968, Winter 1999, Jones 2011). In general, territory density increases with habitat quality across species. Where quality is apparently optimal, Sprague's Pipits will maintain smaller than average territories that are densely packed together (Dale 1983). In marginal habitats, Chestnut-collared Longspur territories have been observed to increase in size up to 4 ha (Fairfield 1968). Territories of McCown's Longspur, however, do not appear to decrease in size with higher densities of breeding territories and do not overlap, suggesting an optimal minimum size for this species (Felske 1971, Greer and Anderson 1989). Density estimates for McCown's Longspur vary dramatically among years and geographic locations, ranging from 11.7-190 pairs per 100 ha (male territory size 0.5-8.6 ha; Finzel 1964, Giezentanner 1970, Wiens 1970, Maher 1973). Large areas of apparently suitable habitat also have been found unoccupied by McCown's Longspur (Felske 1971, Greer and Anderson 1989), and some suitable habitats are likely unoccupied or unsaturated for the other three Species. The mechanisms behind these occurrence patterns are unknown. Baird's Sparrow may exhibit conspecific attraction, with placement of territories often near or adjacent to other Baird's Sparrow territories (Ahlering 2005, Ahlering et al. 2006); conspecific attraction has not been studied in the other three Species.

Nesting Ecology

The Species typically lay 3-5 eggs in small, grass-lined nests on the ground (Green et al. 2002, with 2010, Davis et al. 2014, Bleho et al. 2015). Sprague's Pipits and Baird's Sparrow nests are well concealed, either covered by a tuft of grass, an oven-like nest with an opening on the side, or in the side of a clump of grass with a side entrance. In contrast, longspurs typically have nests with open cups that are not well concealed from above.

Breeding Site Fidelity

As with other grassland birds, the Species are known to be highly nomadic and abundance varies considerably among years (Igl and Johnson 1997), likely in response to variable precipitation and grassland condition (George et al. 1992, Niemuth et al. 2008, Green et al. in review). Site fidelity (i.e., the propensity to return to a previous breeding area in a subsequent year) tends to be low for all four species, although few researchers have evaluated site fidelity in these species. Published return rates of banded adult Sprague's Pipit are very low (0-4%; Jones et al. 2007, Davis et al. 2014). Using stable isotopes, Van Wilgenburg et al. (2012) reported that high proportion of Sprague's Pipits in their study area were apparent immigrants into the breeding population rather than local birds, suggesting low breeding philopatry.

Among the Species, Chestnut-collared Longspurs have the highest documented fidelity. Bleho et al. (2015) reported that 32% of 65 banded females and 67% of 30 banded males returned after one year in Alberta, and 6% of 18 females and 36% of 39 males returned to the previous year's breeding sites in Saskatchewan. Twenty percent of females and 7.7% of males returned for two subsequent years (Bleho et al. 2015). Fairfield (1968) reported that three of 1,067 banded Chestnut-collared Longspurs returned to the location of banding. Few breeding McCown's Longspurs have been banded and resighted in subsequent years; two adult males of an unknown number of banded birds returned to a site at Pawnee National Grasslands in Colorado (Ryder 1972). One study reported annual site fidelity of breeding Baird's Sparrows to be 5.1% of 117 banded birds (Jones et al. 2007), and another study reported 9.6% of 52 color-banded male Baird's Sparrows returned in the year after banding (Ahlering 2005). Return rates reported through mark-recapture of Baird's Sparrows marked with geolocators in North Dakota, Montana, and Alberta estimated an 8% adult return rate between 2016 and 2017 (Bernath-Plaisted et al. 2018).

Migration Phenology

Sprague's Pipit

In spring, the majority of Sprague's Pipits are thought to migrate through the central Great Plains, primarily in April (Robbins and Easterla 1992, Thompson and Ely 1992, Sharpe et al. 2001). Some individuals may linger on wintering grounds in Texas until early May or later (Arvin 1982, eBird.org, accessed 3 May 2018). Fall migration occurs in late September through early November, with arrival on the wintering grounds during the same time period (Phillips et al. 1964, Oberholser 1974, Wood and Schnell 1984, James and Neal 1986, Robbins and Easterla 1992, Thompson and Ely 1992, Sharpe et al. 2001).

Brian Sullivan

Sprague's Pipit in fallow agricultural field in fall migration.

Chestnut-collared Longspur

Spring migration of Chestnut-collared Longspurs occurs March through early May. Fall migration begins in early September and may extend into early November, with birds mostly arriving on their wintering grounds in mid-October (Bleho et al. 2015, E. Juarez pers. comm.). Ellison et al. (2017) deployed geolocators on adult male Chestnut-collared Longspurs and found spring and fall migration lasted 41 ± 5 days and 42 ± 6 days (n=7), respectively, with birds covering an average of <50 km per day for a ~2,000 km migration.

McCown's Longspur

McCown's Longspurs arrive on their breeding grounds in Montana as early as 16 April (DuBois 1937, eBird.org, accessed 3 May 2018), suggesting spring migration occurs in March and April. Fall departure dates vary with latitude, beginning in early August in Saskatchewan, with the last birds typically reported in the third week of September (Bent 1908, DuBois 1937, Maher 1973). Earliest arrivals on their wintering grounds occur in late September in New Mexico (Ligon 1961), early to mid-October in Arizona (Phillips et al. 1964, E. Juarez pers. comm.), late October in Texas (Oberholser 1974), and November in Mexico (Howell and Webb 1995).

Baird's Sparrow

Spring migration for Baird's Sparrow begins in late February and early March in the southern end of its winter range in

Mexico, and peaks through the central plains in April and early May (Green et al. 2002). Fall migration may begin in August, but is largely undetected. Peak fall migration is likely mid-September through October (Green et al. 2002), although a few birds arrive in Arizona in late August (E. Juarez pers. comm.). Preliminary data from geolocator tracking devices indicated that four males breeding near Brooks, Alberta departed their breeding grounds in late July or early August for southwestern Saskatchewan and northeastern Montana, where they staged for 2-3 weeks (Bird Conservancy of the Rockies unpubl. data) before arriving at their wintering grounds by late August-September. Both geolocator and radio-tracking data suggest considerable movement of Baird's Sparrows on their wintering grounds in the Chihuahuan Desert as they utilize a large home range and by late February some birds are already moving northward, which is corroborated by their disappearance from monitoring areas. Spring migration routes are less clear.

Scott Somershoe

Baird's Sparrow captured as part of Bird Conservancy of the Rockies' geolocator study in Valley Co., Montana.

Winter Phenology

Sprague's Pipit

Wintering Sprague's Pipits are secretive and difficult to detect, and little is known about their distribution, behavior, or territoriality on their wintering grounds. Density estimates are highly variable and generally lower than those observed on the breeding grounds. Although winter occurrence and abundance may be related to local habitat conditions (Gryzbowski 1982, Contreras-Balderas et al. 1997, Igl and Ballard 1999, Dieni and Jones 2003, Marx et al. 2008, Macías-Duarte et al. 2009, 2011, Pool et al. 2012, Ruth et al. 2014), recent work suggests that Sprague's Pipit winter abundance may not be related to summer precipitation or early fall Normalized Difference Vegetation Index (NDVI) (Macías-Duarte et. al., in review).

Winter density estimates for Sprague's Pipits vary from complete absence or very low densities of 0.4 birds per 100 ha in New Mexico (Pool et al. 2012) in some years in the northern end of the Chihuahuan Desert to a relatively high densities of 64-90 birds per 100 ha in Texas (Gryzbowski 1982) in a winter with excessive rainfall, with averages of 17.3-24.7 birds per 100 ha in Texas (Emlen 1972, Kostecke et al. 2015). Igl and Ballard (1999) reported Sprague's Pipit densities in five habitat types in southern Texas, ranging from zero to 18.8 birds per 100 ha. Woodin et al. (2010) reported low numbers of wintering Sprague's Pipits in Gulf Coast and inland prairies in southern Texas. Hovick et al. (2014) reported that Sprague's Pipits were observed very infrequently in January and February in burned and grazed tallgrass prairies in the Flint Hills region of northeastern Oklahoma. Densities in the core of the winter range can vary from 3.4 to 9.7 birds per 100 ha across all grassland types in various regions in the Chihuahuan Desert (Pool et al. 2012), although local densities in optimal habitat may be higher. Most detections of Sprague's Pipits in winter are of single individuals, and flocks are rarely observed (Kostecke et al. 2015).

In Mexico, the Grassland Priority Conservation Areas (GPCAs) of Cuchillas de la Zarca, Malpais, Valles Centrales, of Durango and Zacatecas, and Chihuahua, host a combined 60% of the wintering population among all GPCAs in the Chihuahuan Desert (CEC 2013). Among these, Cuchillas de la Zarca hosts the largest known wintering populations, estimated to be around 45,000 Sprague's Pipits (Bird Conservancy of the Rockies unpubl. data). Other GPCAs such as El Tokio in southern Coahuila and Nuevo Leon, Mexico, also host high winter densities of pipits, but overall support fewer birds due to the more limited extent of grasslands there. It is unclear how much of the overall population of this species winters in the Chihuahuan Desert versus the rest of its winter range. The average wintering population in the Chihuahuan Desert from 2007-2013 was estimated to be roughly 200,000 birds inside the GPCAs, with an additional 95,000 birds outside of this region (Bird Conservancy of the Rockies unpubl. data).

Chestnut-collared Longspur

Chestnut-collared Longspurs occur in small- to large-sized flocks in winter, often mixed with McCown's Longspurs and other species, and often in higher densities in winter than during the breeding season. Density estimates vary widely among years and sites from a modest 5-166 birds per 100 ha in Oklahoma (Grzybowski 1982) to a less typical high density of 1289.9 birds per 100 ha at Llano Las Amapolas in the Chihuahuan Desert (Pool et al. 2012). Typical estimates in the Chihuahuan Desert range from 248-595 birds per 100 ha (Pool et al. 2012, CEC 2013). The Valles Centrales GPCA hosts a disproportionate 36% of the Chestnut-collared Longspur population wintering in the Chihuahuan Desert GPCAs (CEC 2013). The Bootheel GPCA in New Mexico and Cuchillas de la Zarca, Lagunas del Este and Janos GPCAs in Mexico are also critically important areas, supporting on average an additional combined 45% of the GPCA wintering population (CEC 2013). Mean density estimates of this species in Marfa, Texas averaged 139 birds per 100 ha from 2009-11 and ranged from 67.8–117.0 birds per 100 ha from 2014-2017 (CEC 2013, Bird Conservancy of the Rockies unpubl. data). Recent work suggests summer precipitation and early fall NDVI may not be related to Chestnut-collared Longspur abundance (Macías-Duarte et. al. in review). Ellison et al. (2017) deployed geolocators on male Chestnut-collared Longspurs and found that birds banded at the same location in Saskatchewan wintered up to possibly >1,200 km apart.

McCown's Longspur

McCown's Longspurs occur in small- to large flocks in winter, often mixed with Chestnut-collared Longspurs and other species. Winter density estimates for McCown's Longspur are limited to one study in Texas with 13-17 birds per 100 ha on one study plot and 62 birds per 100 ha on another study plot (Grzybowski 1980, 1982) and a northwest Texas Christmas Bird Count (CBC) estimate of 105.2 birds per hour of count effort (Root 1988). CBC data suggest wide shifts in abundance among years and long-term declines in winter populations (With 2010).

Baird's Sparrow

Baird's Sparrows have been studied more extensively in winter than the other species due to recent and ongoing research in the Chihuahuan Desert (Pool et al. 2012, Macías Duarte et al. 2017). They do not appear to defend territories, but they are solitary and utilize a home range (Green et al. 2002). Winter home ranges average 4.85 ha, but can reach 40 ha as some individuals do not maintain fixed winter home ranges (Strasser et al. 2018). In contrast, Gordon (2000b) found that radio-marked Baird's Sparrows in upland grasslands in southeastern Arizona tended to remain in fixed home ranges. The average net distance moved between pairs of locations was 113 m. Density estimates range from 1.1-47.2 birds per 100 ha across study sites and years (Pool et al. 2012). The highest average density of 69.9 birds per 100 ha was recorded at Cuchillas de la Zarca in the foothills of the Sierra Madre Occidental in 2011 (Pool et al. 2012). This GPCA also supported the largest wintering population of Baird's Sparrows, estimated at 335,000 individuals or roughly 42% of the total population of birds wintering on GPCAs (CEC 2013). Baird's Sparrow abundance is positively associated with summer primary productivity (NDVI, Macías-Duarte et al. in review).

The Malpais grasslands of southeast Durango and northwest Zacatecas, and the Valles Centrales grasslands of northern Chihuahua, support 108,000 and 93,000 birds, respectively (14% and 12% of GPCA winter population). An additional unquantified wintering population exists in the middle and upper elevations of the Sierra Madre Occidental. Grasslands in this region have been extensively converted to croplands and bird abundance and distribution in this region are unknown (Bird Conservancy of the Rockies unpubl. data).

4.3 Habitat Associations

Sprague's Pipit, Chestnut-collared and McCown's longspurs, and Baird's Sparrow are grassland specialists. All are closely tied to native grasslands on the breeding grounds, showing sensitivity to the amount of grassland in the landscape and fragmentation by agriculture, wetlands, or roads. Locally, each species prefers slightly different vegetation structure, including grass height and density, forb cover, and bare ground. Little is known about habitat use during spring and fall migration. Sprague's Pipit uses taller grassy areas during fall migration, while longspurs congregate in single- or multi-species flocks in shortgrass prairies, grazed mixed-grass prairies, and fallow agricultural fields. Winter habitat varies by species and region, but non-breeding habitat preferences are superficially similar to those documented during breeding (e.g., Igl and Ballard 1999). However, wintering longspurs and Sprague's Pipit will use additional open land habitats, including but not limited to fallow agricultural fields (longspurs), grassy airstrips and roadside ditches (Sprague's Pipit). Sprague's Pipits select areas locally with less ground cover and more bare ground within healthy, heterogeneous grassland landscapes (Strasser et al. in review).

4.4 Landscape Characteristics of Breeding Habitat

Landscape Composition

The Species are strongly associated with large, open grassland landscapes (Sprague's Pipit: Davis 2004, Lipsey et al. 2015, Lipsey et al. 2017; Chestnut-collared Longspur: Davis 2004, Berman 2007, Ribic et al. 2009, Greer et al. 2016; McCown's Longspur: McLachlan 2007; Baird's Sparrow: Davis 2003b, 2004, Greer 2009, Davis et al. 2013, 2016). Each has been shown to be area sensitive, with average minimum patch sizes estimated at 145, 39, 25 and 25 ha for Sprague's Pipit, Chestnut-collared Longspur, McCown's Longspur, and Baird's Sparrow, respectively (Davis 2003b, 2004). Positive association between occurrence and grassland amount has been reported at scales as broad as 9,300-121,000 ha for Sprague's Pipit and Chestnut-collared Longspur (Lipsey et al. 2017) and is likely similar for the other two species. By contrast, abundance is negatively associated with increasing presence of cropland, woodland and wetland on the landscape (McMaster and Davis 1998, Koper and Schmiegelow 2006, Greer 2009, Sliwinski and Koper 2012, Niemuth et al. 2017). Nest survival and fledging rates for Sprague's Pipit and Chestnut-collared Longspur increased with increasing patch size in Saskatchewan (Davis et al. 2006, Berman 2007), whereas Brown-headed Cowbird *(Molothrus ater)* parasitism rates declined with increases in the amount of grassland in the surrounding landscape (Davis and Sealy 2000).

Roads

Road development often involves soil and vegetation disturbances, providing pathways for non-native or invasive plants to expand into adjacent native grasslands. Roads, especially gravel or dirt roads, are attractive to Brown-headed Cowbirds and may influence rates of brood parasitism (Wellicome et al. 2014). In addition, road development may be accompanied by construction of fences or power transmission infrastructure, which provide perches for avian predators, including Common Ravens *(Corvus corax)* and Black-billed Magpies *(Pica hudsonia)* and travel corridors for mammalian predators.

The impact of roads on the Species varies by location and road type. In general, abundance is neutral or positively related to unimproved roads and trails, whereas raised or paved roads may result in avoidance. Koper et al. (2009) found no effect of roads on Sprague's Pipit abundance in Saskatchewan, although it was not noted whether roads were paved or gravel. In contrast, Sprague's Pipit were less abundant near paved and raised roads in Saskatchewan, but more abundant near unimproved roads (Sutter et al. 2000). Chepulis (2016) reported that Sprague's Pipit abundance declined with increasing road densities in western North Dakota. Jones and White (2012) found no effect of distance to roads on Sprague's Pipit daily nest survival. In Alberta, density of Chestnut-collared Longspurs increased with distance to roads (Koper and Schmiegelow 2006), but Sliwinski and Koper (2012) in southwestern Saskatchewan and Chepulis (2016) in western North Dakota found no effect. Sutter et al. (2000) found that paved roads were associated with significantly decreased abundance of Chestnut-collared Longspur and Baird's Sparrow in western Saskatchewan. Linnen (2008) also found reduced Baird's Sparrow densities near roads to gas wells in Alberta. In North Dakota, Chepulis (2016) found that Baird's Sparrow abundance declined with increasing road densities. In contrast, Ludlow et al. (2015) found no effect of roads to gas wells on density of Baird's Sparrow in Alberta.

Energy Development

Oil and gas development has a mixed, but generally negative, effect on the occurrence and abundance of the Species. Abundance of the Species has been shown either to decline with infrastructure density (Linnen 2008, Dale et al. 2009, Hamilton et al. 2011, Gaudet 2013, Rodgers 2013, Rodgers and Koper 2017, Nenninger and Koper 2018) or to increase with distance to infrastructure (Linnen 2008, Dale et al. 2009, Kalyn Bogard and Davis 2014, Thompson et al. 2015). However, observed relationships were sometimes equivocal (Hamilton et al. 2011, Rodgers 2013, Kalyn Bogard and Davis 2014, Chepulis 2016), and changes in vegetation structure related to infrastructure development and human activity were often more influential than the infrastructure itself (Kalyn Bogard 2011, COSEWIC 2012, Rodgers 2013, Kalyn Bogard and Davis 2014, Chepulis 2016, Rodgers and Koper 2017). Yoo (2014) found lower fledging rates and smaller clutches of Chestnut-collared Longspur near gas wells, whereas Gaudet (2013) reported higher fledging rates. Another study found a negative effect of oil and gas infrastructure on parental care in Chestnut-collared Longspur, resulting in reduced fledging success and productivity (Ng 2017). Ludlow et al. (2015) found Baird's Sparrows avoided nesting within 100 m of trails and roads to wells, with fewer young fledged from successful nests near trails and roads. However, they found no effect of proximity to wells on daily nest survival, though Sprague's Pipit nesting in crested wheatgrass associated with infrastructure did experience reduced nesting success (Ludlow et al. 2015). Information about impacts of wind development on the Species is limited to Chestnut-collared Longspur. Shaffer and Buhl (2015) reported both immediate (first year post-construction) and delayed declining responses of Chestnut-collared Longspur to development of wind turbines. McCown's Longspur nest survival was weakly positively associated with vegetation density at the nest site when considering the amount of grassland in the landscape, and turbine density within 1 km of nest site (Mahoney and Chalfoun 2016). There is no information on the effects of wind development on Sprague's Pipit or Baird's Sparrow during the breeding season.

4.5 Local Characteristics of Breeding Habitat

Although the Species select and occupy similar grassland landscapes during the breeding season, habitat preferences are more variable.

Scott Somershoe

Grassland occupied by Sprague's Pipit, Chestnut-collared Longspur, and Baird's Sparrow in Phillips Co., Montana.

Grassland Type and Composition

Sprague's Pipit

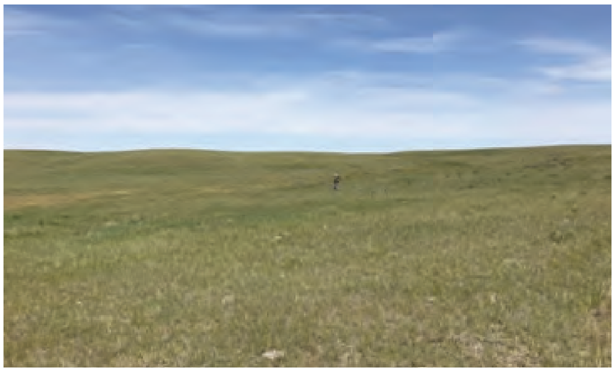
Sprague's Pipit is closely associated with native mixed-grass prairie and rarely breeds in other vegetation types. It avoids areas dominated by non-native grasses like smooth brome *(Bromus inermis)* or crested wheatgrass *(Agropyron cristatum)*, and has been shown to use tame pastures less frequently than native pastures in Saskatchewan (Davis et al. 1999, Dohms 2009). The species also will occasionally nest in grasslands enrolled in the Conservation Reserve Program (CRP) and in cropland (Igl et al. 2008). When the species breeds in non-native vegetation, fledging success may be reduced (Fisher and Davis 2011b). Pipits favor areas dominated by northern wheatgrass *(Elymus lanceolatus)*, western wheatgrass *(Pascopyrum smithii)*, junegrass *(Koeleria macrantha)*, spear grasses *(Hesperostipa spp.)*, blue grama *(Bouteloua gracilis)*, fescue *(Festuca spp.)*, club moss *(Selaginella densa)*, pasture sage *(Artemisia frigida)*, and a variety of other forbs (Sutter 1997, Dieni and Jones 2003, Davis et al. 2013, 2014).

Chestnut-collared Longspur

Chestnut-collared Longspur is also a native prairie specialist, preferring slightly to moderately rolling, short-grass or mixed-grass prairies (Anstey et al. 1995, Blancher 2003, Sedgwick 2004a). The species will use planted grasslands, areas invaded by non-native grasses, haylands, CRP grasslands, and cropland (Anstey et al. 1995, Sutter and Brigham 1998, Davis et al. 1999, Martin and Forsyth 2003, Johnson and Igl 1995, Igl et al. 2008) to a lesser extent and in low densities. Lloyd and Martin (2005) found no difference in Chestnut-collared Longspur densities between native prairie and sites with non-native crested wheatgrass. However, daily nest survival (Lloyd and Martin 2005) and fledging rates (Davis et al. 2016) are lower in fields with crested wheatgrass compared to native prairie. Chestnut-collared Longspur occasionally uses agricultural lands, including small-grain stubble and fallow bare fields, but little is known about nesting attempts or success in these habitats (Snyder and Bly 2009). Chestnut-collared Longspurs tend to avoid CRP grasslands because the grass is typically too tall and thick to meet the species preferences (Johnson and Schwartz 1993, J. G. Jorgensen pers. comm.).

McCown's Longspur

McCown's Longspur prefers native shortgrass prairies in the core of its breeding range, but also uses moderately to heavily grazed mixed-grass prairies. Breeding habitat is dominated by blue grama and buffalograss *(Bouteloua dactyloides;* DuBois 1935, Cassel 1952, Creighton 1974). Other plants found in territories include cactus (e.g., *Opuntia polyacantha)*, other grasses, (e.g., Fendler three-awn, *Aristida purpurea;* Needle-and-thread grass, *Hesperostipa comata)* and small shrubs (e.g., Broom snakeweed, *Gutierrezia sarothrae;* Rabbitbrush, *Ericameria nauseosa;* Fringed sagewort, *Artemisia frigida).* No differences in habitat structure, grassland condition, or other habitat variables have been noted between populations breeding in shortgrass prairies in Colorado and Wyoming and mixed-grass prairies in Montana, Saskatchewan, and Alberta. McCown's Longspur occasionally uses agricultural lands, including small-grain stubble, minimum and conventional-tilled lands, and fallow bare fields (Martin and Forsyth 2003, Snyder and Bly 2009), but little is known about nesting attempts or success in these habitats. McCown's Longspurs rarely use lands enrolled in CRP in the United States or the now defunct Permanent Cover Program (PCP) in Canada, likely due to tall, dense vegetation cover and minimal disturbance on these parcels (McLachlan 2007).



Scott Somershoe

Grasslands with very short structure and extensive areas of bare ground are preferred by McCown's Longspur, Phillips Co., Montana.

Baird's Sparrow

Baird's Sparrow prefers native mixed-grass prairie, but will use a variety of grasslands and pastures, especially where there is standing dead vegetation from the previous growing season (Owens and Myres 1973, Stewart 1975, Dale 1992, Green et al. 2002, Wiggins 2006, Shaffer et al. 2018d). They also have been reported in cropland, wet meadows, dry grassland basins, and many types of planted cover, e.g., CRP grasslands (Renken 1983, Johnson and Schwartz 1993, Davis et al. 1996, McMaster and Davis 2001, Martin and Forsyth 2003, Igl et al. 2008). The species is highly nomadic and densities vary with year and changing conditions (De Smet and Conrad 1991, Green 1992). Abundance is closely related to moisture, declining during droughts and recovering after winter or spring precipitation (Kantrud and Faanes 1979, George et al. 1992, Niemuth et al. 2008). They use grasslands across their breeding range that are dominated by rough fescue *(Festuca altaica)*, sedges *(Carex spp.)*, needlegrasses *(Hesperostipa spp.)*, wheatgrasses *(Agropyron spp.)*, bluegrasses *(Poa spp.)*, junegrass, blue grama, spike oat *(Avenula hookeri)*, foxtail barley *(Hordeum jubatum)*, clubmoss, pasture sage, and western snowberry *(Symphoricarpos occidentalis)* (Owens and Myres 1973, Kantrud and Kologiski 1982, Dale 1983, Sutter et al. 1995, Davis and Duncan 1999, Davis et al. 1999). Some research indicated that Baird's Sparrow occur at higher abundance in non-native pastures than in native (Davis et al. 1996, Davis et al. 1999, Davis and Duncan 1999, Green et al. 2002, Ludlow et al. 2015). In Saskatchewan, Davis et al. (2016) found higher nest success in native prairies than in planted pastures, whereas Ludlow et al. (2015) found no effect. Dale et al. (1997) reported lower daily nest survival in hayfields than in planted or native prairies.

Vegetation Structure

Sprague's Pipit

Sprague's Pipit occupies grasslands with vegetation height <49 cm, grass cover 15-53%, forb cover <25%, shrub cover <18%, litter cover 11-63%, litter depth <11 cm, and bare ground <44% (Shaffer et al. 2018c). Increasing amounts of remaining vegetation from the previous year is a strong predictor of pipit occurrence and abundance (Dale 1983, Davis and Duncan 1999, Davis et al. 2014). Nest-site selection is associated with higher density and height of vegetation, especially dead standing grasses, litter depth, and lower bare ground, shrub and forb cover (Sutter 1997, Davis 2003a, Dieni and Jones 2003, Davis 2005, 2011). However, in at least one study, nest success and nest survival declined with increasing vegetation density and litter depth (Lusk and Koper 2013). In North Dakota, Chepulis (2016) reported that Sprague's Pipit abundance declined with increasing vegetation height-density (i.e., visual obstruction).

Scott Somershoe

Actively grazed pasture with dozens of territorial male Chestnut-collared and McCown's longspurs in Musselshell Co., Montana.

Chestnut-collared Longspur

Chestnut-collared Longspur occupies native prairie with grass cover 15-67%, vegetation height 10-77 cm, litter depth <9 cm, bare ground 1-44%, and without excessive forb 5-16%, shrub 30% or woody vegetation cover <3.5% (Fairfield 1968, Owens and Myers 1973, Schneider 1998, Fritcher et al. 2004, Grant et al. 2004, Greer et al. 2016, Youngberg and Panjabi 2016, Shaffer et al. 2018a). Within short-grass prairie, the species prefers wetter, taller, and more densely vegetated areas than McCown's Longspur (Shaffer et al. 2018a). In Colorado, they select areas with heterogeneous mixes of short and mid-height grasses, and are associated with bunchgrasses (Creighton 1974, Creighton and Baldwin 1974). Chepulis (2016) reported that Chestnut-collared Longspur abundance declined in western North Dakota with increasing vegetation height-density (i.e., visual obstruction). Nests are minimally concealed with little vegetation above the nest cup, tending to be located in areas with relatively greater litter depth, more litter coverage, and more standing dead vegetation (10-20 cm above the ground), lower density of live grass, and less bare ground (Davis 2003b). Daily nest survival was found to increase with litter depth (Berman 2007).

McCown's Longspur

McCown's Longspur prefers shorter, sparser grass cover than the other Species. Breeding sites are characterized by arid, sandy soils with sparse litter and vegetative cover typical of heavily grazed areas. The species also commonly nests in and around black-tailed prairie dog *(Cynomys ludovicianus)* towns. McCown's Longspur occupies breeding areas with the following characteristics: litter cover 10-63%, grass cover 16-67%, forb cover 2-8%, bare ground 2-60%, vegetation height 5-42 cm, and lower litter depth <5 cm (McLachlan 2007, Shaffer et al. 2018b). Territories are frequently located on hilltops, especially southern or southwestern facing hillsides, where the microclimate provides for apparently preferred early snow melt and drier, warmer nest sites. Hilltop and hillside locations also may provide for better aerial territorial displays (Giezentanner 1970, Felske 1971, Creighton and Baldwin 1974). Nests are typically placed in the open, but frequently select nest sites next to a cactus, grass clump, low shrub, or cow pie (With 1994, 2010).

Scott Somershoe

McCown's Longspur displaying from cow pie in Weld Co., Colorado.

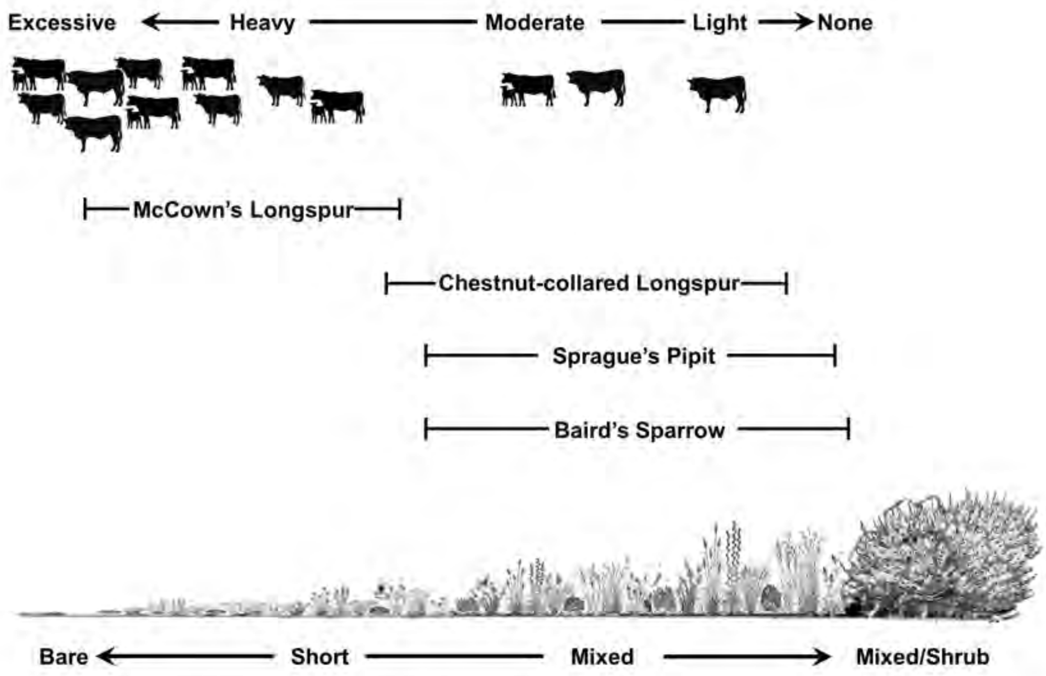


Figure 20. Grassland bird-habitat associations for priority species in the Prairie Potholes Region, BCR 11 and their relationship with grazing intensity. Figure adapted from Knopf and Samson (1997).

Baird's Sparrow

Baird's Sparrow occupies a wide range of grassland conditions with a preference for the following characteristics: vegetation height 14-101 cm, grass cover 15-71%, forb cover 5-25%, shrub cover <50%, litter cover 10-63%, and litter depth <21 cm (Faanes 1982, De Smet and Conrad 1991, Madden et al. 2000, Green et al. 2002, Shaffer et al. 2018d). Abundance declines when grass height is under 10 cm (Anstey et al. 1995). Birds will use areas of drier prairie in wet years and moister areas in dry years to select preferred vegetation conditions (Kantrud and Faanes 1979, Green et al. 2002, Shaffer et al. 2018d). Nests are often placed at the base of or within vegetation clumps with higher grass height, more dense standing dead vegetation (10-20 cm tall), higher litter depth, and lower bare ground or clubmoss cover (Davis and Sealy 1998; Davis 2003b, 2005; Dieni and Jones 2003).

Response to Management

Grazing by domestic and wild ungulates and prescribed fire are highly compatible with and even necessary to maintain native plant species composition and habitat structure needed by the Species (Figure 20). Specific, local-scale responses by the Species to grazing management are not generalizable and vary with species, management history, soil productivity and climate. In some contexts, grazing can influence habitat quality, both positively and negatively for individual species (Lipsey and Naugle 2017). See Appendices K through N for a summary of responses to management, e.g., grazing, fire, and mowing/haying, for each of the Species.

Sprague's Pipit

Sprague's Pipit generally prefers mixed-grass prairies that have been lightly to moderately grazed, depending on rainfall and grassland condition (Kantrud 1981, Madden et al. 1999, Pipher 2011, Sliwinski 2011, Environment Canada 2012, Richardson et al. 2014). Heavily grazed grasslands generally support fewer pipits. Lusk (2009) found no effect of grazing intensity on fledging rates. Pipher (2011) found higher rates of nesting success in ungrazed and moderate grazed pasture than in lightly grazed pastures; however, grazing frequency (2-3 years vs. 15+

continuous years) did not affect nesting success. Nest survival is driven by local vegetation height and forb cover (Bird Conservancy of the Rockies unpubl. data).

Chestnut-collared Longspur

Chestnut-collared Longspur is often positively associated with disturbance (e.g., fire or grazing), but the strength and direction of response depends on habitat structure and regional context. The species reaches highest densities in native prairie that has been recently grazed and avoids undisturbed or idled areas where moisture and soils allow significant vegetation growth (Giezentanner 1970, Owens and Myres 1973, Dale 1983, Huber and Steuter 1984, Madden et al. 1999, McMaster and Davis 2001, Salo et al. 2004, Pipher 2011, Sliwinski 2011, Richardson et al. 2014). Density is higher on grazed versus ungrazed pastures (70-190 pairs versus 0-20 pairs per 100 ha; Maher 1973). Where soil or climatic conditions maintain sparse, open vegetation, Chestnut-collared Longspur will use undisturbed xeric shortgrass and mixed-grass prairies (Jones et al. 2010). There was no effect of grazing on nest success across many studies in mixed-grass prairies in Canada (assessed by Bleho et al. 2014). The species tends to avoid habitats with woody vegetation (Igl et al. 2008).

Scott Somershoe

Grazing by cattle is an important tool for managing grasslands. Chestnut-collared Longspurs were present on this site in Phillips Co., Montana.

Martin et al. (1998) evaluated the indirect effects of the pyrethroid insecticide deltamethrin on reproductive success of Chestnut-collared Longspurs and found that the clutch size and nestling survival were similar between sprayed and unsprayed plots, but egg hatching success was lower on sprayed plots than on control plots. The weight and skeletal size of longspur nestlings at fledging was not significantly affected by insecticide application, and parent longspurs did not fly farther in sprayed plots to feed nestlings than in control plots.

Scott Somershoe

Sparsely vegetated shortgrass prairie occupied by McCown's Longspur in Weld Co., Colorado.

McCown's Longspur

In mixed-grass prairies, McCown's Longspurs avoid ungrazed pastures and are significantly more abundant in heavily grazed pastures than pastures under moderate or low grazing intensities (Felske 1971, Wershler et al. 1991, Bleho 2009, Sliwinski 2011). In short-grass prairies, McCown's Longspur prefers summer grazed over winter grazed pasture (Giezentanner and Ryder 1969, Giezentanner 1970, Wiens 1970) and season-long over early season grazing (Dale and McKeating 1996). The species avoids idle pastures (Felske 1971).

Baird's Sparrow

Baird's Sparrow generally decreases in abundance with increasing grazing intensity (Owens and Myres 1973, Kantrud 1981, Dale 1983, De Smet and Conrad 1991, Davis 1994, Anstey et al. 1995, Madden et al. 1999, Bleho 2009, Sliwinski 2011, Richardson et al. 2014, Lipsey and Naugle 2017), except in very moist portions of the range where productivity can lead to excessive vegetation height and density (Anstey et al. 1995). Baird's Sparrow density may decrease in the first couple years after burning (Renken 1983, Winter 1999, Richardson et al. 2014). The species tends to avoids habitats with woody vegetation (Igl et al. 2008).

Migratory Habitat

Very little is known about habitat use by the Species during migration. They have been reported in native grassland systems and a variety of other habitats including plowed agricultural fields and road sides. Sprague's Pipits have been reported using habitats similar to those used on their breeding and wintering grounds, including pastures, prairie-dog towns, grasslands of various vegetation height (Thompson and Ely 1992, Baumann 2016) and stubble, burned, and fallow agricultural fields (Davis et al. 2014) in fall. Observers have also found migrating Sprague's Pipits on grassy hill tops in east-central Colorado in fall migration (eBird.org, accessed 3 May 2018). Migrating Chestnut-collared Longspurs have been reported in shortgrass prairies (Thompson and Ely 1992), black-tailed prairie-dog towns, scrub and sandsage *(Artemisia filifolia)*, sod (turf) farms, and plowed or fallow agricultural fields in spring and fall (Grzybowski 1983, Smith and Lomolino 2004). McCown's Longspurs have been reported in shortgrass prairies, sod (turf) farms, and plowed agricultural fields during spring and fall migration. The Baird's Sparrow is rarely reported during migration, but has been found in native grasslands, weedy cropland fields, hay fields, and bare shorelines on edges of water bodies (Green et al. 2002).

Winter Habitat

Winter habitat preferences vary by species and region but tend to be superficially similar to those reported in their breeding ranges (Igl and Ballard 1999). Annual occurrence and abundance in winter are highly variable and dependent on vegetation conditions (Macías-Duarte et al. 2009, 2011).

Sprague's Pipit

Sprague's Pipit winter regional abundance varies among years, which may be related to habitat conditions resulting from rainfall from the previous growing season (Gryzbowski 1982, Contreras-Balderas 1997, Dieni et al. 2003, Marx et al. 2008, Macías-Duarte et al. 2009, Macías-Duarte et al. 2011, Pool et al. 2012, Ruth et al. 2014). The species is considered a grassland specialist in winter, selecting higher grass cover and lower shrub cover (Macías-Duarte et al. 2009, but see Igl and Ballard 1999). It also will use sparsely vegetated grasslands (Desmond et al. 2005). Wintering pipits may also occupy a variety of non-native grass habitat, including roadside edges, grassy roadside ditches along agricultural fields, stubble or burned alfalfa and Bermuda grass fields, grassy airports, turf farms, and golf courses (James and Neal 1986, Shackelford 2014, S. G. Somershoe pers. obs.). Sprague's Pipit is also reported to use plowed agricultural fields (Stevens et al. 2013). However, an extensive two-year line-transect survey effort in a variety of crop and fallow habitats available in the El Tokio GPCA in Nuevo Leon and Coahuila, Mexico found no pipits in any cropland habitat with the exception of a single bird observed anecdotally in an unplowed corner of a crop field in between surveys (Ruvalcaba-Ortega et al. 2012).

Pool et al. (2012) reported peak abundance in grasslands with approximately 80% grass cover, grass height of 28 cm, and forb height of 20 cm. Density was negatively related to shrub cover but unrelated to shrub height (Pool et al. 2012). In Texas, grasslands with less than 5% shrub cover were preferred (Grzybowski 1982, Muller 2015). In Texas coastal prairies, Sprague's Pipit preferred areas that had been recently burned, grazed, or mowed and were characterized by lower little depth and shrub coverage, and little to no non-native vegetation (Saalfeld et al. 2016). In southern Texas, Igl and Ballard (1999) reported complete avoidance of brushland and woodland habitats, but found higher densities in shrub-grassland and parkland habitats than in grasslands. Shrub-grasslands were defined as grass-woody plant interspersion with woody plants generally <3 m tall and comprising <30% woody canopy coverage, and parkland was defined as grassland-woodland interspersion, with woody plants >3 m tall and comprising <50% woody canopy coverage.

Although the Sprague's Pipit prefers open grasslands on a landscape level, a study of micro-habitat use by radio-tagged Sprague's Pipits revealed a preference for areas of bare ground and an avoidance of other ground cover such as litter, animal excrement, and rocks (Strasser et al. in review). The species showed no relationship with grass structure. These barren and open microhabitats are likely important for their locomotion, foraging success, and detection and avoidance of predators. This study also revealed that pipits have variable home-range strategies in winter, with some birds moving long distances (e.g., >1 km) between discrete home ranges averaging almost 12 ha. Wind development in central Texas did not affect winter abundance of Sprague's Pipit (Stevens et al. 2013).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Shortgrass occupied by Sprague's Pipit in winter.

Chestnut-collared Longspur

Wintering Chestnut-collared Longspurs prefer shortgrass prairies and desert grasslands dominated by low grasses and forbs with most vegetation <0.5 m (Raitt and Pimm 1976, Grzybowski 1982). Abundance is negatively related to shrub cover with >75% of individuals observed in areas with <1% of shrub cover in desert grasslands (Desmond 2004, Macías-Duarte et al. 2009, Block and Morrison 2010). As with migration, Chestnut-collared Longspurs often use black-tailed prairie dog towns (Desmond 2004) and also will use plowed, stubble, or fallow agricultural fields (Oberholser 1974, Raitt and Pimm 1976).

Pool et al. (2012) found that Chestnut-collared Longspur densities in winter in Chihuahuan grasslands with no shrubs were nearly twice as high as those in grasslands with average shrub cover (~5%). Shrub height was an even stronger predictor of density, with habitat containing shrubs <20 cm high supporting four times as many longspurs as grasslands with average shrub height of 120 cm. Birds also avoid grasslands with tall (>25 cm) forbs in winter (Pool et al. 2012).

McCown's Longspur

McCown's Longspur occupies habitats similar to those occupied on the breeding grounds, including shortgrass prairies and heavily grazed pastures, but the species also utilizes plowed and stubble agricultural fields, desert grasslands, dry lake beds, and playas (shallow prairie wetlands) (Smith and Lomolino 2004, With 2010). Dominant vegetation includes a matrix of blue grama and buffalograss interspersed with other shortgrass species (Grzybowski 1982, With 2010). Large numbers of McCown's Longspur have been reported in black-tailed prairie dog colonies in the Chihuahuan Desert of northern Mexico (Macías-Duarte et al. 2011). The species also has been reported in heavily grazed grasslands, including areas with short and dense grass cover (J.H. Martinez-Guerrero pers. comm. 2017, fide A. O. Panjabi) and short and sparse grass cover (A. O. Panjabi pers. obs.). McCown's Longspur is reported to use playa wetlands managed for wintering waterfowl in the Southern High Plains of Texas (Smith et al. 2004).

Extensive surveys in Chihuahuan Desert grasslands have found very few McCown's Longspurs (Macías-Duarte et al. 2011). The low number of McCown's Longspurs in the Chihuahuan Desert suggests that the species does not overwinter in large numbers in this region or the species occupies a very narrow niche in the winter in that region, which includes prairie dog colonies, other short-statured, open grasslands, and non-grassland habitats (e.g., agricultural fields).

Baird's Sparrow

In the Chihuahuan Desert, Baird's Sparrow winter abundance is positively related to grass cover (>40%) and grass height, and negatively related to shrub cover (Pool et al. 2012). Peak winter abundance occurs in areas with 80% grass cover, grass height around 38 cm, and forb height around 50 cm (Pool et al. 2012).

Among the four species in this strategy, wintering Baird's Sparrows have the strongest preference for taller herbaceous vegetation, and in contrast to the others species, spend much of their time hidden inside dense patches of tall grasses (A. O. Panjabi pers. obs.). A study of micro-habitat use and survival of Baird's Sparrows in Janos, Chihuahua revealed that birds selected the grassiest portions of the landscape (average grass cover of 30%) with the fewest (~1%) and shortest (<50 cm) shrubs (Macías-Duarte et al. 2017).

Although Baird's Sparrows can be found wintering in desert grasslands dominated by various grasses, they prefer areas dominated by native grasses over non-native grasses. Baird's Sparrows wintering in the Chihuahuan Desert consumed mainly seeds of native grasses from the subfamily Panicoideae, including from Panicum spp. and cane bluestem *(Bothriochloa barbinoidis)*, as well seeds from grama grasses *(Bouteloua spp.)*. To a lesser extent, seeds from tobosagrass *(Pleuraphis spp.)*, members of the *Eragrostideae* subfamily, and even seeds of the forb *Verbena* spp. were also consumed (Titulaer et al. 2017). A seed choice study of captive Baird's Sparrows in winter indicated a strong preference for blue grama *(Bouteloua gracilis)* and sideoats grama *(Bouteloua curtipendula)* over two widespread exotic species, Lehmann's lovegrass *(Eragrostis lehmanniana)* and buffelgrass *(Pennisetum ciliare)*, although they readily consumed seeds from natal grass *(Melinis repens)*, an exotic species (Titulaer et al. 2017).

In grasslands in southeastern Arizona, Gordon (2000a) studied the effects of fire and grazing on the abundance of wintering Baird's Sparrow. Baird's Sparrows used burned areas in the first post-burn winter but did not significantly respond to fire. Baird's Sparrows were more abundant in grazed pastures in winter than in an ungrazed study area. Gordon (2000a) concluded that moderate cattle grazing in winter may be compatible with the conservation of this species.

4.6 Demographic Rates

Demographic rates for these species are understudied and limiting factors associated with population declines remain largely unknown. Most research has focused on nest success in the breeding grounds, and very little is known about demographic parameters during winter or migratory periods. Further, even relatively well-examined measures like nest success have been calculated and reported differently across studies, making results difficult to interpret or compare. Of the four Species, the Chestnut-collared Longspur is the best studied thanks to its high densities and the relative ease of locating and monitoring its open, cup-like nests. The majority of demographic research on McCown's Longspur has occurred in the Pawnee National Grassland of northcentral Colorado, adjacent southern Wyoming, and Saskatchewan. There is little published information on demographics for McCown's Longspur from Montana and southern Canada which supports an estimated 60% of the global breeding population (M. K. Sather unpubl. data). Baird's Sparrow and Sprague's Pipit breeding biology has been understudied in comparison to the longspurs due to the difficulty in finding Sprague's Pipit and Baird's Sparrow nests.

4.7 Breeding Demographics

Nest Success

Reported nest success varies considerably across species, sites and years, but generally 25-54% of nests fledge at least one host chick (see Appendices G through J). Annual variation in weather, and local and landscape habitat conditions appear to significantly impact nesting of the Species. Conrey et al. (2016) found that the longspurs showed a negative relationship between nest success and higher temperatures, as well as drier periods and storm events. The effects of temperature are likely to vary according to latitude, time within the breeding season, or annually, with temperature having a positive effect early in the breeding season and at northern latitudes, and a negative effect at more southern latitudes and later in the breeding season (Conrey et al. 2016). Intense weather events also can negatively impact nest survival through exposure (Skagen and Yackel-Adams 2012), and events such as hail storms, have potential to cause high rates of nest loss for grassland birds (>50% of known nests), and can further impact reproduction through direct mortality of adults (Carver et al. 2017).

Sprague's Pipit

Sprague's Pipit nesting success varies with year and by region. Existing estimates range from 28-74%; however, most studies to date have small sample sizes (13-33 nests; Davis 1994, Davis and Sealy 2000, Gaudet 2013, Lusk and Koper 2013, Davis et al. 2014, Ludlow et al. 2014, Bernath-Plaisted et al. 2018, but see Davis 2003b, Jones et al. 2010). Results from studies examining the effects of vegetation and environmental variables on Sprague's Pipit nesting success have been equivocal, with one study finding decreasing nest success with increasing vegetation height and litter depth, while another found that nesting success increases with vegetation height (Lusk and Koper 2013, Bernath-Plaisted et al. unpubl. data). Nest age, temperature, precipitation, and exotic cover have also been shown to impact the nesting success of this species (Davis 2005, Ludlow et al. 2014, Ludlow et al. 2015, Bernath-Plaisted et al. unpubl. data). Average number of young fledged is 0.9-2.9 for successful and unsuccessful nests combined (Davis and Sealy 2000, Davis 2003b, Lusk 2009, Jones et al. 2010, Gaudet 2013, Lusk and Koper 2013, Davis et al. 2014, Ludlow et al. 2014) and 2.5-3.7 for successful nests (Davis and Sealy 2000, Davis 2003b, Jones et al. 2010, Gaudet 2013, Lusk and Koper 2013, Davis et al. 2014, Ludlow et al. 2014).

Chestnut-collared Longspur

Existing nesting success estimates for Chestnut-collared Longspur are more consistent across years and geographies, relative to the other three species. Nesting success typically ranges from 43 to 53% (Davis 1994, Hill 1997, Davis 2003, Lloyd and Martin 2005, Jones et al. 2010, Lusk and Koper 2013, Pipher et al. 2016, Bernath-Plaisted et al. 2018). The lowest recorded estimates was 23% for ungrazed pasture in Saskatchewan (Lusk and Koper 2013). A success rate of 30% was reported in one large study (n=493 nests) in Saskatchewan (Davis 2003b). Chestnut-collared Longspur nesting success appears to be relatively invariant with respect to nest-site vegetation characteristics (Davis 2005, Lusk and Koper 2013, Yoo and Koper 2017, Bernath-Plaisted et al. unpubl. data). However, there is evidence that the nesting success of this species declines in exotic monocultures (Lloyd and Martin 2005). Additionally, Davis et al. (2016) reported higher nest success with higher amounts of restored pastures within 400 m. Across studies and geographies, 3.0-3.6 young were consistently fledged per successful nest (Davis 1994, 2003; Hill 1997; Jones et al. 2010; Gaudet 2013; Yoo 2014; Davis et al. 2016). Lynn and Wingfield (2003) evaluated nestling survival (fledging success) and the importance of biparental care in Chestnut-collared Longspurs by removing parental males from their territories after eggs hatched. The authors demonstrated that male Chestnut-collared Longspurs were critical for nestling survival as no young fledged from female-only nests. Fledging success, i.e. number of young fledged from eggs that hatched, in unmanipulated nests and control nests ranged from 44% to 72%.


Scott Somershoe

Chestnut-collared Longspur nest, Phillips Co., Montana

McCown's Longspur

Reported nest success estimates for McCown's Longspur ranged from 42 to 77% (Mickey 1943, Strong 1971, Creighton and Baldwin 1974, With 1994). However, these values are not directly comparable due to use of different estimation methods. Reproductive success, calculated as number of young fledged per number of eggs per successful nest, was reported as 2.4 (Strong 1971, Porter and Ryder 1974) and 2.9 in Colorado (With 1994) and 3.5 in Wyoming (Mickey 1943). Estimates of young fledged per nesting attempt are comparable across four studies, ranging from 1.1 to 2.0 (Felske 1971, Strong 1971, Porter and Ryder 1974, With 1994).

Baird's Sparrow

Current exposure and Mayfield nesting success estimates for Baird's Sparrow range widely, and have been reported from 17-54% (Davis and Sealy 1998, Green et al. 2002, Jones et al. 2010, Gaudet 2013, Lusk and Koper 2013, Bernath-Plaisted et al. 2018). Additional studies have reported apparent nesting success (percentage of nests successfully fledging at least one young) ranging from 26-75% (Davis and Sealy 1998, Davis 2003b, Gaudet 2013, Ludlow et al. 2014, Pipher at al. 2016, Bernath-Plaisted et al. unpubl. data). Few effects of vegetation on Baird's Sparrow nesting success have been demonstrated (Davis 2005, Lusk and Koper 2013). However, one regional study conducted in western North Dakota and northeastern Montana found that nesting success increased strongly with higher visual obstruction reading (VOR), suggesting higher vegetation and increased cover may be beneficial for this species (Bernath-Plaisted et al. unpubl. data). In Montana, Jones et al. (2010) reported 1.5 Baird's Sparrow young fledged per nest and 3.5 young fledged per successful nest.


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Male Brown-headed Cowbird

Brown-headed Cowbird Parasitism

Brown-headed Cowbird is an obligate brood parasitic icterid that shares the breeding ranges of the Species. The species reaches its highest abundance in the northern Great Plains (Igl and Johnson 2007, Sauer et al. 2017). Nonetheless, brood parasitism rates are relatively low to moderate for these species, estimated at 0-36% with most studies reporting parasitism rates below 15%.

Sprague's Pipit

Parasitism rates by cowbirds on Sprague's Pipit are low compared to other grassland bird species, especially in large, intact landscapes (Davis and Sealy 2000). Of 12 studies reporting rates, most (7) reported no parasitism (Maher 1973, Granfors et al. 2001, Igl and Johnson 2007, Lusk 2009, Pipher 2011, Davis et al. 2014, G. Sutter unpubl. data. in Shaffer et al. 2018c). The remaining estimated rates were between 2 and 18% (De Smet 1992, Davis 2003b, Klippenstine and Sealy 2008, Jones et al. 2010, Davis et al. 2014).

Chestnut-collared Longspur

Most (14 of 20) studies reported less than 10% cowbird parasitism of Chestnut-collared Longspur nests (Harris 1944, Smith and Smith 1966, Fairfield 1968, Regina Museum of Natural History Nest Record Cards in Fairfield 1968, Maher 1973, Lloyd and Martin 2005, Berman 2007, Igl and Johnson 2007, Klippestine and Sealy 2008, Lusk 2009, Jones et al. 2010, Pipher 2011, Bleho et al. 2015). Four studies reported 12-18% parasitism (Maher 1973, De Smet 1992, Davis 1994, Davis 2003b), and only two reported rates above 20% (Stewart 1975, Friedmann 1977). Davis (2003) reported that, on average, parasitism reduced fledging by 1.3 young Chestnut-collared Longspurs per successful nest. Davis et al. (2002) experimentally parasitized Chestnut-collared Longspur nests with mimetic and nonmimetic cowbird eggs to determine whether the low frequency of parasitism reported for this species is due to egg rejection behavior. The authors concluded that low parasitism frequency of longspur nests is not the result of egg rejection behavior but may be related to anti-parasite strategies (e.g., nest defense behavior) to reduce the chances of parasitism.

McCown's Longspur

Although McCown's Longspur nests are poorly concealed, parasitism was not observed in the two nesting studies with adequate sample sizes (71 nests in Wyoming, Mahoney and Chalfoun 2016; 74 nests in Saskatchewan, Maher 1973).

Baird's Sparrow

Of the Species, Baird's Sparrow is likely the most common cowbird host, with parasitism rates estimated at 0-36% (Maher 1973, De Smet and Conrad 1991, De Smet 1992, Davis and Sealy 1998, Granfors et al. 2001, Davis 2003b, Jones et al. 2010, Pipher 2011). Davis and Sealy (2000) and Davis (2003b) reported that, on average, parasitism reduced fledging by 1.4 and 1.8 young Baird's Sparrows per successful nest, respectively.

Predation

Mammalian, avian, and reptilian predation is thought to be the main source of nest failure, although severe or extreme weather (e.g., hail, heat, cool and wet spring weather) also can be deleterious (DuBois 1937, Mickey 1943, Felske 1971, Uresk and Sharps 1986, Greer and Anderson 1989, With 1994, Green et al. 2002, With 2010, Skagen and Yackel-Adams 2012, Bleho et al. 2015, Conrey et al. 2016, Carver et al. 2017). Using video photography, Davis et al. (2012) identified at least 10 predators of pipit nests in Saskatchewan and Montana, with Northern Harrier *(Circus hudsonius)* and thirteen-lined ground squirrel *(Ictidomys tridecemlineatus)* being the most common nest predators.

Pesticides

Pesticides are infrequently considered a potential significant threat to grassland songbirds; however there are direct impacts to adult and juvenile survival. McEwen and Ells (1975) found direct mortality of McCown's Longspurs in Colorado after mid-summer application of toxaphene. Recent studies have shown potential significant impacts on grassland birds, both through direct mortality and indirect mortality as a result of contaminated or reduced food supplies (Hallmann et al. 2014, Gibbons et al. 2015).

Adult and Juvenile Survival

Information about adult and juvenile survival for the Species are limited because of generally very low breeding site fidelity of adult birds and a lack of banding studies. However, adult survival of Baird's Sparrows appears to be high and invariant across years and drought/non-drought years; mean probability of survival estimates ranged from 0.81 to 0.83 from 2015-2017 using logistic exposure analysis methods (Bernath-Plaisted et al. 2018).

Sprague's Pipit juveniles had a 29% chance of surviving 27 days post-fledging, with increased survival for later nesting attempts (COSEWIC 2010, Fisher and Davis 2011b). Fledgling survival was higher in native grassland than seeded/planted grasses (COSEWIC 2010). Natal site fidelity was estimated at zero for banded nestlings of Sprague's Pipit (n=160; Jones et al. 2007), Chestnut-collared Longspur (n=325; Hill 1997), and McCown's Longspur (n=74; With 2010). There is currently ongoing research on adult and juvenile survival and natal site fidelity for Baird's Sparrow in North Dakota and Montana (Bird Conservancy of the Rockies). No estimates of juvenile survival in Chestnut-collared or McCown's longspurs exist to date.

Annual and Lifetime Productivity

No assessments of annual or lifetime productivity have been reported for any of the Species because few banded individuals have been followed through one or more breeding season(s). Return rates may be higher for Chestnut-collared Longspurs (Bleho et al. 2015) and future research could address this question for this species. Estimates of annual productivity could feasibly be estimated with existing nesting data. Females of all four species will renest after nest failure (Davis and Sealy 1998, Lloyd and Martin 2005, Davis 2009, Jones et al. 2010, With 2010). Both longspur species frequently attempt second and third broods, with individual Chestnut-collared Longspur females reported fledging nine or more young per breeding season (Lloyd and Martin 2005). Sprague's Pipit and Baird's Sparrow will attempt second broods when conditions are favorable, but success of two consecutive broods for these species is uncertain (Davis and Sealy 1998, Davis 2009, Jones et al. 2010).

Migration Demographics

There is nothing known about survival and other demographic parameters during the spring and fall migration period for the Species. Chestnut-collared Longspurs are most frequently detected on migration, often in large flocks, but no demographic information has been reported.

Winter Demographics

Very little is known about winter demographics for the Species. Bird occurrence and abundance may vary greatly on given sites among years as birds respond to varying grassland conditions. Macías-Duarte et al. (2017) estimated weekly survival at 92.7% for Baird's Sparrow wintering near Janos, Chihuahua, which can be extrapolated to a very low rate of overwinter survival of 27.7% (CI = 10.8-44.7%). Survival estimates for wintering Baird's Sparrows in Chihuahua, Durango, Coahuila, and Texas ranged from 1-100% over the four wintering months, depending on the site and the year (Strasser et al. 2018). Weekly survival was lower with colder daily minimum temperatures, suggesting that weather exposure represents a physiological stress in winter. Winter site fidelity of banded Baird's Sparrows is low among years, estimated at <1% (2 out of 257 in Chihuahua, Mexico; Bird Conservancy of the Rockies, unpubl. data). This ongoing research is providing important information for Baird's Sparrow, but comparable research is lacking for the other three species.

Chapter 5. Implementation Strategies and Conservation Actions

Habitat conservation issues affecting the priority grassland birds across their annual life-cycle include conversion of native grasslands to other uses, fragmentation of native cover, degradation of rangelands via encroachment of invasive species and woody cover and management regimes incompatible with the requirements of the Species. Populations of predators and brood parasitic Brown-headed Cowbirds have fluctuated dramatically in response to anthropogenic activities. Implementation strategies will focus on the protection, restoration, and enhancement (i.e., management) of grassland communities. Perhaps the single most direct conservation action for the Species is the protection of remaining grasslands from conversion to non-grassland cover types.

Programs and practices that promote and support grass-based agriculture on privately-owned and/or privately-managed, native grasslands should also be emphasized to ensure livestock production across the Species' annual range. Strategies should include a wide array of incentive-based management tools to encourage livestock grazing and prevent the conversion of native grasslands to cropland, which maintains structural diversity to support priority birds. Where cropland conversion has already taken place, conservation partners must work to continue and improve (i.e., allow grazing and encourage native seed mixes) United States Department of Agriculture (USDA) Farm Bill programs such as the CRP and other programs to restore and maintain perennial grassland cover in the United States, Canada, and Mexico.

As is typical of grassland birds, the Species are opportunistic by nature, shifting local abundance with annual changes in vegetation structure, availability of food resources, among others, which is likely an inherent response to historic wet and dry cycles, wildfires, and grazing by native animals, including bison, prairie dogs, and Rocky Mountain locusts *(Melanoplus spretus)* (Igl and Johnson 1999). This opportunism provides some resiliency in these populations; however suitable habitat must be present throughout the annual distribution to reach population trend objectives (see Monitoring and Assessment Chapter). While general approaches to grassland conservation for passerines can be consistent across the entire life-cycle, each of the primary grassland ecoregions will require a different emphasis to meet the needs of the priority species. Those ecoregions include mixed-grass, dry mixed-grass and shortgrass prairies, and Chihuahuan Desert grasslands.

5.1 Strategic Habitat Conservation

A Strategic Habitat Conservation (SHC; U.S. Fish and Wildlife Service 2008b; Figure 21) paradigm is recommended. Using this adaptive-management framework, spatial models developed for the Species provide decision support tools to guide habitat conservation actions. In many cases, a mix of conservation actions (protection, restoration, and enhancement) may be warranted. These actions set the stage for monitoring resulting biological outcomes and demographic responses (see Chapter 6. Monitoring and Assessment). The results of monitoring will inform population and habitat goals in an adaptive management context.

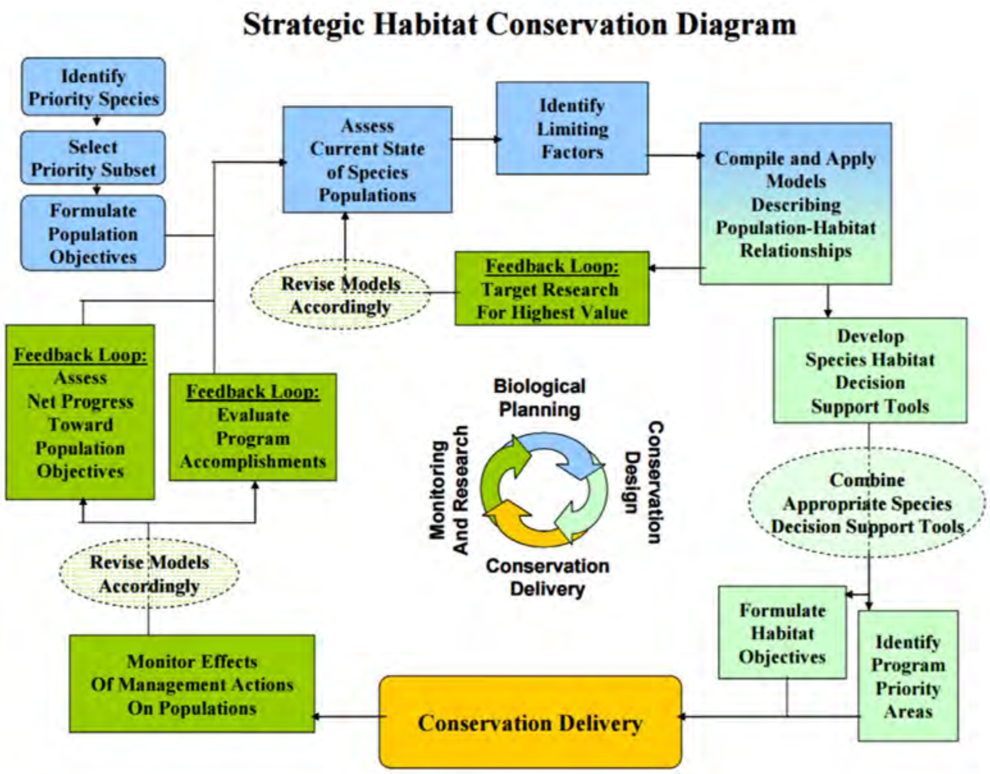

Figure 21. Strategic Habitat Conservation elements (U. S. Fish and Wildlife Service 2008).

Programmatic Elements of Habitat Conservation

Conservation practitioners have long relied on a range of conservation approaches to achieve priority species population goals and related habitat objectives. These approaches range from landscape treatments of restored grasslands to prescriptive management actions aimed at incremental increases in population vital rates, to more universal goals of long-term habitat securement. The different approaches are likely driven by the existing knowledge of population limiting factors and historical and contemporary perspectives on the most appropriate actions to address population changes and habitat degradation.

Perpetual protection is generally recognized as the treatment with the most enduring biological benefits when strategically targeted for the most productive habitats (see Doherty et al 2013). Wetland and grassland easements continue to provide long-term protection to the most valuable habitat resources in the Great Plains grasslands and are often the center of conservation activities in the northern Great Plains. However, perpetually protecting the entirety of priority habitats throughout the Great Plains and Chihuahuan grasslands is unlikely due to the large amount of privately owned grassland, current habitat loss rates, lack of funding, landowner perceptions, and local, regional, and national restrictions on long-term easements. This recognition has driven many Joint Ventures to broaden the scope of conservation activities.

Considering diverse landscapes, limiting factors, and individual partner goals, this broadened scope of activity is an asset to the conservation enterprise, so long as the actions are conducive to stabilizing population trends for the priority species. The tools and tactics required to address grassland bird population declines must be tailored to the individual focal area (e.g., state, ecoregion, Joint Venture). Priority grassland bird species will benefit from the use of strategically targeted habitat protection, restoration, and enhancement

Enhancement	Invasive Plant Control Predator Removal Tax Incentives	Prescribed Fire Grazing Agreements Tree Removal	
Restoration		Conservation Programs (CRP, EQIP, etc)	Grassland Restoration/Reconstruction (with perpetual protection)
Protection	Easement Enforcement O&M of Fee Lands	Nest Cover Establishment and Leases	Easement Acquisition Fee Title Acquisition

Figure 22. Grassland nesting bird conservation tactics are displayed in relation to the three primary programmatic elements (protection, restoration, and enhancement) and the duration of benefits received (annual, term, and perpetual). Adapted from the 2017 PPJV Waterfowl Plan. *CRP – USDA Conservation Reserve Program, EQIP – USDA Environmental Quality Incentives Program, O&M – Operations and Maintenance

actions across time scales from annual to perpetual (Figure 22).

It is important to note that all tools are to be planned and implemented based on an assessment of limiting factors facing the Species within any target landscape. Grassland easements augmented by grazing treatments are a sound strategy or approach for large areas of intact grasslands, while intensive treatments (e.g., grassland restoration) may be targeted to stabilize population declines and increase recruitment in highly fragmented landscapes. Grassland management actions may be used to maintain desired plant species composition (e.g., invasive species control, prescribed fire) and overall grassland productivity and resilience. However, many area-dependent grassland bird species may require larger blocks of grass or a higher percentage of grassland habitat, via more patches, across the landscape and additional/further refinement of programmatic elements of conservation may be necessary. A conceptual matrix of conservation actions can further guide efforts on the landscape for these species (Figure 23).

Population Limiting Factors and Stressors

The Species and grassland birds in general, respond different to habitat fragmentation (O'Connor et al. 1999). Habitat patch size and configuration have become particularly important as cropland and other land cover types have replaced native prairies, and individuals that avoid small patches may need to be more successful in fledging young than individuals that settle on small patches with low reproductive success (Ribic et al. 2009). Highly fragmented habitats have more edge and elevated rates of nest predation (Vickery et al. 1992, Burger et al. 1994, Rosenblatt et al. 2001). These areas also tend to have increased rates of Brown-headed Cowbird parasitism (Davis and Sealy 2000, Koford et al. 2000, Morrison and Hahn 2002), although parasitism rates for the Species are typically quite low and is likely not a population limiting factor. Lower productivity in addition to the habitat loss associated with increased fragmentation is likely contributing to the Species population declines. See Appendices G through

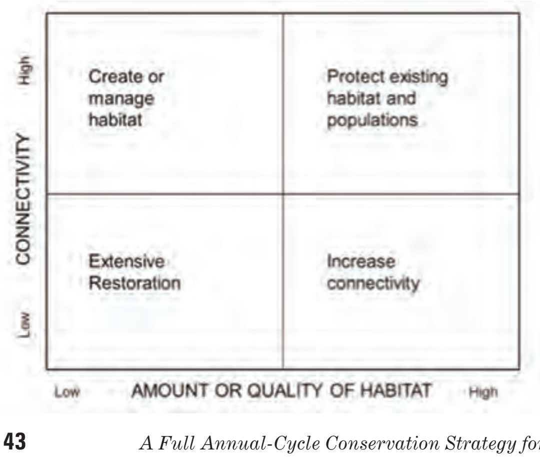

Figure 23. A conceptual decision matrix for area-dependent grassland bird conservation that displays the recommended action in relation to combinations of amount of grassland habitat and connectivity in the landscape.

N for species-specific threats and stressors and associated vital rates.

By strategically restoring and protecting large expanses of grasslands at a landscape scale, e.g. within GBCAs and core population areas (M. K. Lipsey unpubl. data), and that correspond to increasing abundances of the Species, which can be amount of grassland to scales of 9,300-121,000 ha for Sprague's Pipit and Baird's Sparrow (Lipsey et al. 2017), managers can potentially increase population growth rates by providing additional perennial cover and reducing nest depredation resulting in increased nesting success. Similarly on the wintering grounds, restoring grassland via reconstruction and improvement through shrub removal and protecting large expanses of grasslands in areas with high wintering abundance should increase winter survival through decreased predation.

5.2 Recommended Conservation Actions

Appendix A, entitled, "Recommended Conservation Actions for Sprague's Pipit, Chestnut-collared Longspur, McCown's Longspur, and Baird's Sparrow" provides a framework that identifies and ranks priority information needs for the Species. It is intended as a guide for directing research programs and effectively and efficiently allocating funding to address the critical information needs that will ideally mitigate declining trends in these bird populations.

Although this strategy identifies the highest priority information gaps for the Species, the strategy is not designed to provide specific local scale guidance for where and how to conduct research and monitoring or implement conservation actions. However, we recommend focusing conservation actions on maintaining and improving existing native, unplowed prairie. We encourage managing for a heterogeneous grassland structure, i.e. requirements for each of the Species, than focusing solely on requirements of just one of the Species. In many cases, there's overlap in habitat occupancy and preference, so managing for a variety of conditions in large patches (>150 ha) across the landscape will ensure potential habitat is available for the Species expected in a given geography each year. Appendices G through N provide a comprehensive summary of the state of the knowledge of each species, which can be used by readers to identify where on the landscape specific information is lacking. Additionally, we recommend utilizing partnerships, specifically bird habitat Joint Ventures, to develop and/or update/refine conservation planning tools to identify where on the ground conservation actions would provide the greatest benefit for grassland conservation and the Species.

This strategy also does not provide significant "on the ground" habitat management recommendations, although this need is an identified high priority conservation action in Appendix A. However, the species accounts in Appendices O-R provide general management recommendations at a broad scale and can be used as documents for engaging with public and private land owners and land managers. Recommended management practices are best developed at local scales (state or state/BCR). Such recommendations should be developed by teams of grassland and habitat management experts from different geographies as goals and objectives for the Species and the reality of management opportunities vary widely. Further, information is limited in many areas of the annual cycle of these species, especially the non-breeding season. In some parts of the annual cycle, especially on the wintering grounds, there is little information available such that we are not able to provide conservation recommendations beyond protect and enhance existing native grasslands (e.g., reduce shrub encroachment, maintain native grass

Table 3. Migratory and resident bird species that could benefit from conservation actions targeting the Species. Full-annual Cycle refers to breeding, migration and winter period for migrant species, or is inclusive of habitat used by resident species throughout the annual cycle.

Common (Bird) Name	*Scientific Name*	*Season*
Northern Bobwhite	*Colinus virginianus*	Full-annual Cycle
Scaled Quail	*Callipepla squamata*	Full-annual Cycle
Ring-necked Pheasant	*Phasianus colchicus*	Full-annual Cycle
Sharp-tailed Grouse	*Tympanuchus phasianellus*	Full-annual Cycle
Greater Prairie-Chicken	*Tympanuchus cupido*	Full-annual Cycle
Lesser Prairie-Chicken	*Tympanuchus pallidicinctus*	Full-annual Cycle
Northern Harrier	*Circus cyaneus*	Full-annual Cycle
Swainson's Hawk	*Buteo swainsoni*	Breeding
Ferruginous Hawk	*Buteo regalis*	Full-annual Cycle
Mountain Plover	*Charadrius montanus*	Full-annual Cycle
Upland Sandpiper	*Bartramia longicauda*	Breeding, Migration
Long-billed Curlew	*Numenius americanus*	Full-annual Cycle
Burrowing Owl	*Athene cunicularia*	Full-annual Cycle
Short-eared Owl	*Asio flammeus*	Full-annual Cycle
Common Nighthawk	*Chordeiles minor*	Breeding, Migration
Horned Lark	*Eremophila alpestris*	Full-annual Cycle
Vesper Sparrow	*Pooecetes gramineus*	Full-annual Cycle
Lark Bunting	*Calamospiza melanocorys*	Full-annual Cycle
Savannah Sparrow	*Passerculus sandwichensis*	Full-annual Cycle
Grasshopper Sparrow	*Ammodramus savannarum*	Full-annual Cycle
Bobolink	*Dolichonyx oryzivorus*	Breeding, Migration
Eastern Meadowlark	*Sturnella magna*	Full-annual Cycle
Western Meadowlark	*Sturnella neglecta*	Full-annual Cycle
Brewer's Blackbird	*Euphagus cyanocephalus*	Full-annual Cycle

in large patches). Information is needed in order to develop specific habitat management recommendations for the wintering grounds. However, assessment and synthesis of existing habitat management recommendations, incorporating information from recent and ongoing studies, is a critical next step to providing updated, science-based guidance on the breeding grounds.

Benefits to Other Species of Wildlife

The goal of this strategy is to improve the population status of the Species through on the ground conservation actions. Implementing conservation actions for the Species could also benefit a suite of other birds and mammals, including species of conservation concern and game species (Table 3). It should be noted that due to the life history of the Species (e.g., area sensitivity and specific habitat requirements), management for other birds and mammals many not provide similar benefits to the Species.

Table 3. Migratory and resident bird species that could benefit from conservation actions targeting the Species. Full-annual Cycle refers to breeding, migration and winter period for migrant species, or is inclusive of habitat used by resident species throughout the annual cycle. *(continued)*

Common (Mammal) Name	*Scientific Name*	*Season*
Mule Deer	*Odocoileus hemionus*	Full-annual Cycle
White-tailed Deer	*Odocoileus virginianus*	Full-annual Cycle
Pronghorn	*Antilocapra americana*	Full-annual Cycle
Swift Fox	*Vulpes velox*	Full-annual Cycle
Black-footed Ferret	*Mustela nigripes*	Full-annual Cycle
White-tailed Prairie Dog	*Cynomys leucurus*	Full-annual Cycle
Black-tailed Prairie Dog	*Cynomys ludovicianus*	Full-annual Cycle

Conservation Targeting Strategies Using Decision Support Tools

Migratory bird Joint Ventures commonly use a biological model-based approach to decision support for conservation programs. Selected models are based on research that demonstrates a strong linkage between habitat characteristics and species occurrence or abundance. The models are updated as new population monitoring and habitat information becomes available, demonstrating the iterative, adaptive approach that is the foundation of Strategic Habitat Conservation. Several conceptual and data-driven empirical grassland bird distribution models have been developed for species breeding in the Northern Great Plains and wintering in the Chihuahuan Desert. Decision-support tools are derived from species distribution models by integrating the spatial model with specific information about planned conservation actions and are used to determine the amount, type, or location of conservation treatments.

5.3 Breeding Conceptual Models

Grassland Bird Conservation Areas

Grassland Bird Conservation Areas (GBCAs) are priority areas for grassland protection and enhancement that are thought to provide suitable habitat for many priority grassland bird species in portions of the U.S. Northern Great Plains. GBCAs identify habitat based on sensitivity of many species of grassland birds to patch size and landscape structure. A conceptual model for GBCAs was first described by Sample and Mossman (1997) and recommended for the U.S. PPR by Partners in Flight (Fitzgerald et al. 1998, 1999). All GBCAs consist of a grassland core with a surrounding 1600m wide matrix. Core areas are at least 95% grassland, at least 50 m from woody vegetation, and may contain up to 30% wetland habitat. GBCAs have been defined at 3 levels (i.e., types) to address the needs of breeding grassland species with different area requirements (Figure 24). Each type is differentiated on the basis of size, width, amount of grass in the landscape, and the types of wetlands considered compatible (e.g., temporary wetlands are considered compatible for all GBCA types because they are typically dry for much of the nesting season). Species-specific empirical grassland bird models provide similar predictions to GBCAs about the distribution of area-sensitive grassland bird species that require large, contiguous blocks of grassland in grassland-rich landscapes (Niemuth et al. 2005, Johnson et al. 2010).

Type 1 – at least 260 ha of grassland at least 1600m wide. Matrix and core are at least 40% grassland.

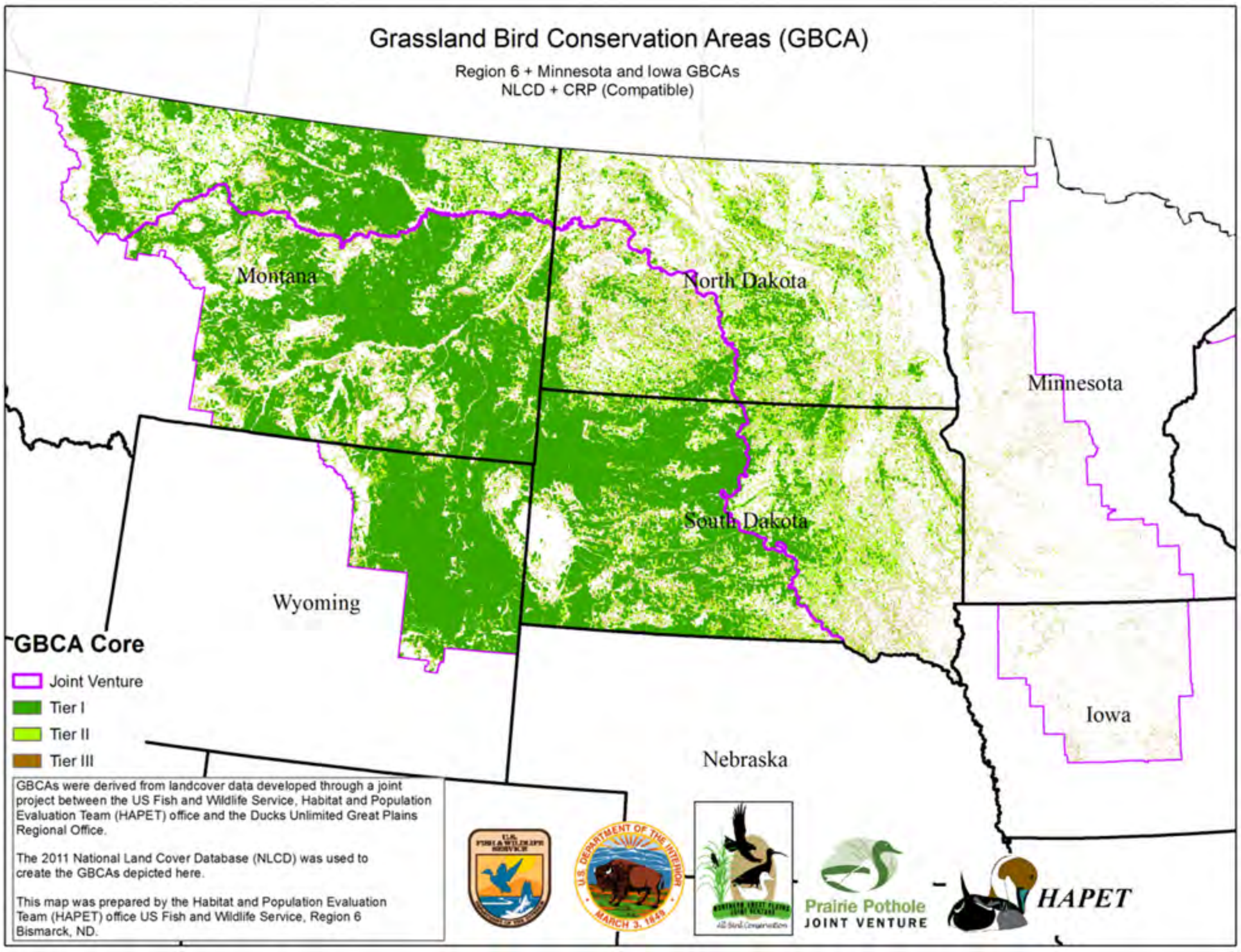

Figure 24. Grassland Bird Conservation Areas (GBCAs) were developed from a conceptual model that identifies contiguous blocks of grassland bird habitat. The three core sizes correspond to differing levels of area sensitivity in grassland birds (Johnson et al. 2010).

Type 2 – at least 65 ha of grassland at least 800m wide. Matrix and core are at least 30% grassland.

Type 3 – at least 22 ha of grassland at least 400 mile wide. Matrix and core are at least 20% grassland.

Type 3 GBCAs are combined with empirical breeding duck density and distribution models to identify areas across the Prairie Pothole Joint Venture (PPJV) landscapes that are priority areas for both bird groups. Although limited funds are available for grassland bird habitat conservation, this decision-support tool provides an integrated approach that allows funding for breeding waterfowl to be leveraged to benefit breeding grassland birds.

Breeding Empirical Models

Species-specific empirical models relating grassland birds to their habitats at landscape scales have been developed in the Northern Great Plains using data from various sources (Table 4). These models cover different geographic extents and inform conservation for different subsets of the Species. Table 4 provides an abbreviated list of models that have been completed for the Species.

Breeding Range-wide Distribution Models

A Sprague's Pipit distribution model was developed by Lipsey et al. (2015) in cooperation with the University of Montana and Canadian and U.S. partners. Point count data collected from various sources

Table 4. Priority landbird species models used to guide conservation in the Northern Great Plains. Model type, geographic extent and model source are listed for each species.

Source	*Species*	*Geographic Extent*	*Model Type*
Drum et al. (2015)	Baird's Sparrow	PPJV	Abundance
	Chestnut-collared Longspur	PPJV	Abundance
	Sprague's Pipit	PPJV	Occurrence
Lipsey et al. (2015)	Baird's Sparrow	Breeding range-wide	Occurrence
	Chestnut-collared Longspur	Breeding range-wide	Occurrence
	McCown's Longspur	Breeding range-wide	Occurrence
	Sprague's Pipit	Breeding range-wide	Occurrence
Niemuth et al. (2017)	Sprague's Pipit	U.S. Northern Great Plains	Occurrence
Fedy et al. (2018)	Baird's Sparrow	PHJV	Occurrence
	Chestnut-collared Longspur	PHJV	Occurrence
	McCown's Longspur	PHJV	Occurrence
	Sprague's Pipit	PHJV	Occurrence
B. Robinson (unpubl. data)	Baird's Sparrow	PHJV	Density
	Chestnut-collared Longspur	PHJV	Density
	McCown's Longspur	PHJV	Density
	Sprague's Pipit	PHJV	Density

between 2007 and 2012 were used in an integrated analysis across the entire breeding range. The model was developed to inform the species status assessment for the petition to list the Sprague's Pipit under the Endangered Species Act. The modeling effort represents the first successful attempt at building an international model for non-game species between Canadian and U.S. partners in the PPR. Similar techniques were used to create breeding range-wide distribution models for the other three priority grassland bird species (Figure 25, after Lipsey et al. 2015).

U.S. Breeding Distribution Models

Niemuth et al. (2005, 2008, 2017) used stop-level data from the BBS in conjunction with environmental data to model the distribution of several species of grassland birds (including Sprague's Pipit) in the U.S. Northern Great Plains. The authors used relationships derived from models to develop spatially explicit decision-support tools, which are used extensively to target areas for conservation treatments and assess conservation actions for multiple conservation programs and joint ventures (e.g., Prairie Pothole, Rainwater Basin, and Northern Great Plains joint ventures) in the U.S. Northern Great Plains (Figure 26). This process has also been used to develop abundance models for some species of grassland birds in the Northern Great Plains.

U.S. PPR Breeding Distribution Models

Drum et al. (2015) developed grassland bird models to estimate breeding pair abundance for several grassland passerine species. These models used data from 100 m fixed-radius point counts collected during May/June 2003–2005 (Quamen 2007) and were analyzed using 2005 landcover data to develop grassland bird models separately for the tallgrass and mixed-grass ecoregions of the PPJV. The ecoregions were analyzed separately due to the ecological differences in land use and landcover, climate, and breeding range for the modeled species.

Canadian PPR Breeding Distribution Models

Fedy et al. (2018) developed distribution models for 10 grassland songbird species to estimate probability of occurrence throughout the Canadian portion of the Prairie Pothole Region. These models related counts from BBS data to spatial covariates including landcover type and the amount of open water surrounding BBS stop locations at various spatial scales. They ranked the landscape in terms of conservation priority based on the number of species with >75% predicted probability of occurrence (Figure 27).

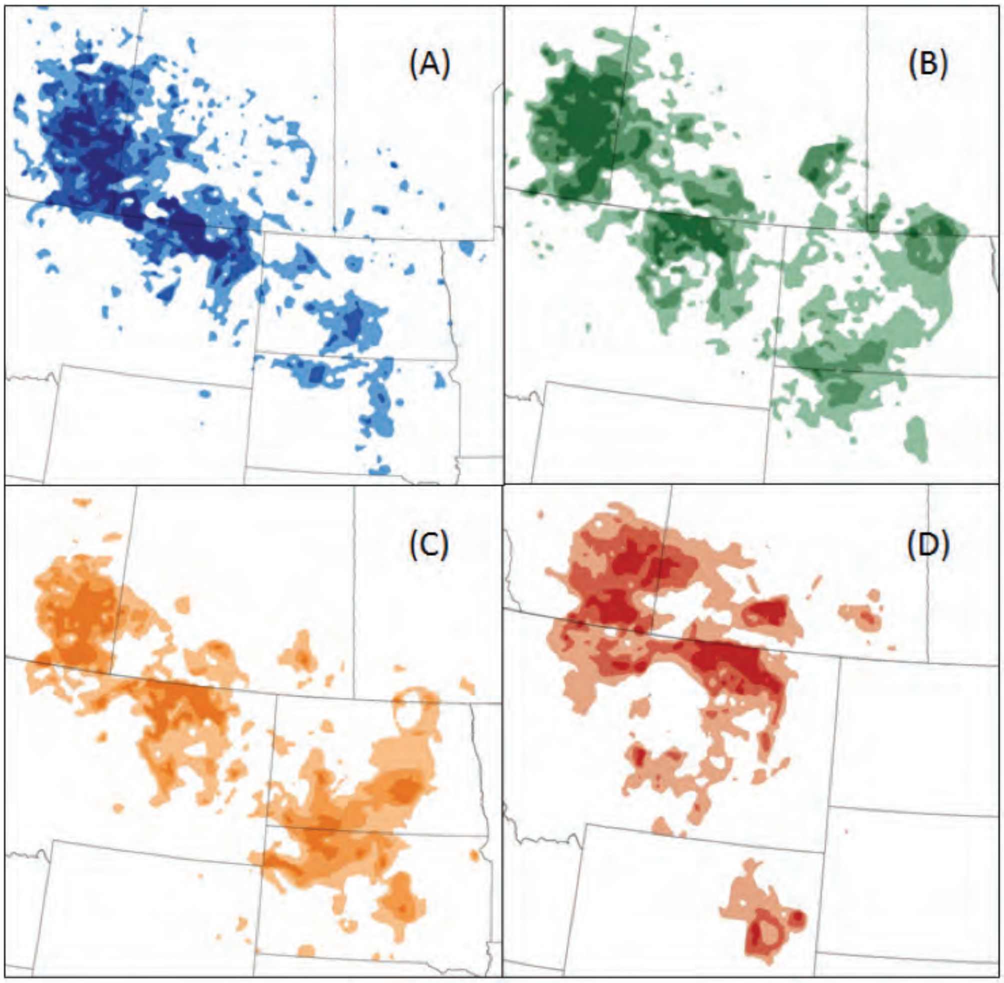

Figure 25. Predicted breeding population cores for the four grassland songbirds of concern; (A) Sprague's Pipit, (B) Baird's Sparrow, (C) Chestnut-collared Longspur, (D) McCown's Longspur. Deepest colors represent 25% population core, middle shade represents 50% population core, lightest shade represents 75% population core (Lipsey 2015).

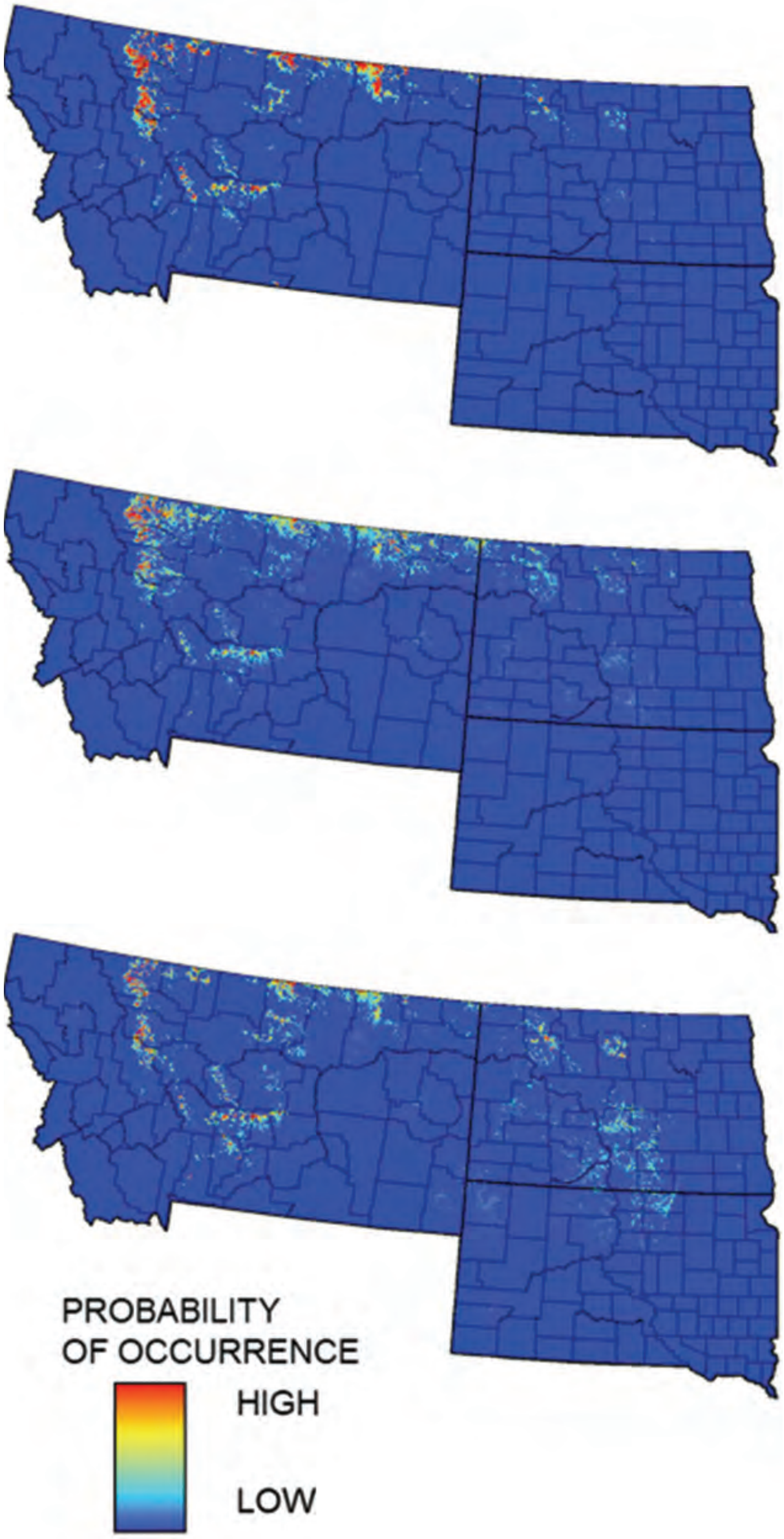

Figure 26. Spatial models of Sprague's Pipit (top), Baird's Sparrow (middle), and Chestnut-collared Longspur (bottom) occurrence in Montana, North Dakota, and South Dakota provides a foundation for evaluating populations, assessing threats, and guiding conservation in the PPJV relative to a broader landscape (Niemuth et al. 2017).

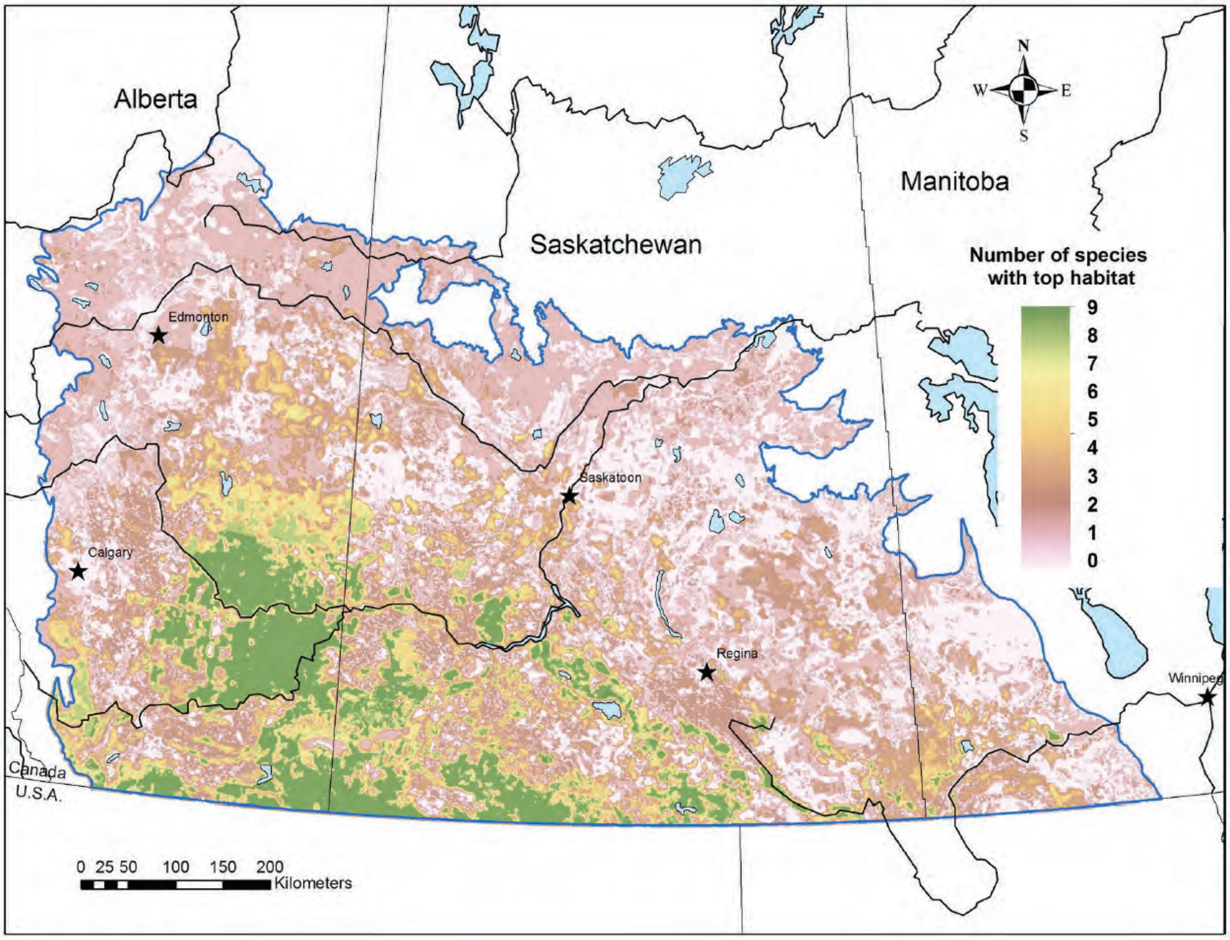

Figure 27. Combined >75% predicted probability of occurrence for 10 grassland songbird species, including the Species, throughout the Canadian portion of the Prairie Pothole Region (Fedy et al. 2018).

The CWS is in the process of producing spatial density models for a number of prairie landbirds, including the Species targeted in this conservation strategy (B. G. Robinson unpubl. data). The models are based on count data from >100,000 point counts collected by academia, provincial and federal biologists, and NGOs. Spatial covariates used in the models include landcover type, NDVI, Topographic Wetness Index, and easting and northing coordinates. These models will predict spatial variation in the density of singing males throughout the Canadian Prairie Pothole Region.

5.4 Wintering

In 2002, the Commission for Environmental Cooperation (CEC) and The Nature Conservancy initiated a process to identify priority areas for conservation in the North American grasslands (CEC and TNC 2005). The resulting Grassland Priority Areas for Conservation (GPCA) were refined by Pool and Panjabi (2011). The significance of the GPCAs was further ascertained by assessing their importance for 20 priority grassland bird and mammal species, resulting in the identification of 55 GPCAs across the central grasslands from Canada to Mexico (Figure 28). The original GPCAs and the process used to define them are further described by CEC and TNC (2005). Pool and Panjabi (2011) solicited revisions to the GPCA network, adding four new GPCAs in Mexico and expanding the boundaries of several others.

The Chihuahuan Desert Grassland Bird Conservation Plan (Pool et al. 2012) includes species-habitat relationships and winter distribution models throughout the southern GPCAs for all of the Species

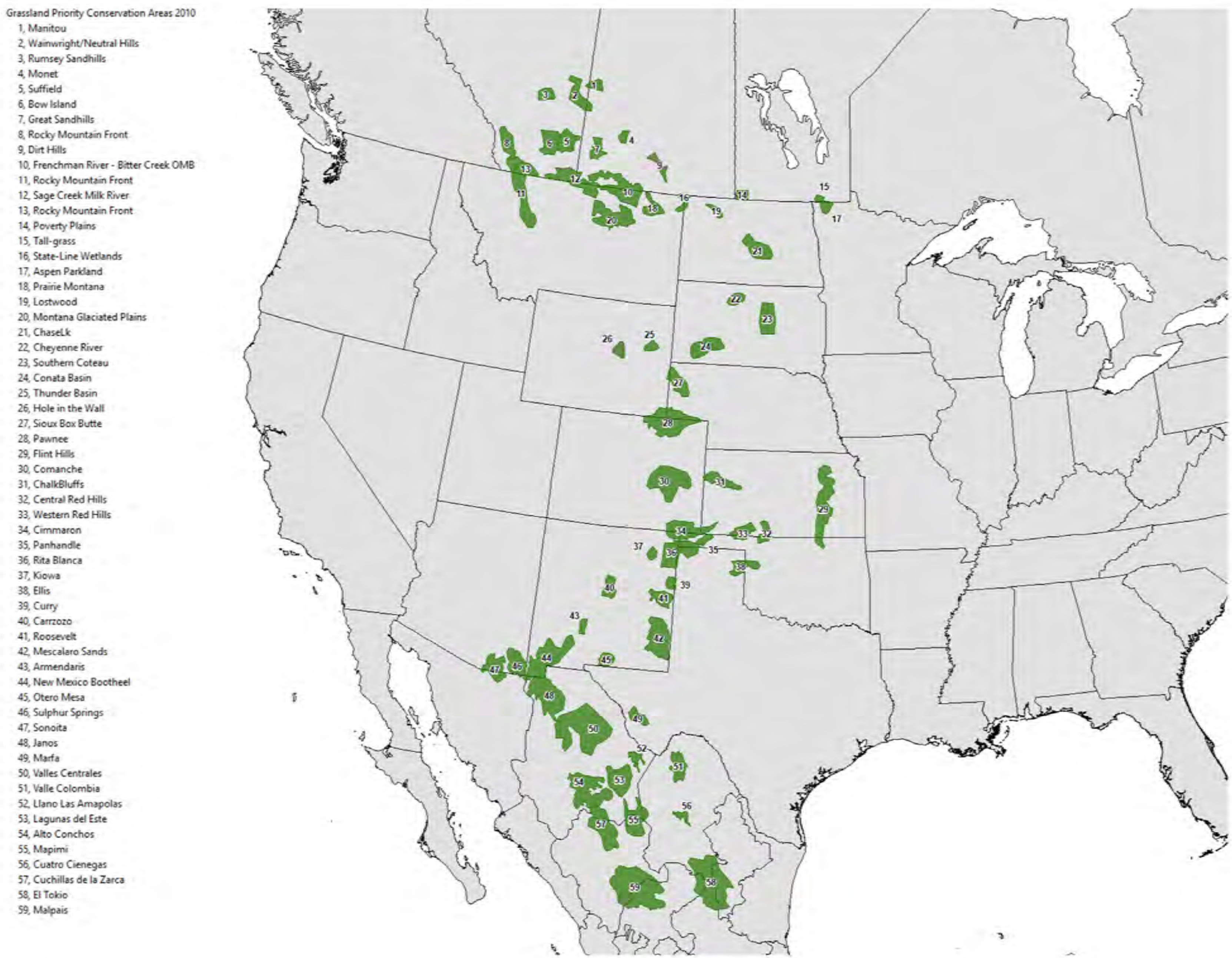

Figure 28. Grassland Priority Conservation Areas (Pool and Panjabi 2011).

except McCown's Longspur (Figure 29). The report includes tools for habitat treatment for each species' optimal response. Recommended conservation actions include protection of functioning grasslands, shrub removal in appropriate areas, alteration of grazing regimes, and restoration of degraded lands.

Figure 29. Grassland Priority Conservation Areas in the Chihuahuan Desert (CEC and TNC 2005, Pool and Panjabi 2011) and wintering grassland bird sampling blocks surveyed in 2011. Green shading shows the extent of desert grasslands (Pool et al. 2012).

Chapter 6. Monitoring and Assessment

6.1 Measuring Success – Outputs vs. Outcomes

Accomplishments related to habitat, such as area of grassland protected and restored (i.e., conservation outputs), are often used to measure conservation success for priority grassland species. However, conservation accomplishments may not accurately reflect success when goals and objectives relate to measures of population performance. Alternatively, population responses to conservation delivery (i.e., biological outcomes) are generally more appropriate to gauge success of species-specific conservation strategies. The need exists to describe accomplishments related to habitat with accomplishments related to biological outcomes to elucidate population performance issues that are disconnected from habitat conservation. For example, negative effects of climate change and pesticide accumulation on passerine food availability and resulting impacts to survival will not be detected if only accomplishments related to habitat are used to gauge success. Being able to identify and measure strategic conservation objectives as they relate to population performance (e.g., demographics, population trends) is an important aspect of this strategy. This strategy will focus to inform habitat conservation delivery and policy decisions to ultimately support healthy populations of the Species and reduce the possibility that these priority birds require specialized protection.

6.2 Population Trend Objectives

The 2004 Partners in Flight North American Landbird Conservation Plan (PIF NALCP) (Rich et al. 2004) was the first attempt to identify priority species of continental importance and establish population estimates and objectives. The PIF NALCP was revised in 2016 (Rosenberg et al. 2016), reassessing the vulnerability of 448 species of North American landbirds and recommending high priority landbird conservation actions.

Beginning in 2009, the U.S. North American Bird Conservation Initiative (NABCI) Committee has produced the State of the Birds (SOTB); the first of which was to provide a comprehensive analysis of the state of U.S. bird populations (North American Bird Conservation Initiative 2009). Subsequent reports have focused on key issues, such as climate change and private lands conservation. In 2016, the SOTB report expanded to include a comprehensive analysis of the state of all the birds of North America (North American Bird Conservation Initiative 2016). The report included birds of highest conservation concern occurring in Canada, the U.S., and Mexico, derived largely from the Avian Conservation Assessment Database (https://www.partnersinflight.org/what-we-do/science/databases/). The PIF Watch List, derived from the same database, is used to help inform the SOTB reports and includes many of the species listed under SARA in Canada and the ESA in the U.S., additional species that require immediate conservation attention, and others on or near the brink of being threatened that warrant continued vigilance. The 2016 PIF NALCP relies on the PIF Watch List to identify priority landbird species of continental importance (Table 5) and the PIF Population Estimates Databases (PIF Science Committee 2013) is maintained for estimates of landbird populations published in the plan. The population estimates allow direct step-down of continental population objectives to regional (e.g., Bird Conservation Regions, state/province) objectives by applying the continental objective against the regional population estimate. Although Bird Conservation Regions (BCR; Figure 30) objectives offered a starting point for the development of regional habitat-based conservation approaches, continental objectives might not be appropriate at smaller geographic scales if differences in population trends are occurring at those extents. Further, regional habitat trends also may differ substantially from continental trends. Basing objectives on reducing local declines may be necessary to maintain stable populations at the larger geographic scales over the long term. This is particularly true when it remains unclear what segment of the annual cycle (i.e., breeding, migration or wintering) is the predominant driver of observed trends in priority grassland bird population data.

The 2016 PIF NALCP provided guidance on developing population objectives for priority species and highlighted an approach to allocate trend-based population objectives by BCR. The breeding ranges of the Species addressed in this conservation strategy include portions of five BCRs, each with differing population trends and a different amount of breeding habitat. Over the 30 year period from 2016-2046, the 2016 PIF NALCP objective for the priority species is to reduce the rate of decline in the first 10 years and then stabilize and ultimately increase the 2016 population size by 5% to 15% as measured by the BBS. The objectives recognize population declines will continue over that first 10 year period before those declines are slowed, halted, or reversed for each species (Table 6).
For each species, applying a uniform population trend goal for every region is not reasonable due to the differences across BCRs. Alternatively, applying a range of trend goals by BCR to balance the positive and negative trends, is a more reasonable approach to achieve stable populations (Figure 31). Habitat objectives can be estimated based on breeding density estimates per unit suitable habitat area in the region (Table 7). The approach represents a logical alternative to developing BCR-specific population goals that can be stepped down to habitat goals. Meeting trend-based population objectives for priority species requires maintaining or increasing the amount of suitable habitat or improving the quality of habitats already protected where breeding can successfully occur. In light of the current rates of habitat loss, these objectives will be difficult to achieve without strategic targeting of priority habitats for conservation actions.

Species	Vulnerability Factors						Loss	Urgency/ Half-Life (years)	Continental Threat	Regions of Highest Importance		Primary Breeding Habitat
	PS	Distribution		Threats		PT				Breeding	Wintering	
		BD	ND	TB	TN							
Sprague's Pipit							73%	27	A, R, E, I	11	36, 37, 35, 21, 34	Grassland
Chestnut-collared Longspur							85%	21	A, R, E, I	11, 17	35, 34	Grassland
McCown's Longspur							86%	> 50	A, R, E, I	11, 18, 17, 10	35, 21, 18, 34, 19	Grassland
Baird's Sparrow							72%	> 50	A, R, E	11	34	Grassland

Table 5. PIF Watch List population loss, vulnerability factors, threats, and regions of highest conservation importance for the Species (NALCP 2016). Vulerability Factor – Red: High; Orange: Moderately High; Yellow: Moderate. Continental Threats – A: Agricultural Conversion, R: Changing Rangeland Conditions, E: Energy/Resource Extraction, I: Invasive Species.

Species	Status 1970-2014		Objectives for 2016 - 2026		Objectives for 2016 - 2046		Federally Listed
	Loss	Trend	Pop'n Change	Annual Trend	Pop'n Change	Annual Trend	
Red Watch List Species - RECOVER							
all Red Watch List Species			25% to 35%	2.26% to 3.05%	75% to 100%	1.88% to 2.34%	[2]see footnote
Yellow R Watch List Species - PREVENT DECLINE							
all Yellow R Watch List Species			-3% to 3%	-.30% to .30%	-3% to 3%	-.10% to 0.0%	[2]see footnote
Yellow D Watch List Species - REVERSE DECLINE							
Sprague's Pipit	75%	-3.10%	-12% to -7%	-1.24% to -0.77%	5% to 15% for all Yellow D Watch List species	0.16% to 0.47% for all Yellow D Watch List species	CA
Chestnut-collared Longspur	85%	-4.25%	-16% to -10%	-1.70% to -1.06%			CA
McCown's Longspur	94%	-6.12%	-22% to -14%	-2.45% to -1.53%			CA
Baird's Sparrow	71%	-2.74%	-10% to -7%	-1.10% to -0.69%			CA*

[1]reflects federally listed bird species as of April 2016, CA = listed in Canada, US = listed in the United States, ^ = listed only in part of its range,
** = assessed by COSEWIC and qualified for listing but not yet legally protected under the Species at Risk Act at the time of this report's publication.*

Table 6. Population trends and objectives for PIF Watch List species (NALCP 2016).

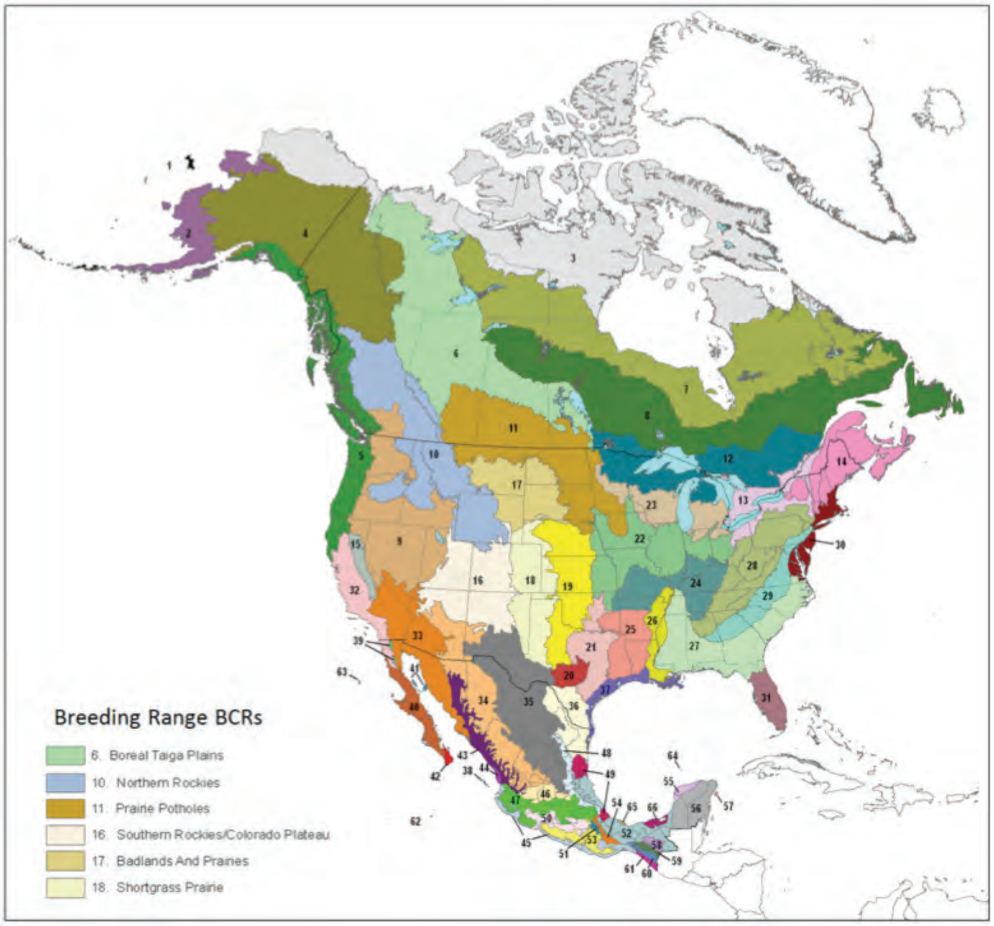

Figure 30. Bird Conservation Regions of North America. Adapted from Bird Studies Canada and NABCI (2014). Only the BCRs encompassing the Species breeding range with PIF population estimates are listed in the legend. See original map for full list of BCR names.

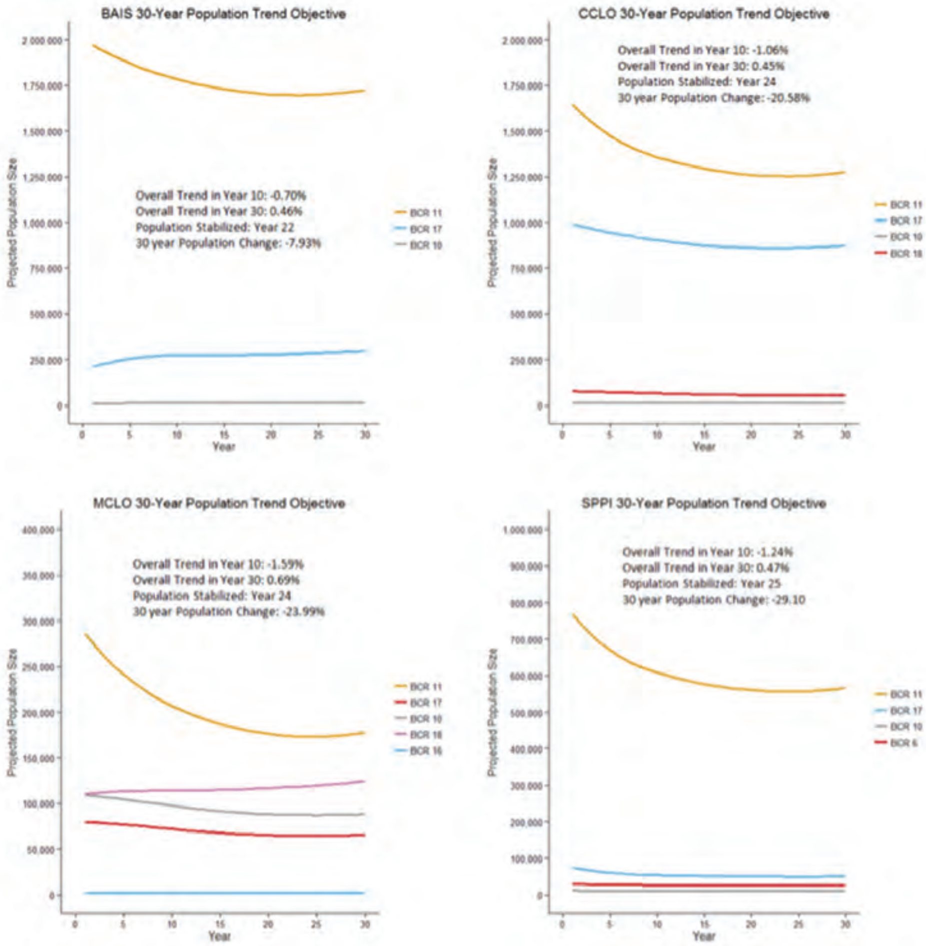

Figure 31. Population trend objectives for the Species Species abbreviations: SPPI - Sprague's Pipit; CCLO - Chestnut-collared Longspur; MCLO - McCown's Longspur, BAIS - Baird's Sparrow. (Rosenberg et al. 2016).

Species	BCR	BBS Population Estimate	BBS Population Trend 2005-2015 (%)	10 yr Population Trend Objective (%)	30 yr Population Trend Goal (%)	Density (birds per acre)	Net loss of birds	Estimated Acres to Achieve 10-yr Trend	Acre Objectives Notes
BAIS	11	2,000,000	-1.55	-0.80	0.40	0.1	73,004	730,039	Needed Gains
	17	200,000	7.02	0.00	0.80	0.1	121,726	1,217,260	Allowable Losses
	10	8,000	14.28	0.00	0.00	0.1	16,356	155,917	Allowable Losses
SPPI	11	800,000	-1.56	-1.30	0.50	0.08	98,633	1,232,914	Needed Gains
	17	80,000	-7.35	-1.00	0.25	0.08	16,598	207,481	Needed Gains
	10	12,000	-1.56	0.00	0.40	0.08	928	11,606	Needed Gains
	6	30,000	-1.53	-0.77	0.20	0.08	1,112	13,899	Needed Gains
CCLO	11	1,700,000	-3.47	-1.20	0.50	0.35	111,263	317,895	Needed Gains
	17	1,000,000	-1.28	-0.80	0.42	0.35	23,786	67,960	Needed Gains
	10	13,000	0	0.00	0.00	0.35	0	-	Stable
	18	80,000	-1.77	-1.77	0.00	0.35	0	-	Stable
MCLO	11	300,000	-5.02	-2.50	0.80	0.05	27,884	557,678	Needed Gains
	17	80,000	-0.42	-1.53	0.47	0.05	4,579	91,571	Allowable Losses
	10	110,000	-0.81	-1.53	0.47	0.05	25,692	513,840	Needed Gains
	18	110,000	0.85	0.00	0.80	0.05	5,439	108,772	Allowable Losses
	16	2,000	0	0.00	0.00	0.05	0	-	Stable

Table 7. BCR-based population trend objectives for the Species based on 2005-2015 BBS trends (Rosenberg et al. 2016, Sauer et al. 2017). Species abbreviations: SPPI - Sprague's Pipit; CCLO - Chestnut-collared Longspur; MCLO - McCown's Longspur, BAIS - Baird's Sparrow.

6.3 Systematic Population Monitoring Programs Across the Annual Cycle

Monitoring programs for population abundance and trends exist at different geographic scales across the life-cycle for the Species. These programs employ a range of approaches, from citizen-centered programs to academia-based research and can provide measures of success towards population objectives.

Breeding

Several monitoring programs for breeding-ground populations are conducted for the Species including the North American BBS, Integrated Monitoring in Bird Conservation Region (IMBCR), and state-based surveys.

The North American Breeding Bird Survey

The BBS is a long-term, large-scale, international avian monitoring program initiated in 1966 (1967 west of the Mississippi River) to track the status and trends of North American bird populations (Bystrak 1981). The BBS is the primary source of information regarding populations of many North American bird species. Observers record all bird species seen and heard within 400 m of each of 50 stops, or survey points, located 800 m apart along 40 km routes, with routes constrained to secondary roads (Sauer et al. 2013). Routes are run once each year at the height of the breeding season; surveys begin one-half hour before sunrise and continue until the route is completed, with a three-minute stationary count period at each stop (Sauer et al. 2013). Each survey typically requires 4-4.5 hours to complete.

Because the BBS is a roadside survey, concerns have been expressed that routes do not represent the surrounding landscape. However, landscape analyses indicate that the BBS accurately represents most surrounding land-cover types, although landscapes immediately adjacent to BBS routes are somewhat more fragmented than the general landscape (Niemuth et al. 2007, Veech et al. 2012).

The widespread distribution of BBS routes (Figure 32), large number of routes that are surveyed each year, and the long timeframe over which BBS data have been collected enable trend analyses at multiple time and spatial scales, as well as comparisons among geographic regions. These factors, along with the consistent sampling framework and variety of habitat types and land uses that the BBS encounters, make BBS data valuable for developing spatial models as well as monitoring avian population trends (Niemuth et al. 2005, Thogmartin et al. 2006, Sauer et al. 2013).

A power analysis was conducted to assess the ability of the BBS to detect the Species population declines over a consecutive two-year period. Breeding range-wide BBS data from 2015-2016 were analyzed in R package simR using Monte Carlo simulations to estimate the power to detect three different levels of population declines. For all species except McCown's Longspur, BBS data has sufficient statistical power (β = 80%, significance of α = 0.05) to detect a 10% population decline in consecutive years (Table 8). Simulation models for McCown's Longspur did not converge, most likely due to the small population size and limited number of BBS routes within the species' breeding range, resulting in relatively few observations.

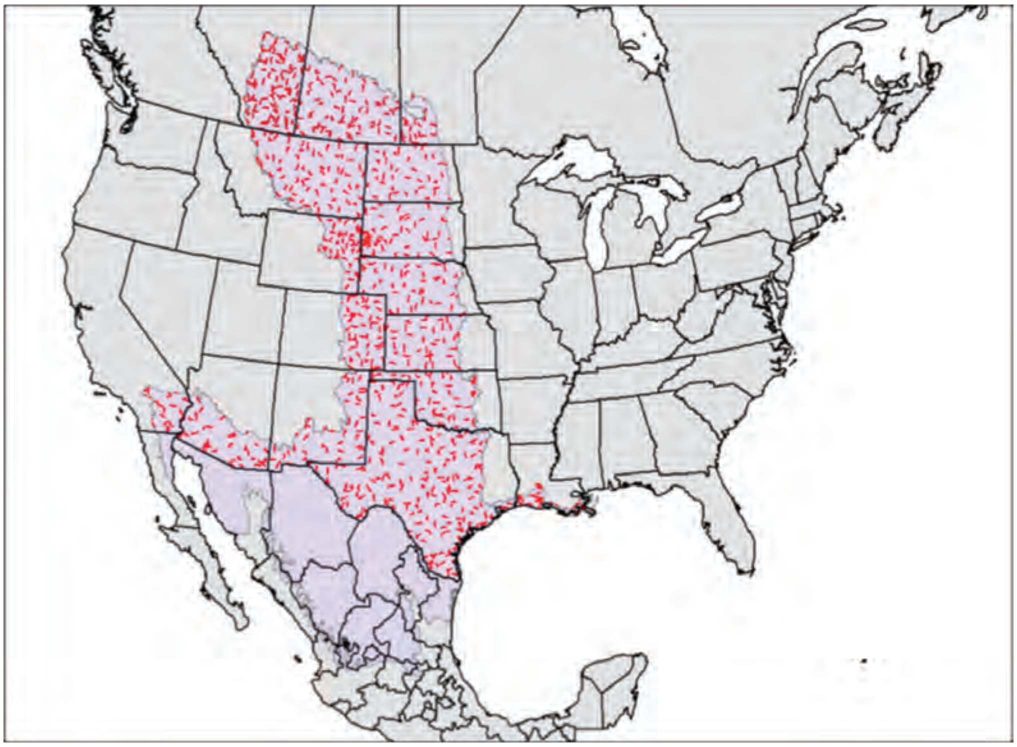

Figure 32. Breeding Bird Survey routes (red lines, n = 1055) located within the primary annual cycle geography (purple area) of the Species.

Table 8. Statistical power to detect breeding range-wide population declines using BBS data from 2015-2016 with a significance of $\alpha = 0.05$.

Species	*PIF Population Estimate (2013)*	*Number of Routes* [a]	*Population Decline (i.e., Effect Size)*		
			-5%	-7%	-10%
Sprague's Pipit	900,000	233	60.9%	78.7%	94.9%
Chestnut-collared Longspur	2,800,000	262	90.1%	96.9%	99.2%
McCown's Longspur [b]	600,000	281	-	-	-
Baird's Sparrow	2,200,000	179	58.9%	76.2%	93.7%

[a] number of routes within the BBS derived distribution for species-specific relative abundance analysis (see Sauer et al. 2017)

[b] Model simulations for McCown's Longspur did not converge with 2 or more years of data, likely due to small population size resulting in few observations

Integrated Monitoring in Bird Conservation Region

Integrated Monitoring in Bird Conservation Regions (IMBCR) was developed by the Bird Conservancy of the Rockies to address proposed improvements needed in avian monitoring as identified by the NABCI (U.S. North American Bird Conservation Initiative Monitoring Subcommittee 2007). Bird conservation partners in the western United States have collaborated to implement this broad-scale, all-lands monitoring program since 2008. The program has expanded its survey area in each subsequent year (Figure 33).

The IMBCR program provides population density and species occupancy estimates across a range of geographic extents through a series of point-count surveys at locations determined using a Generalized Random Tessellation Sampling (GRTS; Stevens and Olsen 2004). GRTS allows sampling locations to be chosen at random while maintaining a survey effort that is spatially balanced across multiple scales.

During the height of the breeding season, birds are surveyed from a grid of 16 points, arranged in a 4×4 matrix and spaced 250 m apart, during a 6 minute time frame. Surveys begin and end on the same day for each sampling unit. Observers record distances to each bird and the 1 minute interval during which each bird was detected. Surveys are conducted by paid field technicians who receive six or more days of training prior to beginning of sampling. Data collected are used to estimate occupancy rates at two spatial scales using a removal design (MacKenzie et al. 2006) and density using distance-sampling theory (Buckland et al. 2001).

Recently, IMBCR partners moved to a Bayesian analysis framework through which points would be the replicates and not grids. This would allow the program to include non-grid surveys, including single points, in IMBCR. This also will allow inferences to be made at much smaller scales than the 1 km^2 grid cells under the IMBCR program and will allow for the evaluation of avian response to habitat enhancement projects occurring on small parcels.

Strengths of the IMBCR program include a statistically rigorous design based on random sampling, a broad network of partners that support the program and its reach across many states and boundary lines, including public and private lands

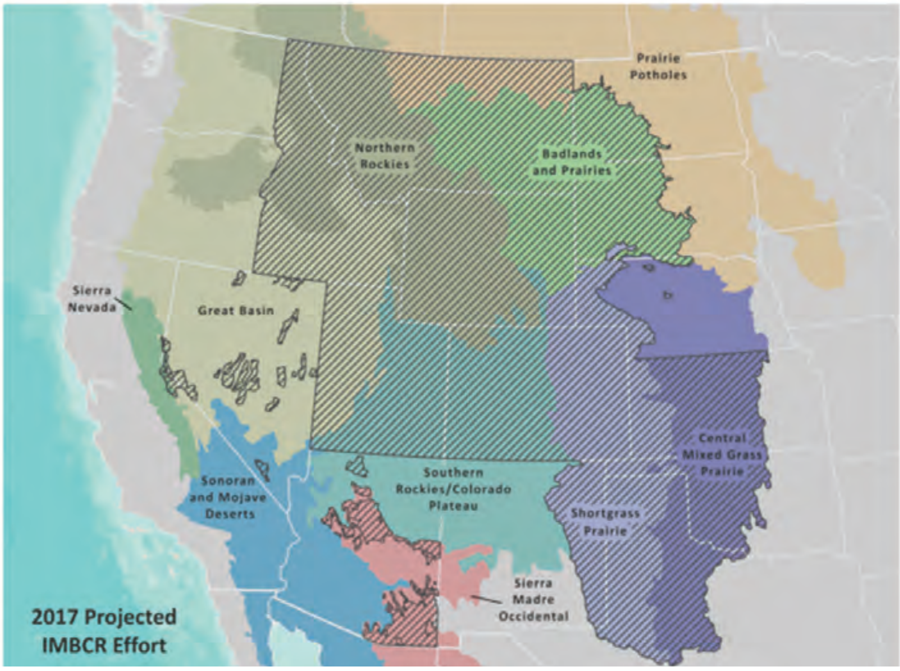

Figure 33. IMBCR survey effort during the 2017 survey season.

(White et al. 2016). The design and broad partnership allow the IMBCR program to address the following conservation objectives identified by the North American Bird Conservation Initiative Monitoring Subcommittee (2007) through the produced occupancy and density estimates, habitat modeling, and production of predictive distribution models: (1) determine status and trends, (2) inform management and policies to achieve conservation, (3) determine causes of population change, (4) evaluate conservation efforts, (5) set population objectives and priorities, and (6) inform conservation design.

Currently, there is no monitoring program equivalent to IMBCR in Canada. The Canadian Wildlife Service is in the process of developing a grassland bird monitoring program for the Prairie Habitat Joint Venture delivery area, which will likely follow the IMBCR protocol.

Migration

eBird

Systematic monitoring programs for the Species during migration do not currently exist, although citizen science programs do track observations during all life-cycle phases. In 2002, a partnership between the Cornell Lab of Ornithology and the National Audubon Society launched eBird (http://ebird.org/), an online database that compiles international bird observations throughout the year from recreational and professional bird watchers. This free service has transformed bird checklist reporting and information accessibility for the birding community across the entire world. By extensively utilizing citizen science, eBird has developed an almost real-time avian monitoring resource that explores species' biological patterns and the factors that influence them through time (Sullivan et al. 2009).

Data input is facilitated by creating protocols that mimic the typical process of birding, which includes logging information such as date, location, species, and individuals observed (Wood et al. 2011). These basic data collected from around the world has shed substantial light on bird abundance and distribution at a variety of spatiotemporal scales, facilitating the development of species occurrence models related to environmental factors such as habitat, climate, and elevation. A resulting product of these statistical models are the predictions of bird abundance and distribution across the life-cycle–information that can then be utilized by ecologists to identify, prioritize, and strategy conservation across large-scale landscapes (Figure 34; Wood et al. 2011).

Wintering

Christmas Bird Count

The CBC was established by the National Audubon Society in 1900 as a citizen-centered program that harnesses the participation of tens of thousands of volunteers each winter for bird surveys across North America. Over the program's lifetime, the data have provided long-term health information and general population statuses of North American bird species during early winter, which creates a big picture visual of how bird populations have changed over time and space. These data have also informed conservation strategies focused on protecting birds and their habitats, while identifying potential environmental threats with implications for humans as well. CBC data have been utilized by reports such as the State of the Birds report (NABCI 2009), for the development of Audubon's Common Birds in Decline Report (Butcher and Niven 2007), and National Audubon Society's 2014 Climate Change Report (National Audubon Society 2015).

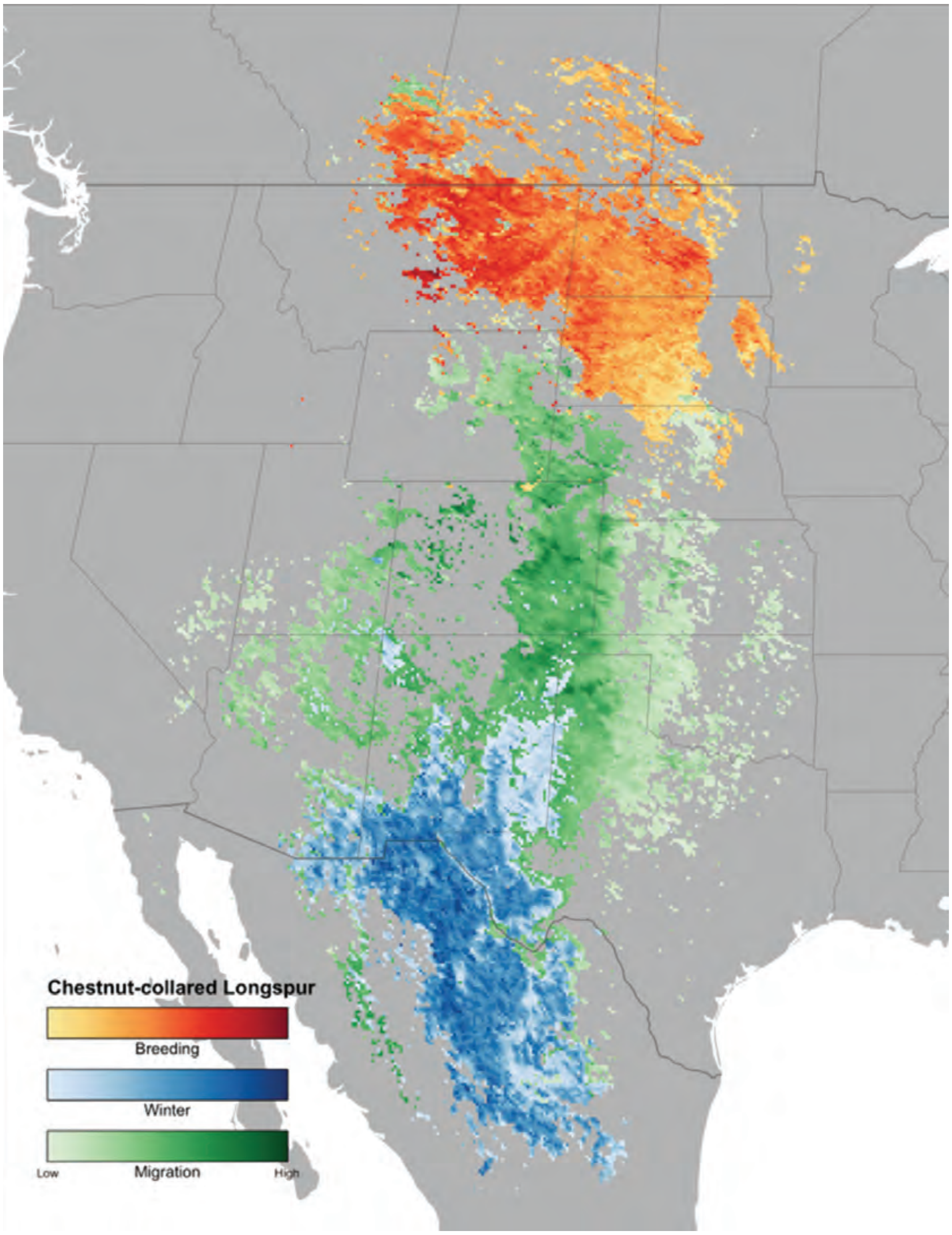

Figure 34. Chestnut-collared Longspur relative density and distribution across the annual life-cycle derived from eBird data (Cornell Lab of Ornithology 2017).

Chapter 7. Information Gaps

Although there is information about the Species, habitats, and effects of anthropogenic change, there is a general scarcity of key life history information across all parts of the annual cycle and the factors limiting populations are essentially unknown. Evidence suggests that loss and degradation of habitat, fragmentation of remaining grasslands, and disturbance inconsistent with needs of the Species are responsible for population declines. However, the direct effects of these variables and their interactions on demographic parameters are largely unknown. In spite of information gaps, the conservation community has broad scale information to continue implementing conservation actions that likely benefit the Species and the grassland community, including maintaining native, unbroken prairie, increasing patch size via restoring grasslands, and reducing and preventing degradation of grasslands on the landscape. We need to continue to improve monitoring, focus research and funding to the highest priority information and needs to inform conservation actions, and adapt our management planning and implementation as new information becomes available.

This chapter outlines some of the key information and knowledge gaps for the Species by season as research, inventory and monitoring, and conservation planning and implementation is typically conducted at a finite spatial and temporal scale and often aligns with the breeding, migration, or the non-breeding season. Appendix A, entitled, "Recommended Conservation Actions for Sprague's Pipit, Chestnut-collared Longspur, McCown's Longspur, and Baird's Sparrow" provides a framework that identifies and ranks priority information needs for the Species. It is intended as a guide for directing research programs and effectively allocating funding to address the critical information needs that will guide effective conservation actions and ideally mitigate declining trends in these bird populations.

Although this strategy identifies the highest priority information gaps for the Species, the strategy is not designed to provide specific local scale guidance for where and how to conduct research and monitoring or implement conservation actions. Appendices G through N provide a comprehensive summary of the state of the knowledge of each species, which can be used by readers to identify where on the landscape specific information is lacking. Additionally, we recommend utilizing partnerships, specifically bird habitat Joint Ventures, to develop and/or update/refine conservation planning tools to identify where on the ground conservation actions would provide the greatest benefit for grassland conservation and the Species.

7.1 The Breeding Season

Population estimates and trends are based on information collected solely on the breeding grounds. Uncertainty about population estimates and trends based on BBS data, including possible road side avoidance by the Species, needs to be thoroughly assessed. Information on species abundance, density, and trends need to be cross walked with other population monitoring programs such as IMBCR and others in order to assess local and large scale population changes and refine population estimates.

The current literature provides a basic

understanding of habitat use and preferences and landscape requirements for these Species during the breeding season. Information on bird response to habitat and landscape variables and management is often inconsistent, both spatially and temporally, likely a result of varying annual precipitation and grassland condition, indicating the need for more research to better understand the factors driving observed bird responses. In addition to abundance or density responses to various habitat and management variables, relatively few studies have attempted to relate grassland structure and estimates of abundance and/or density to key vital rates. Vital rates such as nest density, nest survival, number of fledglings per nest and adult and juvenile survival are critical to understanding conditions that sustain or increase populations (e.g., source populations), and should be the focus of research in order to inform management recommendations.

Research on habitat impacts on nesting demographics have primarily been studied via short-term projects of only a few years, which may not be long enough to assess vegetation and bird responses to different weather conditions. In addition, studies have been generally focused in a few locations for each species. As a result, there is little information on the Species across large portions of their breeding ranges with different grassland types, annual precipitation, landscape composition, and edaphic conditions. Data from one study may not be applicable outside a specific geographic region or across the entire range of a species, and regional information must be used appropriately for effective conservation. For example, McCown's Longspur has two distinct breeding populations: one in shortgrass prairie in southern Wyoming and northern Colorado, and one in mixed-grass prairie of Montana, Alberta, and Saskatchewan. The grasslands in these regions differ significantly and receive different amounts of average annual precipitation, which affects grassland condition and requires differing approaches to management to create preferred or optimal conditions.

For developing more effective conservation actions for the Species, an assessment of current conservation programs and practices and bird responses is needed. We recommend assessing bird utilization, e.g. occurrence, abundance, and density, nest density, nesting success, of restored grasslands (e.g., CRP) and how the Species respond at the landscape scale to restoration, not just on the restored pasture. Assessing bird response to conservation practices will help inform effective conservation planning at the landscape scale. In addition, a range wide reassessment of grassland conservation focal areas (e.g. GPCAs, GBCAs, and other identified areas of importance for grassland birds from decision support tools, among others) is warranted. The plethora of new information and population and density models may support modifying focal area boundaries or possibly even adding new focal areas.

In spite of the information need about vital rates and management needs, preventing further habitat loss, degradation, fragmentation, and disturbance incompatible with the requirements of the Species on the breeding grounds is critical.

7.2 The Non-breeding Season (Migration and Winter)

Information on migration routes, habitat preferences, landscape requirements, and survival estimates for the migratory and winter periods is largely unknown for three of the four species. Anecdotal documentation of habitat occupied during migration has been recorded, but little is known about habitat requirements. For instance, Sprague's Pipit and Baird's Sparrow are rarely detected during migration and are reported only in certain habitats, possibly because of very low detectability, difficulty in identifying these species during the nonbreeding season, or lack of effort surveying occupied habitats (Igl and Ballard 1999).

On the wintering grounds, there is information on habitat use and preferences for three of the Species on the GPCAs in the U.S. and Mexico. McCown's Longspurs are largely wintering outside the GPCAs and little is known about the habitats they are utilizing and their relative importance. Chestnut-collared Longspurs and Sprague's Pipits are also regularly found outside the GPCA's in the winter period, thus further research is needed on these species. Moreover, there is little known about habitat conditions that support high rates of overwinter survival and facilitate optimal physiological condition for northward migration and subsequent productivity (Marra et al. 1998, Norris and Taylor 2006, Cooper et al. 2015).

Demographic information, such as winter site fidelity and overwinter survival, are largely unknown for the non-breeding season, except for ongoing research that is providing such information on Baird's Sparrows and to a lesser extent, Sprague's Pipit. The ongoing work in the Chihuahuan Desert is providing estimates of Baird's Sparrow winter survival (e.g. Macías-Duarte et al. 2017, Strasser et al. 2018), although how management actions affect survival as well as survival during migration still remains understudied.

In spite of the information need about vital rates and management needs, preventing further habitat loss, degradation, fragmentation, and disturbance incompatible with the requirements of the Species on the wintering grounds is critical.

7.3 Recommended Management Practices

The aforementioned information is needed in order to develop and implement effective recommended management practices to provide the greatest benefits to the Species. We recommend assessing existing recommended management practices and develop, where possible or appropriate, state or BCR within state level recommendations that are specific and appropriate to local conditions (e.g., grassland type, edaphic conditions). Such recommendations should be developed by teams of local grassland and habitat management experts as goals and objectives for the Species and the reality of management opportunities vary widely.

Further, information is limited in many areas of the annual cycle of these species, especially the non-breeding season. As a result of significant information gaps in the non-breeding season, we are not able to provide conservation recommendations beyond protect and enhance existing native, unplowed grasslands (e.g., reduce shrub encroachment). Information is needed in order to develop specific habitat management recommendations for the wintering grounds and migration. However, assessment and synthesis of existing habitat management recommendations, incorporating information from recent and ongoing studies, is a critical next step to providing specific guidance on the breeding grounds.

7.4 Full Annual-Cycle Knowledge Gaps

The key information needs about the Species outlined above and in Appendix A support multiple functions. The information helps inform where and how to implement conservation actions to benefit the Species, but also provides needed information for the development of full-annual cycle integrated population models (IPMs). Full-annual cycle IPMs integrate seasonal demographic and environmental processes to elucidate the factors that limit population growth. IPMs are designed as tools used for both estimating demographic parameters and projecting population through time across the annual geography.

With more demographic information now available for several grassland bird species of concern, especially Baird's Sparrow, integrated population models are a feasible tool to help guide conservation actions for these birds.

7.5 Scale of Research and Implementation

Success in attaining the goals and objectives of this strategy are dependent on collection of information at scales that will facilitate appropriate interpretation of information as well as implementation of conservation actions. The vast geography of the conservation strategy requires careful assessment of information and application of actions at the appropriate scale to maximize the impact towards the stated goals and objectives for the Species.

This chapter emphasizes the need for targeted and coordinated new research to improve our current understanding of demographic parameters for the Species across their annual cycle. This need is not dissimilar to the needs for many species of conservation concern, highlighting the vast gaps in basic knowledge and the difficulty in moving forward with conservation measures to slow or reverse population declines with only a limited understanding of the factors that limit their populations.

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Appendix A. Recommended Conservation Actions for Sprague's Pipit, Chestnut-collared Longspur, McCown's Longspur, and Baird's Sparrow.

The Objectives, Sub-objectives, and Action Items in this appendix represent the needs of highest importance in order to identify limiting factors and to reduce and reverse the declines of the Species. Objectives and Sub-objectives are not prioritized. Actions for each species are assigned a priority ranking to highlight the relative importance of each action; however, all research, inventory and monitoring, conservation planning, implementation, and outreach actions in this appendix are important and critical to the conservation of the Species. Background information and justification for these recommended conservation actions can be found in the text of the strategy.

SPPI: Sprague's Pipit; CCLO: Chestnut-collared Longspur; MCLO: McCown's Longspur, BAIS: Baird's Sparrow.

Objective	*Sub-objective*	*Action*	*Description*	*Annual Cycle*	*Ranking Priority* SPPI	CCLO	MCLO	BAIS
1			**Develop population and habitats targets**					
1	1.1		Evaluate current population status, trends, and distribution.					
1	1.1	1.1.1	Assess survey data to identify how population trends vary in time and space.					
			a. Assess how ranges have contracted and shifted over time.	Breeding	High	High	High	High
			b. Assess population changes at various spatial scales, i.e., BCR, state/province, ecoregion.		High	High	High	High
1	1.1	1.1.2	Develop/maintain species-habitat distribution models.					
			a. Inventory, update, and coordinate range-wide modeling efforts.	All	Moderate	Moderate	Moderate	Moderate
			1) Update Sather (2015) range occurrence models to include breeding ranges in Colorado and Wyoming.	Breeding	Low	High	High	Low
			2) Update Niemuth et al. (2017) models for breeding range occurrence models.	Breeding	Low	High	High	High
			3) Develop eBird STEM models.	Migration, Winter	Moderate	Low	Moderate	Moderate
			b. Compile existing point count data into centralized system to facilitate model updates.	All	Moderate	Moderate	Moderate	Moderate
			c. Make the information available to diverse partners.	All	Moderate	Moderate	Moderate	Moderate
1	1.1	1.1.3	Update global, national, and regional population estimates.					
			a. Evaluate population estimates from different data sources and explicitly acknowledge and estimate error.	Breeding	High	High	High	High
1	1.1	1.1.4	Review and refine breeding population trend objectives based on 2016 PIF NALCP recommendations.	Breeding	High	High	High	High

Objective	Sub-objective	Action	Description	Annual Cycle	*Ranking Priority* SPPI	CCLO	MCLO	BAIS
1	1.1	1.1.5	Develop population and habitat objectives at multiple scales, e.g., JVs, states, BCRs, by stepping down PIF population trend objectives.	Breeding, Winter	High	High	High	High
1	1.2		Optimize inventory and monitoring activities to inform status, trend, population estimates, and management actions.	All				
1	1.2	1.2.1	Conduct power analysis to assess the ability of BBS and IMBCR to detect population changes at desired time intervals and population thresholds.	Breeding	Moderate	Moderate	Moderate	Moderate
1	1.2	1.2.2	Increase the use and efficiency (i.e., statistical power) of the BBS to detect changes in populations.					
			a. Increase annual completion rates of current BBS routes by recruiting and training additional observers.	Breeding	High	High	High	High
			b. Assess the need for new BBS routes in areas with insufficient coverage.		Moderate	Moderate	Moderate	Moderate
			c. Increase awareness of applications and limitations.		Low	Low	Low	Low
1	1.2	1.2.3	Increase the use and efficiency (i.e., statistical power) of the IMBCR to detect changes in regional populations.					
			a. Maintain partnership support in current survey areas.	Breeding	High	High	High	High
			b. Assess the efficacy of management actions.		High	High	High	High
			c. Expand survey in regions where partnership funding is available.		Moderate	Moderate	Moderate	Moderate
			d. Increase awareness of applications and limitations.		Moderate	Moderate	Moderate	Moderate
			e. Increase availability of data to public for analysis.		Low	Low	Low	Low

Objective	Sub-objective	Action	Description	Annual Cycle	*Ranking Priority* SPPI	CCLO	MCLO	BAIS
1	1.2	1.2.4	Explore new applications and limitations of other surveys (e.g. eBird, Christmas Bird Count)	Breeding Migration Winter	Low High High	Low High High	Low High High	Low High High
1	1.2	1.2.5	Identify migration distribution.					
			a. Develop new surveys (e.g., RADAR, MOTUS Wildlife Tracking Systems, genetics).	Migration	High	High	High	High
			b. Use maps developed in Action 1.1.2 (eBird STEM) to target coordinated migration surveys.		High	High	High	High
			c. Identify important connectivity and stopover sites.		High	High	High	High
			d. Recruit and train additional observers and provide guidance for appropriate survey methods.		Moderate	Moderate	Moderate	Moderate
1	1.2	1.2.6	Expand surveys on the wintering grounds.					
			a. Assess the need across in the wintering range with insufficient coverage and/or information.	Winter	High	High	High	High
			b. Recruit and train additional observers and provide guidance for appropriate survey methods coverage.		High	High	High	High
1	1.2	1.2.7	Test operational survey assumptions (i.e., road side bias, observer effects, and species detection rates) and potential effects on resulting analyses.	All	Moderate	Moderate	Moderate	Moderate
1	1.2	1.2.8	Develop additional surveys or enhance existing surveys to inform management actions that are not addressed.	All	High	High	High	High

Objective	*Sub-objective*	*Action*	*Description*	*Annual Cycle*	*Ranking Priority* SPPI	CCLO	MCLO	BAIS
2			**Synthesize existing information and identify key knowledge gaps.**					
2	2.1		Compile and summarize current information.	All				
2	2.1	2.1.1	Identify baseline demographic parameters including information gaps in vital rates.	All	High	High	High	High
2	2.1	2.1.2	Assess relative influence of vital rates on population viability and identify limiting factors (i.e., integrated population model).	All	High	High	High	High
2	2.1	2.1.3	Synthesize existing management guidance for beneficial management practices.	All	High	High	High	High
2	2.1	2.1.4	Estimate current grassland distribution, condition, quantity, and protection status throughout the annual cycle and track changes over time.					
			a. Expand multi-JV undisturbed grassland assessment to include time series analysis.	All	Moderate	Moderate	Moderate	Moderate
			b. Support continued development of periodic regional and continental spatial land cover data.		Low	Low	Low	Low
2	2.2		Prioritize research to inform conservation delivery.					
2	2.2	2.2.1	Link occurrence and abundance and, where possible, key vital rates to habitat condition and management relative to the following stressors:					
			a. Grassland management (e.g., haying, grazing, mowing, prescribed fire, shrub removal, rest, interseeding, reseeding, cropping history) on native and non-native, plowed and unplowed, restored and reconstructed pasture.	All	High	High	High	High
			b. Landscape fragmentation (e.g. roads, agricultural and wetland edges, patch size, woody edges, shrub encroachment, and landscape composition).		High	High	High	High

Objective	Sub-objective	Action	Description	Annual Cycle	*Ranking Priority* SPPI	CCLO	MCLO	BAIS
2	2.2	2.2.1 *(cont.)*	c. Energy development (e.g., oil and gas, wind, and associated infrastructure, including wells, noise, roads and trails, power lines).	All	High	High	High	High
			d. Long-term weather patterns.		High	High	High	High
			e. Non-native and invasive species.		High	High	High	High
			f. Vegetative biomass and structure.		Moderate	Moderate	Moderate	Moderate
			g. Predation.		Moderate	Moderate	Moderate	Moderate
			h. Parasitism.		Moderate	Moderate	Moderate	Moderate
			i. Pesticide.		Moderate	Moderate	Moderate	Moderate
			j. Food availability.		Low	Low	Low	Low
			k. Disease.		Low	Low	Low	Low
2	2.2	2.2.2	Identify factors influencing low occupancy or vacant habitat.	Breeding Migration Winter	Moderate Low Moderate	Moderate Low Moderate	High Low Moderate	Moderate Low Moderate
2	2.2	2.2.3	Conduct baseline studies on migration ecology, stopover habitats, migration routes, and migration behavior.	Migration	High	High	High	High
2	2.2	2.2.4	Compare habitat use, genetics, behavior in disjunct populations.	Breeding	Low	Low	High	Low
2	2.2	2.2.5	Query and synthesize information from landowners and managers on current and emerging threats and stressors.	All	Moderate	Moderate	Moderate	Moderate

Objective	Sub-objective	Action	Description	Annual Cycle	*Ranking Priority* SPPI	CCLO	MCLO	BAIS
3			**Prioritize conservation and outreach actions.**					
3	3.1	3.1.1	Quantify effects of existing conservation programs and potential scenarios.					
			a. Promote and prioritize programs benefiting or have the potential to benefit the Species. Alter, discontinue, or do not encourage implementation of ineffective or detrimental programs.	All	High	High	High	High
3	3.1	3.1.2	Develop and/or refine decision support tools to prioritize conservation efforts (i.e., protection, restoration, and enhancement).	All	High	High	High	High
3	3.1	3.1.3	Promote conservation programs and incentives to protect native and restored grassland in priority areas.					
			a. Encourage voluntary perpetual easements and/or term-limited leases (e.g., ALE, FWS, state, NGO).	All	High	High	High	High
			b. Promote management actions that prioritize grazing and promote grass-based agriculture.		High	High	High	High
3	3.1	3.1.4	Promote and increase habitat quality standards of grassland restoration programs and practices, e.g., increase patch size, reduce hard edges, minimize woody/shrub cover in key areas, minimize tame grass encroachment.					
			a. Identify focal areas for targeting restoration programs.	All	High	High	High	High
			b. Promote existing programs (e.g., CRP, EQIP, PFW) and increase incentives.	All	Moderate	Moderate	Moderate	Moderate
			c. Recommend seeding prescriptions using geographically specific native grass and forb mixes.	All	Moderate	Moderate	Moderate	Moderate
			d. Manage for appropriate shrub density.	Winter	High	High	Moderate	High
3	3.2		Improve outreach and partnership opportunities.	All				

Objective	Sub-objective	Action	Description	Annual Cycle	Ranking Priority SPPI	CCLO	MCLO	BAIS
3	3.2	3.2.1	Foster partnerships and engage with key stakeholders (e.g., energy, agriculture, First Nations/tribes, land trusts, ejidos).	All	High	High	High	High
3	3.2	3.2.2	Produce geographically-appropriate, stakeholder-specific Beneficial Management Practice guidance based on best available science.	All	High	High	High	High
3	3.2	3.2.3	Improve coordination in future planning efforts.	All	Moderate	Moderate	Moderate	Moderate
3	3.2	3.2.4	Identify and integrate existing planning efforts.	All	Moderate	Moderate	Moderate	Moderate
3	3.2	3.2.5	Foster international partnerships (e.g., RGJV, SJV, IMC, others) on the wintering grounds.					
			a. Develop appropriate guidance for habitats in the Chihuahuan and Sonoran deserts.	Winter	High	High	High	High
			b. Identify potential mechanisms for influencing conservation actions (e.g., prevent conversion to center pivot agriculture, reducing woody encroachment).		High	High	High	High
3	3.2	3.2.6	Foster partnerships with private landowners.	All	High	High	High	High
3	3.2	3.2.7	Make the information available to diverse Partners.	All	Moderate	Moderate	Moderate	Moderate
3	3.3		Inform policy development.	All				
3	3.3	3.3.1	Engage agricultural communities and agencies to support grass-based agriculture.	All	High	High	High	High
3	3.3	3.3.2	Education, outreach, and decision support tools for policy makers.	All	Moderate	Moderate	Moderate	Moderate

Appendix B. Sprague's Pipit Status and Trends.

Status and trends are summarized and organized at three geographic scales that are utilized in analyses by the Breeding Bird Survey (BBS): Survey wide/country, Bird Conservation Region (BCR), and state/province. Official Species Status (Regulatory): Species at Risk Act (SARA) and State status: "E" = Endangered, "T" = Threatened. State/Provincial Conservation Status represents State Wildlife Action Plan (SWAP) status and Provincial status: Tiers range 1-3 with Tier 1 the highest level of conservation priority. "SGCN" (Species of Greatest Conservation Need) are priority species without assigned tiers. Tier 1A is the highest designation of conservation priority for Arizona; Tier S3N is vulnerable as a nonbreeding species. For the BBS trends: n = number of survey routes on which the species was encountered during the entire (1967–2015) interval. BBS trends are presented as yearly percentage change. Numbers in parentheses are the credible intervals for the trend estimate; the values represent the 2.5% and 97.5% percentiles of the posterior distribution of trend estimates (Sauer et al. 2017). Trends for which credible intervals do not include zero can be considered significant (red text represents a significant negative trend). "n/a" is used where there are data deficiencies or where the species does not breed, meaning no data available or not applicable.

Region	Official Species Status	State/ Provincial Conservation Status	BBS Sample size (n)	BBS Trend 1967-2015 (%/yr, 95% CI)	BBS Trend 2005-2015 (%/yr, 95% CI)	Population estimate	Percentage of breeding population
Range wide							
Survey wide			263	-3.1 (-4.3, -2.0) [a]	-4.3 (-7.1, -1.3) [a]	900,000 [d]	
United States			72	-0.9 (-3.1, 1.2) [a]	-2.0 (-8.6, 4.7) [a]	170,000	19.5 [d]
Canada	T		191	-3.5 (-4.8, -2.4) [a]	-5.0 (-8.0, -1.7) [a]	700,000	80.5
BCR-level							
Prairie Potholes BCR			190	-3.1 (-4.3, -2.0) [a]	-4.4 (-7.4, -1.4) [a]	870,000 [d]	87.1
Badlands and Prairies BCR			32	-1.3 (-4.6, 2.0) [b]	-7.4 (-17.5, 2.4) [b]	80,000	8.5
Boreal Taiga Plains BCR			35	-4.1 (-8.3, 0.3) [b]	-1.5 (-14.9, 15.8) [b]	30,000	3.0
Northern Rockies BCR			6	-1.9 (-4.6, 2.0) [c]	-1.6 (-10.3, 10.7) [c]	12,000	1.4
United States							
Arizona		Tier 1A	n/a	n/a	n/a	n/a	n/a
Kansas		Tier 2	n/a	n/a	n/a	n/a	n/a
Minnesota	E	SGCN	n/a	n/a	n/a	n/a	n/a
Montana		Tier 3	32	0.01 (-3.0, 3.0) [a]	0.7 (-7.1, 8.7) [a]	110,000	12
Nebraska		Tier 1	n/a	n/a	n/a	n/a	n/a
New Mexico		SGCN	n/a	n/a	n/a	n/a	n/a
North Dakota		Tier 1	31	-3.0 (-5.3, -0.7) [a]	-10.3 (-20.2, -2.03) [a]	60,000 [e]	7.1
Oklahoma		Tier 3	n/a	n/a	n/a	n/a	n/a
South Dakota		SGCN	9	1.1 (-5.22, 8.6) [c]	5.8 (-6.7, 49.3) [c]	3,000	0.4
Texas		Tier S3N	n/a	n/a	n/a	n/a	n/a
Canada							
Alberta			92	-3.3 (-5.1, -1.5) [a]	-6.4 (-10.4, -2.3) [a]	500,000	51.5
Manitoba			26	-4.0 (-8.0, -0.5) [b]	-2.6 (-8.9, 6.3) [b]	16,000	1.8
Saskatchewan			73	-3.6 (-5.2, -2.0) [a]	-3.6 (-8.2, 1.2) [a]	200,000	27.2

BBS trends: [a] High confidence, [b] Medium confidence, [c] Low confidence in reliability of the trend assessments (Sauer et al. 2017).

[d] Population estimate and percentage of population are based on BBS data and other estimators, thus numbers and percentages by country, BCR, or state/province do not necessarily add up to the global population estimate or 100%, respectively (Blancher et al. 2013).

[e] State estimates (95% Confidence Intervals [CI]) for Sprague's Pipit in North Dakota in 1967, 1992, and 1993 were 15,000 (2,000-28,000), 29,000 (5,000-2,000), and 42,000 (8,000-75,000) breeding pairs, respectively (Igl et al. 1999).

Appendix C. Chestnut-collared Longspur Status and Trends.

Status and trends are summarized and organized at three geographic scales that are utilized in analyses by the Breeding Bird Survey (BBS): Survey wide/country, Bird Conservation Region (BCR), and state/province. Official Species Status (Regulatory): Species at Risk Act (SARA), state, and provincial status: “E” = Endangered, “T” = Threatened. State/Provincial Conservation Status represents State Wildlife Action Plan (SWAP) status and Provincial status: Tiers range 1-2 with Tier 1 the highest level of conservation priority. “SGCN” (Species of Greatest Conservation Need) are priority species without assigned tiers. Tier 1C is the lowest designation of conservation priority in Arizona. For the BBS trends: n = number of survey routes on which the species was encountered during the entire (1967–2015) interval. BBS trends are presented as yearly percentage change. Numbers in parentheses are the credible intervals for the trend estimate; the values represent the 2.5% and 97.5% percentiles of the posterior distribution of trend estimates (Sauer et al. 2017). Trends for which credible intervals do not include zero can be considered significant (red text represents a significant negative trend). “n/a” is used where there are data deficiencies or where the species does not breed, meaning no data available or not applicable.

Region	Official Species Status	State/ Provincial Conservation Status	BBS Sample size (n)	BBS Trend 1967-2015 (%/yr, 95% CI)	BBS Trend 2005-2015 (%/yr, 95% CI)	Population estimate	Percentage of breeding population
Range wide							
Survey wide			220	-4.2 (-5.1, -3.3) [a]	-2.9 (-4.6, -0.9) [a]	3,000,000 [d]	
United States			123	-3.5 (-4.4, -2.5) [a]	-2.3 (-4.4, 0.2)	2,000,000	76.9 [d]
Canada	T		97	-5.5 (-7.0, -4.0) [a]	-4.7 (-7.5, -1.6) [a]	600,000	23.1
BCR-level							
Prairie Potholes BCR			155	-4.3 (-5.4, -3.3) [a]	-3.5 (-5.3, -1.3) [a]	1,700,000 [d]	61.4
Shortgrass Prairie BCR			7	-2.4 (-7.7, 3.4) [c]	-1.8 (-12.8, 10.6) [c]	80,000	3
Badlands and Prairies BCR			58	-3.8 (-5.3, -2.3) [a]	-1.3 (-5.4, 3.5) [a]	1,000,000	35.2
Northern Rockies BCR			n/a	n/a	n/a	13,000	0.5
United States							
Arizona		Tier 1C	n/a	n/a	n/a	n/a	n/a
Colorado		Tier 2	7	-2.4 (-7.7, 3.4)	-1.8 (-12.8, 10.6)	12,000	0.4
Kansas		Tier 1	n/a	n/a	n/a	n/a	n/a
Minnesota	E	SGCN	n/a	n/a	n/a	n/a	n/a
Montana		Tier 2	32	-2.3 (-3.6, -0.9) [a]	-1.9 (-4.3, 1.2)	800,000	29.8
Nebraska		Tier 1	n/a	n/a	n/a	n/a	n/a
New Mexico		SGCN	n/a	n/a	n/a	n/a	n/a
North Dakota		Tier 1	39	-4.2 (-5.7, -2.8) [a]	-3.4 (-7.2, 1.3)	900,000 [e]	32.8
Oklahoma		Tier 2	n/a	n/a	n/a	n/a	n/a
South Dakota		SGCN	36	-4.9 (-6.5, -3.2) [a]	-1.0 (-7.2, 6.5) [a]	300,000	11.1
Wyoming		Tier 2	9	-8.3 (-13.7, -2.1) [c]	-8.2 (-15.5, 2.3) [c]	50,000	1.9
Canada							
Alberta			45	-7.3 (-9.0, -5.6) [a]	-7.5 (-11.8, -3.0) [a]	400,000	14.2
Manitoba	E		12	-7.7 (-11.4, -4.2) [b]	-7.5 (-12.6, -0.8) [b]	19,000	0.7
Saskatchewan			41	-4.9 (-6.5, -3.2) [a]	-3.6 (-6.7, 0.3) [a]	180,000	6.8

BBS trends: [a] High confidence, [b] Medium confidence, [c] Low confidence in reliability of the trend assessments (Sauer et al. 2017)

[d] Population estimate and percentage of population are based on BBS data and other estimators, thus numbers and percentages by country, BCR, or state/province do not necessarily add up to the global population estimate or 100%, respectively (Blancher et al. 2013).

[e] State estimates (95% CI) for Chestnut-collared Longspur in North Dakota in 1967, 1992, and 1993 were 2,544,000 (1,987,000-3,101,000), 1,351,000 (913,000-1,789,000), and 1,707,000 (1,183,000-2,232,000) breeding pairs, respectively (Stewart and Kantrud 1972, Igl and Johnson 1997).

Appendix D. McCown's Longspur Status and Trends.

Status and trends are summarized and organized at three geographic scales that are utilized in analyses by the Breeding Bird Survey (BBS): Survey wide/country, Bird Conservation Region (BCR), and state/province. Official Species Status (Regulatory): Species at Risk Act (SARA) and State status: "T" = Threatened. State/Provincial Conservation Status represents State Wildlife Action Plan (SWAP) status and Provincial status: Tiers range 1-3 with Tier 1 the highest level of conservation priority. "SGCN" (Species of Greatest Conservation Need) are priority species without assigned tiers. Tier 1C and S4 are low designations of conservation priority for Arizona and Texas, respectively. For the BBS trends: n = number of survey routes on which the species was encountered during the entire (1967–2015) interval. BBS trends are presented as yearly percentage change. Numbers in parentheses are the credible intervals for the trend estimate; the values represent the 2.5% and 97.5% percentiles of the posterior distribution of trend estimates (Sauer et al. 2017). Trends for which credible intervals do not include zero can be considered significant (red text represents a significant negative trend). "n/a" is used where there are data deficiencies or where the species does not breed, meaning no data available or not applicable.

Region	Official Species Status	State/ Provincial Conservation Status	BBS Sample size (n)	BBS Trend 1967-2015 (%/yr, 95% CI)	BBS Trend 2005-2015 (%/yr, 95% CI)	Population estimate	Percentage of breeding population
Range wide							
Survey wide			117	-5.9 (-9.1, -2.8) [b]	-2.8 (-7.6, 2.8)	600,000 [d]	
United States			61	-0.7 (-3.3, 1.8)	0.9 (-4.3, 6.6)	400,000	75.5 [d]
Canada	T		56	-8.0 (-11.6, -4.1) [b]	-7.8 (-13.8, 2.01)	130,000	32.5
BCR-level							
Prairie Potholes BCR			69	-7.1 (-10.4, -3.5) [b]	-5.0 (-10.8, 3.1)	300,000 [d]	45.8
Shortgrass Prairie BCR			8	1.4 (-3.3, 6.3)	0.9 (-5.2, 6.7)	110,000	19.5
Badlands and Prairies BCR			20	-1.0 (-5.4, 3.3)	-0.4 (-10.3, 9.2)	80,000	14.1
Northern Rockies BCR			20	-2.7 (-6.8, 1.7)	-0.8 (-6.7, 9.1)	110,000	20.2
United States							
Arizona		Tier 1C	n/a	n/a	n/a	n/a	n/a
Colorado		Tier 2	8	1.4 (-3.3, 6.3)	0.9 (-5.2, 6.7)	80,000	13.7
Kansas		Tier 2	n/a	n/a	n/a	n/a	n/a
Montana		Tier 3	24	-1.4 (-4.6, 1.8)	0.2 (-8.1, 9.6)	190,000	34.2
Nebraska		Tier 1	n/a	n/a	n/a	n/a	n/a
New Mexico		SGCN	n/a	n/a	n/a	n/a	n/a
North Dakota		Tier 3	n/a	n/a	n/a	n/a [e]	n/a
Oklahoma		Tier 2	n/a	n/a	n/a	n/a	n/a
Texas		Tier S4	n/a	n/a	n/a	n/a	n/a
Wyoming		Tier 2	29	-0.2 (-4.6, 4.4)	1.1 (-4.5, 8.8)	160,000	27.8
Canada							
Alberta			31	-7.9 (-10.9, -5.1) [a]	-9.6 (-18.2, -3.8) [a]	70,000	11.9
Saskatchewan			25	-8.0 (-12.1, -3.0) [b]	-7.4 (-14.4, 3.8)	60,000	10.7

BBS trends: [a] High confidence, [b] Medium confidence, [c] Low confidence in reliability of the trend assessments (Sauer et al. 2017)

[d] Population estimate and percentage of population are based on BBS data and other estimators, thus numbers and percentages by country, BCR, or state/province do not necessarily add up to the global population estimate or 100%, respectively (Blancher et al. 2013).

[e] State estimates (95% CI) for McCown's Longspur in North Dakota in 1967, 1992, and 1993 were 50,000 (0-99,000), 4,000 (0-12,000), and 2,000 (0-6,000) breeding pairs respectively (Igl et al. 1999).

Appendix E. Baird's Sparrow Status and Trends.

Status and trends are summarized and organized at three geographic scales that are utilized in analyses by the Breeding Bird Survey (BBS): Survey wide/country, Bird Conservation Region (BCR), and state/province. Official Species Status (Regulatory): Species at Risk Act (SARA) and State status: "E" = Endangered, "T" = Threatened, and "SC" = Special Concern. State/Provincial Conservation Status represents State Wildlife Action Plan (SWAP) status and Provincial status: Tiers range 1-3 with Tier 1 the highest level of conservation priority. "SGCN" (Species of Greatest Conservation Need) are priority species without assigned tiers. Tier 1C is the lowest designation of conservation priority for Arizona, while S2 is a relatively high priority for Texas. For the BBS trends: n = number of survey routes on which the species was encountered during the entire (1967–2015) interval. BBS trends are presented as yearly percentage change. Numbers in parentheses are the credible intervals for the trend estimate; the values represent the 2.5% and 97.5% percentiles of the posterior distribution of trend estimates (Sauer et al. 2017). Trends for which credible intervals do not include zero can be considered significant (red text represents a significant negative trend). "n/a" is used where there are data deficiencies or where the species does not breed, meaning no data available or not applicable.

Region	Official Species Status	State/ Provincial Conservation Status	BBS Sample size (n)	BBS Trend 1967-2015 (%/yr, 95% CI)	BBS Trend 2005-2015 (%/yr, 95% CI)	Population estimate	Percentage of breeding population
Range wide							
Survey wide			227	-2.2 (-3.7, -0.7) [a]	-0.03 (-4.2, 4.8)	2,000,000 [d]	
United States			91	-2.0 (-3.7, -0.1) [a]	5.3 (-1.2, 13.9)	1,600,000	69.5 [d]
Canada	SC		136	-2.3 (-4.2, -0.3) [a]	-2.6 (-7.4, 2.6)	700,000	30.5
BCR-level							
Prairie Potholes BCR			180	-2.6 (-4.1, -1.1) [a]	-1.6 (-5.75, 3.1) [a]	2,000,000 [d]	90.5 [d]
Badlands and Prairies BCR			42	-1.3 (-4.4, 2.6) [b]	2.2 (-7.1, 18.1) [a]	200,000	9.1
Northern Rockies BCR			5	7.3 (-3.6, 20.6) [c]	14.3 (-21, 69.0) [c]	8,000	0.3
United States							
Arizona		Tier 1C	n/a	n/a	n/a	n/a	n/a
Kansas		Tier 2	n/a	n/a	n/a	n/a	n/a
Minnesota	E	SGCN	n/a	n/a	n/a	n/a	n/a
Montana		Tier 3	35	0.8 (-2.0, 3.9) [a]	5.1 (-3.6, 16.3) [a]	300,000	12.2
Nebraska		Tier 1	n/a	n/a	n/a	n/a	n/a
New Mexico	T	SGCN	n/a	n/a	n/a	n/a	n/a
North Dakota		Tier 1	37	-3.6 (-5.8, -1.1) [a]	4.4 (-4.8, 16.2) [a]	400,000 [e]	16.2
Oklahoma		Tier 3	n/a	n/a	n/a	n/a	n/a
South Dakota		SGCN	14	0.3 (-3.8, 4.8) [b]	3.4 (-5.1, 21.6) [b]	10,000	0.4
Texas		Tier S2	n/a	n/a	n/a	n/a	n/a
Wyoming		Tier 2	5	13.7 (-1.3, 36.4) [c]	14.0 (-16.3, 71.5) [c]	8,000	0.4
Canada							
Alberta			63	-1.1 (-3.8, 1.7) [a]	-3.0 (-8.8, 3.3) [a]	500,000	22.3
Manitoba	E		10	-10.3 (-16, -4.3) [c]	-9.9 (-21.1, 11.8) [c]	11,000	0.5
Saskatchewan			63	-2.3 (-4.6, 0.2) [a]	-2.5 (-8.8, 4.5) [a]	1,100,000	48.1

BBS trends: [a] High confidence, [b] Medium confidence, [c] Low confidence in reliability of the trend assessments (Sauer et al. 2017)

[d] Population estimate and percentage of population are based on BBS data and other estimators, thus numbers and percentages by country, BCR, or state/province do not necessarily add up to the global population estimate or 100%, respectively (Blancher et al. 2013).

[e] State estimates (95% CI) for Baird's Sparrow in North Dakota in 1967, 1992, and 1993 were 376,000 (208,000-543,000), 171,000 (90,000-251,000), and 279,000 (140,000-418,000) breeding pairs, respectively (Stewart and Kantrud 1972, Igl and Johnson 1997).

Appendix F. Regulatory and Conservation Status.

Regulatory Status

Regulatory status refers to federal, state, and provincial laws protecting listed species. Federal regulatory protections include the Migratory Bird Conservation Act (MBCA), the Species at Risk Act (SARA) in Canada, and the MBTA in the United States, Canada, and Mexico. States and provinces also identify species receiving regulatory protection.

A. Canada (Federal and Provincial)

Sprague's Pipit, Chestnut-collared Longspur, McCown's Longspur, and Baird's Sparrow are protected under the MBCA and the Migratory Birds Regulations.

Sprague's Pipit – Sprague's Pipit was officially listed under SARA in June 2003 (Environment Canada 2012).

Chestnut-collared Longspur – Chestnut-collared Longspur was listed as Threatened under SARA in 2012. The species is listed as Endangered under Manitoba's Endangered Species and Ecosystems Act (Environment and Climate Change Canada 2016).

McCown's Longspur – McCown's Longspur was officially listed as Special Concern under SARA in 2007 (Environment Canada 2014).

Baird's Sparrow – Baird's Sparrow was officially listed as Special Concern under SARA in 2017 (Canada Gazette 2017). Baird's Sparrow is listed as Endangered in Manitoba (https://www.gov.mb.ca/sd/wildlife/sar/index.html).

B. United States (National and State)

Sprague's Pipit – Sprague's Pipit is covered by the MBTA in the United States. Sprague's Pipit is a former candidate species under the ESA. Sprague's Pipit is listed as "endangered" in Minnesota.

Chestnut-collared Longspur – Chestnut-collared Longspur is covered by the MBTA in the United States. Chestnut-collared Longspur is listed as "endangered" in Minnesota.

McCown's Longspur – McCown's Longspur is covered by the MBTA in the United States.

Baird's Sparrow – Baird's Sparrow is covered by the MBTA in the United States. Baird's Sparrow was twice petitioned for listing species under the ESA. Baird's Sparrow is listed as "endangered" in Minnesota. Baird's Sparrow is listed as Threatened in New Mexico (New Mexico Department of Game and Fish 2016).

C. Mexico

Sprague's Pipit, Chestnut-collared and McCown's Longspur, and Baird's Sparrow are covered by the MBTA in Mexico but have no regulatory status in any state and no other official or regulatory designation (SEMARNAT 2010).

Conservation Status

Conservation status refers to non-legally binding status of species of conservation concern. State and provincial agencies utilize various types of conservation statuses to identify and prioritize species of conservation concern that may or may not also have federal, state or provincial regulatory status. The advisory body of Committee on the Status of Endangered Wildlife (COSEWIC) in Canada makes non-binding recommendations to the Government of Canada and the Minister of the Environment for potential federal listing.

A. Global

Sprague's Pipit is listed on the International Union for the Conservation of Nature (IUCN) Red List as "Vulnerable"* (BirdLife International 2017d), but is not listed on the Convention on International Trade in Endangered Species list (Inskipp and Gillett 2005). Chestnut-collared Longspur is listed on the IUCN Red List as "Near Threatened" (BirdLife International 2016a). McCown's Longspur and Baird's Sparrow are listed on the IUCN Red List as "Least Concern" (BirdLife International 2016b,c).

*IUCN Red List ranking from highest to lowest priority: Vulnerable, Near Threatened, Least Concern. The category of "Threatened" includes the categories of "Critically Endangered, Endangered, and Vulnerable".

B. Canada, United States, and Mexico – National

Sprague's Pipit, Chestnut-collared and McCown's longspurs, and Baird's Sparrow are listed on the "D" Yellow Watch List in 2016 PIF NALCP for reversing declines (Rosenberg et al. 2016). The Species are classified by the USFWS as "Bird of Conservation Concern" (BCC) at the national level in the draft 2016 BCC update (Table 9). The Species do not have conservation status in Mexico.

Sprague's Pipit received designation as Threatened by the COSEWIC in 2000 (Environment Canada 2012). Chestnut-collared Longspur was listed as Threatened in 2009 by COSEWIC (Environment and Climate Change Canada 2016). McCown's Longspur was assigned the status of Special Concern by COSEWIC in 2006 (Environment Canada 2014). In 2016, COSEWIC reassessed McCown's Longspur and recommended that its status be changed to Threatened (COSEWIC 2016). Baird's Sparrow was assigned the status of Special Concern by COSEWIC in 2013 (COSEWIC 2013)

C. Canada – Provincial

In Alberta, Baird's Sparrow, Chestnut-collared Longspur, and Sprague's Pipit are considered sensitive (Prescott 1997, Alberta Environment and Sustainable Resource Development and Alberta Conservation Association 2015) and McCown's Longspur is classified as "May be at Risk" (Government of Alberta 2017).

In Saskatchewan, Sprague's Pipit is ranked as "Vulnerable"; with breeding and migrant populations considered at moderate risk of extinction or extirpation. Chestnut-collared and McCown's Longspur are ranked in Saskatchewan as Vulnerable with breeding population considered at moderate risk of extinction or extirpation. Baird's Sparrow is ranked as Apparently Secure in Saskatchewan (Saskatchewan Conservation Data Centre 2018).

See Appendices B-E for summary of provincial listing status by species.

D. United States – Regional

The USFWS maintains the BCC list and identifies breeding and non-breeding priority species by BCR (U.S. Fish and Wildlife Service 2008a). The Species are recognized as birds of conservation concern throughout their annual cycle (Table 9).

Bird habitat Joint Ventures (JV) provide one of the main delivery mechanisms of landbird conservation in the U.S. and Canada, with an increasing role in parts of Mexico. Each JV has developed an implementation plan and has identified priority or focal species. The Species have been identified as priority or focal species in JV's throughout their annual cycle (Table 10).

E. United States – State

Sprague's Pipit, Chestnut-collared and McCown's longspurs, and Baird's Sparrow are listed as "Species of Greatest Conservation Need" (SGCN) in many states throughout the breeding, migration, and wintering ranges. See Appendices B-E for summary of state listing status by species.

F. Mexico – State

The Species have no national or state designations.

Table 9. USFWS Birds of Conservation Concern (BCC) listing status by BCR for breeding (B) or non-breeding season (NB) in the 2008 BCC (U.S. Fish and Wildlife Service 2008a) and the 2017 draft BCC update.

BCR	*Sprague's Pipit*	*Chestnut-collared Longspur*	*McCown's Longspur*	*Baird's Sparrow*
Prairie Potholes (BCR11)	B	B	B	B
Southern Rockies/Colorado Plateau (BCR 16)		B		
Badlands and Prairies (BCR 17)	B	B	B	B
Shortgrass Prairie (BCR 18)	B	B	B	
Central Mixed-Grass Prairie (BCR19)	B	B	B	
Edwards Plateau (BCR 20)		NB	NB	
Oaks and Prairies (BCR 21)	NB			
West Gulf Coastal Plain/Ouachitas (BCR 25)	NB			
Sierra Madre Occidental (BCR 34)	NB	NB		NB
Chihuahuan Desert (BCR 35)	NB	NB	NB	NB
Tamaulipan Brushlands (BCR 36)	NB	NB		
Gulf Coast Prairie (BCR 37)	NB			

Table 10. Designation as a priority or focal species by the bird habitat Joint Ventures.

Joint Venture/BCR	*Sprague's Pipit*	*Chestnut-collared Longspur*	*McCown's Longspur*	*Baird's Sparrow*
Prairie Potholes JV (US)	X	X	X	X
Prairie Habitat JV (CA)	X	X	X	X
Intermountain West JV		X	X	X
Northern Great Plains JV	X	X	X	X
Playa Lakes JV	X	X	X	X
Rainwater Basin JV	X			X
Rio Grande JV	X	X	X	X
Sonoran JV	X	X	X	X

Appendix G. Vital rates and demographic parameters for Sprague’s Pipit.

Vital rates, demographic information, and the effects of habitat and landscape covariates on occurrence, abundance, density, and nesting biology of Sprague’s Pipit.

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Breeding - Ad	Occurrence	AB	Distance from two track roads	Roads	+	Dale et al. (2009)
			ND	Effect of aspen woodland cover within 500 m	Vegetation Structure: Shrub/woodland cover	0	Grant et al. (2004)
				Effect of increasing edge-to-area ratio and decreasing patch size	Landscape: Patch size	-	Davis et al. (2006)
				Effect of number of potholes in current and previous year	Landscape: Wetlands	-	Niemuth et al. (2008)
			SK	50% probability of occupancy at patch of 145 ha	Landscape: Patch size	-	Davis (2003, 2004)
				Minimum patch size for occupancy, 29 ha	Landscape: Patch size	NA	Davis (2004, 2006)
Abundance	Breeding - Ad	Abundance	AB	Effect of roads	Roads	0	Koper and Schmiegelow (2006), Koper at al. (2009), Sliwinski and Koper (2012)
				Within 50m of oil wells or roads than >250m	Energy Development: Oil wells, Roads	- -	Linnen et al. (2008)
				Increasing well density (1.5 to 6.2 wells km^{-2})	Energy Development: Gas/Oil infrastructure	-	Dale et al. (2009)
				Effect of increasing well density from 3.5 km^{-2} to 6.2 km^{-2}	Energy Development: Gas/Oil infrastructure	-	Hamilton et al. (2011)
				Within 0.35 km of water and 0.91 km of crops	Landscape: Wetland, Cropland	- (-25%) - (-25%)	Sliwinski and Koper (2012)
				Effect of well density (0-7.7 wells km^{-2}) or vegetation structure	Energy Development: Gas/Oil infrastructure, Vegetation structure	0 0	Rodgers (2013)
				Reduced distance to shallow wells	Energy Development: Gas/Oil infrastructure	-	
				Reduced near roads vs. off-road (0.16 vs. 0.28 birds per point count, respectively)	Roads: Roadside, Off-road	- +	Wellicome et al. (2014)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Breeding - Ad	Abundance	AB	Reduced distance to oil and gas well infrastructure	Energy Development: Gas/Oil infrastructure	-	Rodgers and Koper (2017)
			MT	Various intensities of grazing	Grazing intensity	-	Lipsey and Naugle (2016)
				Reduction in soil productivity	Soil productivity	-	Lipsey and Naugle (2017)
			SK	Native prairie vs. tame grassland	Grassland Type: Native, Tame	 + -	Davis et al. (1999), Dohms (2009)
				Paved and raised roads with smooth brome; Near two track roads	Roads: Paved road, Two track road, Invasive plants	 - + -	Sutter et al. (2000)
				Male territory size 2.5 ha (n=30 territories) during first week of fledging period	NA	NA	Davis and Fisher (2009)
				Increasing grazing intensity	Grazing Intensity	-	Sliwinski (2011)
				Effect of increasing well density (0-15.7 wells km^{-2}) or vegetation structure	Energy Development: Gas/Oil infrastructure, Vegetation structure	 0 0	Kalyn Bogard and Davis (2014)
			SK, ND	Native prairie vs. all other types of grassland	Grassland Type: Native, Others	 + -	Davis (2004), Grant et al. (2004), Davis et al. (2014)
				Reduced (SK) and absent (ND) in bison grazed prairie	Grazing: Bison	-	Lueders et al. (2006), Pipher (2011)
Abundance	Migration	Abundance	-	None			
Abundance	Wintering - Ad	Abundance	Mexico	Abundance with grass ~29 cm tall	Vegetation structure	+ (max)	Pool et al. (2002)
				Increasing shrub density and height	Vegetation structure: Shrub density, Shrub height	 - 0	
			TX	Effect of wind turbines	Energy Development: Wind turbines	0	Stevens et al. (2013)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Wintering - Ad	Abundance	TX	>5% shrub cover	Vegetation structure: Shrub/woodland cover	-	Gryzbowski (1982), Muller (2015)
				Grass >50 cm tall	Vegetation structure	-	Muller (2015)
Abundance	Breeding - Ad	Territory Size	AB	Territory size average 0.1-2 ha	NA	NA	Hamilton (2010)
			MT	Territory size average 0.45 ha (n=41)	NA	NA	Jones (2011)
			SK	Territory size average 2.5 ha (n=30)	NA	NA	Davis and Fisher (2009)
				Territory size average 1.9 ha (range 0.1-5.4 ha, n=94) in native prairie; Territory size average 1.7 ha (range 0.4-6.4 ha, n=97) in tame hayfields	Grassland type: Native, Tame	NA NA	Fisher and Davis (2011a)
Abundance	Breeding - Ad	Density	MT	2 birds per 100 ha mean (867 pts) 21 birds per 100 ha maximum	NA	NA	Lipsey (unpubl. data)
				0.5-0.8 birds per 100 ha (2011, 2014-15); 1.3-3.7 birds per 100 ha (2011, 2014-17) in BCR 11; 3.3-5.6 birds per 100 ha (2014, 2016-17) on BLM land in BCR 11	NA	NA	Bird Conservancy of the Rockies (2018)
			ND	Drought years	Climate: Precipitation	-	George et al. (1992)
			SK	22-41 birds per 100 ha 11-21 pairs per 100 ha	NA	NA	Maher (1973)
				Increasing patch size	Landscape: Patch size	+	Davis et al. (2006)
			MN, MT, ND, SD	0.21 pairs per 100 ha (range 0-1.42 pairs per 100 ha)	NA	NA	Igl (2009)
Abundance	Migration	Density	-	None			
Abundance	Wintering - Ad	Density	Sonoita, AZ	Average 2.53 birds per 100 ha (2008-12)	NA	NA	CEC (2013)
			Bootheel, NM	Average 0.32 birds per 100 ha (2011-12)	NA	NA	
			NM	0.4 birds per 100 ha	NA	NA	Pool et al. (2012)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Wintering - Ad	Density	Otero Mesa, NM	Average 0.45 birds per 100 ha (2011-12)	NA	NA	CEC (2013)
			TX	0-19.8 birds per 100 ha	NA	NA	Igl and Ballard (1999)
			s. TX	17.3-24.7 birds per 100 ha	NA	NA	Kostecke et al. (2015)
				<0.7 birds per 100 ha	NA	NA	Saalfeld et al. (2016)
			Central coastal TX	Average densities on different study plots per year: 4 birds per 100 ha (1979); 90, 28, and 42 birds per 100 ha (1977, 1978, 1979, respectively); 80 and 64 birds per 100 ha (1979 and 1979, respectively)	NA	NA	Gryzbowski (1980, 1982)
			San Patricio Co., TX	4.4 birds per 100 ha	NA	NA	Emlen (1972)
			Marfa, TX	Average 2.9 birds per 100 ha (2009-11)	NA	NA	CEC (2013)
				Average mean density of 1.6-10.1 birds per 100 ha (2014-17)	NA	NA	Bird Conservancy of the Rockies (unpubl. data)
			Alto Conchos, Chihuahua	Average 0.85 birds per 100 ha (2012-13)	NA	NA	CEC (2013)
			Cuatro Ciénegas, Coahuila	Average 1.77 birds per 100 ha (2007-10)	NA	NA	
			Cuchillas de la Zarca, Durango	Average 6.36 birds per 100 ha (2007-12)	NA	NA	
			Janos, Chihuahua	Average 2.58 birds per 100 ha (2007-12)	NA	NA	
			Lagunas del Este, Chihuahua	Average 2.53 birds per 100 ha (2009-12)	NA	NA	

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Wintering - Ad	Density	Llano Las Amapolas, Chihuahua	Average 4.01 birds per 100 ha (2011-12)	NA	NA	CEC (2013)
			Malpaís, Durango	Average 3.33 birds per 100 ha (2010-2013)	NA	NA	
			Mapimí, Chihuahua and Durango	Average 0.83 birds per 100 ha (2007-2012)	NA	NA	
			El Tokio, primarily Coahuila	Average 6.95 birds per 100 ha (2007-13); Average 8.6 birds per 100 ha (2007-12), max 12 birds per 100 ha	NA	NA	CEC (2013), Pool et al. (2012)
			Valles Centrales, Chihuahua	Average 2.52 birds per 100 ha (2007-13)	NA	NA	CEC (2013)
			Valle Colombia, Coahuila	Average 9.69 birds per 100 ha (2007-13)	NA	NA	CEC (2013)
Reproduction	Breeding	Nest Success	AB	Nesting success: 46% (n=33) [c]	Predation, Increasing precipitation	- -	Gaudet (2013)
				Nesting success: 52% (n=21) [c]	Predation, parasitism [c]	- -	Ludlow (2013)
			MB	Nesting success: 44% (n=17)	Predation	-	Davis (1994), Davis and Sealy (2000)
			MT	Nesting success: 24% [c], Mayfield estimate: 37% (n=128)	Predation, Weather	- -	Jones et al. (2010)
			MT and ND	Nest survival: 33% (logistic exposure method)	Temperature, Habitat Conditions	- -	Bernath-Plaisted et al. (2018)
			SK	Nesting success: 24% [c], Mayfield estimate (n=65)	Predation	-	Davis (2003)
				Nesting success: 46% (n=63)	Predation	-	Pipher (2011)
				Nesting survival: 75% (n=14, grazed) [d], 66% (n=17, ungrazed) [d]	Predation, Grazing	- 0	Lusk and Koper (2013)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Reproduction	Breeding	Nest Success	SK	Nesting success: 34% (n=187) [c]	Predation	-	Davis (2014)
				Effect of ungrazed and moderate grazed prairie vs. light grazed	Grazing: Ungrazed/ Moderate, Light	+ -	Pipher et al. (2016)
				Effect of years grazed (2-3 years vs 15+ years)	Grazing: Frequency	0	
				Effect of stocking rate: light or moderate	Grazing: Intensity	-	Lusk (2009), Lusk and Koper (2013)
				Increasing vegetation density and litter depth	Grassland condition	-	Lusk and Koper (2013)
				Overall nest success: 27% (range 1.6-63.5%, n=58)	Predation	-	Sutter et al. (2016)
				Nesting success: Planted grasslands (30%, Mayfield 25%, n=76); Native grasslands (35%, Mayfield 23%, n=110)	Grassland type: Planted, Native	0	Davis (2017)
Reproduction	Breeding	Productivity	AB	1.9 host young fledged per nest (n=21), 3.6 host young fledged per successful nest (n=11)	NA	NA	Ludlow et al. (2014)
			MB	0.9 young fledged per nest (n=unknown), 2.5 young fledged per successful nest (n=17)	Predation	NA	Davis (1994), Davis and Sealy (2000)
				Effect of grazing type: grazed or ungrazed on number of young fledged per nest or successful nest (n=35)	Grazing: Intensity	0	Lusk (2009)
			MT	1.3 young fledged per nest (n=129), 3.4 young fledged per successful nest (n=49)	Predation	-	Jones et al. (2010)
			SK	1.0 young fledged per nest (n=65), 3.4 young fledged per successful nest (n=unknown)	Annual variation, Predation	- -	Davis (2003b)
				Increasing patch size effect on number of fledglings	Landscape: Patch size	+	Davis et al. (2006)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Reproduction	Breeding	Productivity	SK	2.9 young fledged per nest (n=13), 3.4 young fledged per successful nest on grazed sites (n=11); 2.6 young fledged per nest (n=17), 3.7 young fledged per successful nest on ungrazed sites (n=12)	Grazing	0	Lusk (2009)
				1.7 young fledged per nest (n=33), 3.7 young fledged per successful nest (n=15)	Predation	-	Gaudet (2013)
				Number of nestlings surviving to day 8 with respect to distance to pipeline right-of-way	Energy Development: Distance from pipeline	+	Sutter et al. (2016)
				Planted grasslands: 0.9 young fledged per nest (n=76), 2.9 young fledged per successful nest (n=24); Native grasslands: 1.2 young fledged per nest (n=76), 3.3 young fledged per successful nest (n=39)	Predation, Grassland type: Planted, Native	- - 0	Davis (2017)
				3.6 young fledged per successful nest (n=24)	Predation	-	Sutter et al. (2016)
Reproduction	Breeding	Brown-headed Cowbird (BHCO) Parasitism	AB	0% BHCO parasitism (n=21 nests)	NA	0	Ludlow et al. (2014)
			MB	15% BHCO parasitism (n=20 nests)	Parasitism	-	De Smet (1992)
				18% BHCO parasitism (n=17 nests)	Parasitism	-	Davis (1994), Davis and Sealy (2000)
				Parasitism rates with decreasing patch size from 64 ha to 22 ha	Patch size	-	Davis and Sealy (2000)
			MT	2% BHCO parasitism (n=128 nests)	Parasitism	-	Jones et al. (2010)
				0% BHCO parasitism (n=7 nests)	NA	0	Pulliam and USFWS (unpubl. data)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Reproduction	Breeding	Brown-headed Cowbird (BHCO) Parasitism	ND	0% BHCO parasitism (n=7 nests)	NA	0	Granfors et al. (2001)
			SK	0% BHCO parasitism (n=33 nests)	NA	0	Maher (1973)
				0% BHCO parasitism (n=24 nests)	NA	0	Dale unpubl. data. in Davis et al. (2014)
				15% BHCO parasitism (n=65 nests)	Parasitism	-	Davis (2003)
				16% BHCO parasitism (n=19 nests)	Parasitism	-	Klippenstine and Sealy (2008)
				0% BHCO parasitism (n=11 nests)	NA	0	Lusk (2009)
				0% BHCO parasitism (n=61 nests)	NA	0	Pipher (2011)
				0% BHCO parasitism (n=33 nests)	NA	0	Gaudet (2013)
				1% BHCO parasitism (n=69 nests)	Parasitism	-	Sutter et al. (2016)
				0% BHCO parasitism (n=50 nests)	NA	0	Sutter, Royal Saskatchewan Museum, Regina, Saskatchewan unpubl. data fide J. Shaffer
			MN, MT, ND, SD	0% BHCO parasitism (n=2 nests)	NA	0	Igl and Johnson (2007)
Reproduction	Breeding	Nest Placement	SK	Effect of distance from pipeline right-of-way on number of nests	Energy Development: Distance from pipeline	0	Sutter et al. (2016)
Reproduction	Breeding	Number of Clutches	SK	Average 1.5 clutches per year, some likely due to re-nesting after failure. Double-brooding rates poorly known	NA	NA	Maher (1973)
Reproduction	Breeding	Clutch Size	SK	Average 4-5 eggs per clutch, range 3-6	NA	NA	Davis (2003), Ludlow et al. (2014)
Reproduction	Breeding	Daily Nest Survival	MT	Effect of distance to roads	Roads	0	Jones and White (2012)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Reproduction	Breeding	Daily Nest Survival	SK	Effect of grazing: grazed vs. ungrazed	Grazing	0	Lusk (2009)
				Effect of increasing distance from pipeline right-of-way	Energy Development: Distance from pipeline	+	Sutter et al. (2016)
Survival	Breeding - Fl	Survival	SK	29% chance of fledglings surviving 27 days, survival was higher in native grasslands	Grassland Type: Predation, Native, Planted	+ + -	COSEWIC (2010), Davis and Fisher (2009)
Survival	Breeding - Fl	Daily Survival Rate	SK	0.971±0.007 SE in native prairie, 0.857±0.037 SE in restored grassland	Grassland Type: Native Restored	+ -	Fisher and Davis (2011b)
Survival	Breeding - Ad	Survival	-	None			
Survival	Breeding - Ad	Site Fidelity	MT	2% (1 of 48)	Unknown	NA	Jones et al. (2007)
			SK	Male return rate: 4% (8 of 190) Female return rate: 2.7% (2 of 74)	Unknown	NA	Davis et al. (2014)
Survival	Breeding - Fl	Natal Site Fidelity	MT	0 of 160 banded nestlings returned	Unknown	NA	Jones et al. (2007)
			SK	0 of 168 banded nestlings returned	Unknown	NA	Davis et al. (2014)
Survival	Breeding - Ad	Longevity	SK	One male 4 years old, one female at least 3 years old	NA	NA	Davis et al. (2014)
Survival	Migration	Survival	-	None			
Survival	Migration	Stopover Ecology	-	None			
Survival	Wintering	Site Fidelity	-	None			
Survival	Wintering	Survival	-	None			

[a] Ad– Adult, Fl –Fledgling

[b] Effect: = is a positive response, - = negative response, 0 = no effect, NA = not applicable.

[c] Nest success = raw % of nests that were successful

[d] Nest that fledged at least one host or cowbird chick

Appendix H. Vital rates and demographic parameters for Chestnut-collared Longspur.

Vital rates, demographic information, and effects of habitat and landscape on abundance and density for Chestnut-collared Longspur.

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Breeding - Ad	Occurrence	CO, KS, NE, OK	Occurrence in dryland agriculture or Conservation Reserve Program (CRP)	Habitat Type: Dryland Agriculture, CRP	- (absent) - (absent)	McLachlan (2017)
			ND	Increase of shrub cover to 10%	Vegetation Structure: Shrub/Woodland Cover	- (-90%)	Grant et al. (2004)
			SD	Increase of shrub cover to 50%, Increase of shrub cover to 3.5%	Vegetation Structure: Shrub/Woodland Cover to 50% To 3.5%	- (99%) - (90%)	Greer et al. (2016)
				Effect of percentage grass within 3.2 km	Landscape: Grassland Cover	0	Greer et al. (2016)
			SK	Minimum patch size for occupancy, 39 ha	Landscape: Patch size	NA	Davis (2004)
Abundance	Breeding - Ad	Abundance	AB	Increasing distance from gas well, Increasing distance from roads (>150 m)	Energy Development: Gas wells, Roads	+ +	Linnen (2008)
				Effect of high or low gas well density	Energy development: Gas wells	0	Hamilton et al. (2011)
				Within 1.95 km of cropland edges, Within 1.05 km of wetland edges, Effect of roads	Landscape: Cropland, Wetlands, Roads	- (-25%) - (-25%) 0	Sliwinski and Koper (2012)
				Effect of shallow gas wells	Energy Development: Gas wells	0	Rodgers (2013)
				Reduced near roads vs. off-road (0.84 vs. 1.48 birds per point count, respectively)	Roads: Roadside, Off-road	- +	Wellicome et al. (2014)
			ND	Effect of reduced aspen cover within 500 m	Vegetation Structure: Shrub/Woodland Cover	+	Grant et al. (2004)
				Effect of distance from oil drilling (<550 m), Effect of roads	Energy development- Oil wells, Roads	- 0	Thompson et al. (2015)
				Effect of wind turbine development: Immediate vs. delayed effect post-development	Energy Development: Wind turbines	-	Shaffer and Buhl (2016)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Breeding - Ad	Abundance	SK	Effect 1 year post burn, Effect 2 years post burn	Fire: 1 yr post-burn 2 yrs post-burn	- +	Maher (1973)
				Effect of roads: Reduced distance from two tracks vs. paved roads	Roads: Two tracks, Paved roads	+ -	Sutter et al. (2000)
				Effect of grazing: Grazed vs. ungrazed	Grazing: Grazed, Ungrazed	+ (3x) -	Bleho (2009), Lusk (2009)
				Effect of increasing gas well infrastructure	Energy Development: Gas well density, Distance from wells	+ +	Kalyn Bogard (2011)
				Effect of altered vegetation structure and gas wells	Energy Development: Gas wells, Vegetation Structure	0 0	
				Effect of distance (>200 m) from gas wells	Energy Development: Gas wells	+	Kalyn Bogard and Davis (2014)
				Effect of increased gas well density	Energy Development: Gas wells	+	
				Effect of increased hayland in landscape	Landscape: Percentage hayland	-	Davis et al. (2016)
Abundance	Migration	Abundance	-	None			
Abundance	Wintering - Ad	Abundance	Chihuahua, Mexico	Abundance on prairie dog colonies vs. away from prairie dog colonies	Presence of prairie dogs	+	Desmond (2004)
				Effect of grazing intensity	Grazing: Overgrazing	-	
				Effect of vegetation structure where grass is <0.5 m tall and <1% shrub cover	Vegetation Structure: Shrub/Woodland Cover	+	Macías-Duarte et al. (2009)
Abundance	Breeding - Ad	Territory Size	AB	Territory size average 1.0 ha	NA	NA	Bleho et al. (2015)
			MB	Territory size range 0.2-0.4 ha	NA	NA	Harris (1944)
			SK	Territory size 0.4-0.8 ha, max 4.0 ha in marginal habitat	Grassland condition: Reduced condition	+	Fairfield (1968)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Breeding - Ad	Density	AB	Effect of increasing percentage of grass in landscape	Landscape: Grass coverage	+	Koper and Schmiegelow (2006)
				Effect of increasing length of wetland edges	Landscape: Wetland size	+	
				Effect of increasing distance from water, crops, roads	Landscape: Wetlands, Crops, Roads	+ + +	
				Effect of increasing distance to water, crops and roads	Landscape: Wetlands, Crops, Roads	+ + 0	Sliwinski and Koper (2012)
			BCR 17 (Prairies and Badlands)	5.2-40.3 birds per 100 ha (2009-2017)	NA	NA	Bird Conservancy of the Rockies (2018)
			MT	Effect of crested wheatgrass vs. native prairie	Grassland Type: Native, Crested Wheatgrass	0 0	Lloyd and Martin (2005)
				Range 170-190 (mean 180) pairs per 100 ha in native prairie; Range 60-180 (mean 120) pairs per 100 ha in tame grassland	Grassland Type: Native, Tame	+ 0	
				Predicted abundance: Rest-rotation: 9.0 (2013) and 5.8 (2014) birds per 100 ha; Season-long: 8.0 (2013) and 5.2 (2014) birds per 100 ha	Grazing: Rest-rotation vs. Season-long	0	Golding and Dreitz (2017)
				140 birds per 100 ha mean (867 pts), 620 birds per 100 ha maximum	NA	NA	Lipsey (unpubl. data)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Breeding - Ad	Density	MT	1.7-9.5 birds per 100 ha (2010-2015); 4.3-41.9 birds per 100 ha (2011-12, 2014-2017) in BCR 11; 14.6-96.9 birds per 100 ha (2010-12, 2014-17) on BLM land in BCR 11	NA	NA	Bird Conservancy of the Rockies (2018)
			ND	Effect of distance to cattle water structures	Cattle water structures	0	Fontaine et al. (2004)
				4.4-49.9 birds per 100 ha (2011-17) in BCR17 in ND	NA	NA	Bird Conservancy of the Rockies (2018)
			SD	Effect of increasing woody cover	Vegetation Structure: Shrub/Woodland Cover	-	Greer et al. (2006)
				Effect of patch size: large (>100 ha) vs. small (<50 ha) patches	Landscape/ Patch Size: >100 ha, <50 ha	+ -	Berman (2007)
				Effect of wind turbines	Energy Development: Wind turbines	0	Shaffer and Johnson (2008)
				2.3-56.2 birds per 100 ha (2010-2017) in BCR17	NA	NA	Bird Conservancy of the Rockies (2018)
			SK	70-120 (mean 90) pairs per 100 ha, grazed native prairie; 0-20 (mean 10) pairs per 100 ha, ungrazed native prairie	Grazing: Grazed, native, Ungrazed, native	+ -	Maher (1973)
				Effect of increased disturbance, Effect of increasing vegetation height and volume	Vegetation structure: Vegetation height Vegetation volume, Disturbance	+ + -	Gaudet (2013)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Breeding - Ad	Density	MN, MT, ND, SD	0.50 pairs per 100 ha (range 0-1.38 pairs per 100 ha)	NA	NA	Igl (2009)
Abundance	Migration	Density	-	None			
Abundance	Wintering - Ad	Density	Sonoita, AZ	Average 92.4 birds per 100 ha (2008-12)	NA	NA	CEC (2013)
			Sulfur Springs, AZ	Average 6.5 birds per 100 ha (2011-12)	NA	NA	
			Bootheel, NM	Average 141.6 birds per 100 ha (2011-12)	NA	NA	
			Otero Mesa, NM	Average 138.2 birds per 100 ha (2011-12)	NA	NA	
			Armendaris, NM	Average 73.4 birds per 100 ha (2011-12)	NA	NA	
			OK	Average densities on different study plots per year: 5 and 37 birds per 100 ha (1978, 1979, respectively); 69 birds per 100 ha (1977); 41 and 46 birds per 100 ha (1976, 1978, respectively); 46 birds per 100 ha (1977); 83 birds per 100 ha (1976); 166 birds per 100 ha (1978)	NA	NA	Gryzbowski (1982)
			Marfa, TX	Average 130.9 birds per 100 ha (2009-11); Range 67.8–117.0 birds per 100 ha (2014-17)	NA	NA	CEC (2013), Bird Conservancy of the Rockies (unpubl. data)
			w. TX	Average densities on different study plots per year: 16, 5, and 30 birds per 100 ha (1977, 1978, 1979, respectively); 14, 3 birds per 100 ha (1977, 1979, respectively); 22, 35, and 122 birds per 100 ha (1977, 1978, 1979, respectively)	NA	NA	Grzybowski (1980)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Wintering - Ad	Density	Alto Conchos, Chihuahua	Average 41.9 birds per 100 ha (2012-13)	NA	NA	CEC (2013)
			Cuchillas de la Zarca, Durango	Average 145.4 birds per 100 ha (2007-2012)	NA	NA	
			Janos, Chihuahua	Average 161.1 birds per 100 ha (2007-2012)	NA	NA	
			Lagunas del Este, Chihuahua	Average 243.9 birds per 100 ha (2009-12)	NA	NA	
			Llano Las Amapolas, Chihuahua	Average 275.2 birds per 100 ha (2011-12)	NA	NA	
			Mapimí, Durango	Average 48.4 birds per 100 ha (2007-12)	NA	NA	
			El Tokio, primarily Coahuila	Average 0.11 birds per 100 ha (2007-13)	NA	NA	
			Valles Centrales, Chihuahua	Average 287.4 birds per 100 ha (2007-13)	NA	NA	
			Valle Colombia, Coahuila	Average 40.3 birds per 100 ha (2007-13)	NA	NA	
Reproduction	Breeding - Ad	Nest Success	AB	Effect of gas wells on apparent nest success	Energy Development: Gas wells	0	Yoo (2014)
			Canada	Effect of grazing type in meta-analysis of nests across multiple studies (n=351)	Grazing	0	Bleho et al. (2014)
			CO	Overall nest survival: 0.254 ± 0.069 (SE); Effect of increased drought, average temperature, storms	Climate: Drought, Average temperature, Storms	- - -	Conrey et al. (2016)
			MB	Nesting success: 45% (n=57) [c]	NA	NA	Davis (1994)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Reproduction	Breeding - Ad	Nest Success	MT	Fledging success (number of young fledged per egg hatched): 48% (1997), 72% (1998)	Predation	-	Lynn and Wingfield (2003)
				Nesting success (nests that fledged any young): 57% (1997, n=14), 74% (1998, n=19)	Predation	-	
				Nesting success: 47.9% in native grass (n=167) [c], 41% in tame grass (n=134) [c]	Grassland Type: Native vs. Tame	0	Lloyd and Martin (2005)
				Nesting success: 44% (n=770) [c]	Predation, Weather	- -	Jones et al. (2010)
				Apparent nest success: 40% (2017, n=102), 25% (2018, n=128)	NA	NA	Pulliam and USFWS (unpubl. data)
			MT and ND	Nest survival: 36% (logistic exposure method)	Increasing temperature, Reduced grassland conditions	- -	Bernath-Plaisted et al. (2018)
			SD	Nesting success: 55% (n=42) [c] Mayfield: 29%	Predation	-	Berman (2007)
			SK	Nesting success: 30% (n=474) [c]	Predation	-	Davis (2003)
				Effect of increasing distance from edges	Landscape: Edge effect	-	Davis (2004, 2006)
				Effect of increasing patch size	Landscape: Patch size	+	Davis et al. (2006)
				Effect of light or moderate grazing	Grazing Intensity: Light, Moderate	0 0	Lusk (2009)
				Nesting success: 41% (n=133) [c]	NA	NA	Pipher (2011)
				Nesting success: 30.3% (n=212) [c]	NA	NA	Gaudet (2013)
				Effect of gas wells on apparent nest success	Energy Development: Gas wells	0	

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Reproduction	Breeding - Ad	Nest Success	SK	Nesting success: 30% (n=57, grazed) [c], 23% (n=14, ungrazed) [c]	Predation; Grazing Intensity: Grazed, Ungrazed	- 0 0	Lusk and Koper (2013)
				Effect of increasing percentage planted pasture within 400 m	Landscape: Percentage planted pasture	+	Davis et al. (2016)
Reproduction	Breeding - Ad	Productivity	AB	Effect of reduced distance to well pads on number of fledged young per nest	Energy Development: Gas wells	-	Yoo (2014)
				3.4 young fledged per successful nest (n=142)	NA	NA	Hill (1997)
				Fewer young fledged per successful nests with decreasing distance to well pads	Energy Development: Gas wells	-	Yoo (2014)
			CO	Number of young fledged per successful nest: 3.4 (n=10)	Predation, Weather	- -	Conrey et al. (2016)
			MB	3.5 young fledged per successful nest (n=26)	NA	NA	Davis (1994)
			MT	Number of young fledged per successful nest: 3.6 (1997, n=14), 4.25 (1998, n=19)	Predation	-	Lynn and Wingfield (2003)
				1.5 young fledged per nest (n=770), 3.4 young fledged per successful nest (n=342)	NA	NA	Jones et al. (2010)
			SD	1.8 young fledged per nest (n=42)	NA	NA	Berman (2007)
			SK	0.9 host young fledged per nest (n=474), 3.0 host young fledged per successful nest (n=141)	Predation	-	Davis (2003b)
				1.4 young fledged per nest (n=40) [d], 2.9 young fledged per successful nest on grazed sites (n=19) [d], 1.0 young fledged per nest (n=8) [d], 2.7 young fledged per successful nest on ungrazed sites (n=3) [d]	Grazing Intensity: Grazed, Ungrazed	 + -	Lusk (2009)
				Effect of reduced distance to well pads on number of fledged young per nest	Energy Development: Gas wells	+	Gaudet (2013)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Reproduction	Breeding - Ad	Productivity	SK	1.0 young fledged per nest (n=212); 3.2 young fledged per successful nest (n=64)	NA	NA	Gaudet (2013)
				Effect of reduced distance to well pads on number of fledged young per successful nest	Energy Development: Gas wells	+	
				0.6 more young fledged per nest in native prairie vs tame grass	Grassland Type: Native, Tame	+ -	Davis et al. (2016)
Reproduction	Breeding - Ad	Brown-headed Cowbird (BHCO) Parasitism	AB	Effect of distance to roads or gas wells	Energy Development: Roads, Gas wells	0 0	Ludlow et al. (2015)
				0% BHCO parasitism (n=254 nests)	NA	NA	Bleho et al. (2015)
			MB	4% BHCO parasitism (n=23 nests)	Parasitism	-	Harris (1944)
				12% BHCO parasitism (n=26 nests)	Parasitism	-	De Smet (1992)
				14% BHCO parasitism (n=57 nests)	Parasitism	-	Davis (1994), Davis and Sealy (2000)
			MN, MT, SD, ND	8% BHCO parasitism (n=26 nests)	Parasitism	-	Igl and Johnson (2007)
			MT	2% BHCO parasitism (n=134 nests) tame grassland	Parasitism	-	Lloyd and Martin (2005)
				2% BHCO parasitism (n=770 nests)	Parasitism	-	Jones et al. (2010)
				3% BHCO parasitism (n=167 nests) native grassland	Parasitism	-	Lloyd and Martin (2005)
				0% BHCO parasitism (n=264 nests)	NA	NA	Pulliam and USFWS (unpubl. data)
			ND	22% BHCO parasitism (n=37 nests)	Parasitism	-	R.E. Stewart in Friedmann et al. (1977)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Reproduction	Breeding - Ad	Brown-headed Cowbird (BHCO) Parasitism	ND	23% BHCO parasitism (n=62 nests)	Parasitism	-	Stewart (1975)
				4% BHCO parasitism (n=71 nests)	Parasitism	-	Granfors et al. (2001)
			SD	7% BHCO parasitism (n=42 nests)	Parasitism	-	Berman (2007)
			SK	4% BHCO parasitism (n=27 nests)	Parasitism	-	Smith and Smith (1966)
				0% BHCO parasitism (n=36 nests)	NA	NA	Fairfield (1968)
				0% BHCO parasitism (n=38 nests)	NA	NA	Regina Museum of Natural History Nest Record Cards in Fairfield (1968)
				0% BHCO parasitism (n=111 nests)	NA	NA	Maher (1973)
				18% BHCO parasitism (n=22 nests)	Parasitism	-	Prairie Nest Records Scheme in Maher (1973)
				16% BHCO parasitism (n=490 nests)	Parasitism	-	Davis (2003)
				Effect on parasitism rates	Landscape: Patch size	0	Davis et al. (2006)
				5% BHCO parasitism (n=96 nests)	Parasitism	-	Klippestine and Sealy (2008)
				0% BHCO parasitism (n=54 nests)	NA	NA	Lusk (2009)
				0% BHCO parasitism (n=115 nests)	NA	NA	Pipher (2011)
				<0.01% BHCO parasitism (n=212 nests)	Parasitism	NA	Gaudet (2013)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Reproduction	Breeding - Ad	Nest Placement	AB	Nesting within 100 m of roads or trails to gas wells	Energy Development: Gas wells	- (no nesting)	Ludlow et al. (2015)
			SK	Effect of increasing distance from gas wells on nest occurrence	Energy Development: Gas wells	+	Gaudet (2013)
				Effect of gas well noise, fences or roads	Energy Development: Gas well noise, Fences, Roads	0 0 0	
Reproduction	Breeding - Ad	Clutch Size	AB	Effect of increasing distance from gas wells	Energy Development: Gas wells	+	Yoo (2014)
				Effect of high or low impact roads	Roads: High impact, Low impact	0 0	
			MT	Range 3.8-4.1 eggs per nest (n=212), effect of grassland type, i.e., native vs tame	Grassland Type: Native vs. Tame	0	Lloyd and Martin (2005)
			SK	Effect of distance to gas wells	Energy Development: Gas wells	0	Gaudet (2013)
Reproduction	Breeding - Ad	Number of Clutches	SK	Often double brooded, possibly treble brooded. Frequently re-nests after failure with up to 4 nests per year after successive failures	NA	NA	Bleho et al. (2015)
Reproduction	Breeding - Ad	Daily Nest Survival	CO	0.940 ± 0.012 (SE)	Predation, Climate	- -	Conrey et al. (2016)
			MT	Effect of grassland type, i.e., crested wheatgrass vs native prairie	Grassland Type: Native, Crested Wheatgrass	+ - (-17%)	Lloyd and Martin (2005)
			SD	Effect of patch size: large (>100 ha) vs. small (<50 ha) patches	Landscape: Patch size >100 ha, <50 ha	+ -	Berman (2007)
				Effect of increasing litter depth	Vegetation Structure: Litter depth	+	
Survival	Breeding - Ad	Site Fidelity	AB	Male return rates: 67% (20 of 30), Female return rates: 32% (5 of 18)	NA	NA	Bleho et al. (2015)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Survival	Breeding - Ad	Site Fidelity	SK	Male return rate: 35.9% (14 of 39), Female return rate: 32.3% (21 of 65)	NA	NA	K. Ellison in Bleho et al. (2015)
Survival	Breeding - Fl	Natal Site Fidelity	AB	0% of 325 banded nestlings returned	NA	NA	Hill (1997)
Survival	Breeding - Ad	Survival	-	None			
Survival	Breeding - Fl	Survival	-	None			
Survival	Migration	Survival	-	None			
Survival	Migration	Stopover Ecology	-	None			
Survival	Wintering	Site Fidelity	-	None			
Survival	Wintering	Survival	-	None			

[a] Ad– Adult, Fl –Fledgling

[b] Effect: = positive response, - = negative response, 0 = no effect, NA = not applicable.

[c] Nest success = raw % of nests that were successful

[d] Nest that fledged at least one host or cowbird chick

Appendix I. Vital rates and demographic parameters for McCown's Longspur.

Vital rates, demographic information, and effects of habitat and landscape on abundance and density for McCown's Longspur.

Population Parameter	Life Cycle Phase / Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Breeding - Ad	Occurrence	CO, KS, MT, NE, OK	Occurrence where 75% of grass <15 cm	Vegetation height	+	McLachlan (2007)
			SD	Male occurrence with increasing percentage grass within 800 m	Landscape: Grassland cover	+	Greer (2009)
			SK	Minimum patch size for occupancy, 25 ha	Landscape: Patch size	NA	Davis (2003a), (2004)
				Increasing edge-to-area ratio	Landscape: Edge effects	-	
Abundance	Breeding - Ad	Abundance	BBS	Increased annual precipitation	Precipitation	+	Conrey et al. (2016)
			AB	Decreasing distance from wells and access roads (nearly absent within 300 m)	Energy development: Gas wells, Roads	- -	Linnen (2008)
				Reduced near roads vs. off-road (0.12 vs. 0.29 birds per point count, respectively)	Roads: Roadside, Off-road	- +	Wellicome et al. (2014)
			CO/WY	Increasing proximity to prairie dog colonies	Proximity to prairie dog colonies	+	Augustine and Baker (2013)
			MT	Decreasing soil productivity	Soil productivity	+	Lipsey and Naugle (2017)
			SK	Increasing percentage grass near Permanent Cover Program (PCP) lands	Landscape: Grassland cover	+	McMaster and Davis (1998)
				Effect of amount of crop and wetlands within 1.6 km on number of pairs	Landscape: Crop, Wetland	0 0	McMaster et al. (1999)
				Increasing litter and percentage of grass coverage	Vegetation structure	-	White (2009)
				Effect <600 m from gas wells	Energy development: Gas wells	-	Kalyn Bogard (2011), Kalyn Bogard and Davis (2014)
				Effect of increasing number of gas wells from no wells to more than one	Energy development: Gas wells	-	

Population Parameter	Life Cycle Phase / Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Breeding - Ad	Abundance	SK	Effect of reduced grass cover and low litter cover	Vegetation structure	+	Kalyn Bogard and Davis (2014)
				Effect of increasing grass cover within 400 m	Landscape: Grassland cover	+	Davis et al. (2016)
			WY	Effect of area of suitable habitat or high prey abundance	Habitat availability, Prey abundance	0 0	Greer and Anderson (1989)
Abundance	Migration	Abundance	-	None			
Abundance	Wintering	Abundance	-	None			
Abundance	Breeding - Ad	Territory Size	CO	Territory size range 1.1-1.4 ha (n=14)	NA	NA	Wiens (1970, 1971)
				Territory size average 0.93 ha (n=20)	NA	NA	With (2010)
			SK	Territory size range 0.5-1.0 ha	NA	NA	Felske (1971)
			WY	Territory size average 0.6 ha (n=74)	NA	NA	Greer (1988), Greer and Anderson (1989)
Abundance	Breeding - Ad	Density	BCR 17 (Badlands and Prairies)	0.57 and 0.96 birds per 100 ha (2013 and 2016, respectively)	NA	NA	Bird Conservancy of the Rockies (2018)
			CO	41 and 46 pairs per 100 ha, heavy grazing, short grass	Grazing intensity: Heavy	+	Giezentanner (1970)
				13.6 and 40.8 pairs per 100 ha, light grazing, short grass	Grazing intensity: Light	-	
				12-14 pairs per 100 ha average across all plots in study; 82-94 birds per 100 ha	NA	NA	
				76 birds per 100 ha, heavy grazing, short grass	Grazing intensity: Heavy	+	Wiens (1970)
				81.5 birds per 100 ha	NA	NA	Porter and Ryder (1974)

Population Parameter	Life Cycle Phase / Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Breeding - Ad	Density	CO	2.1-4.1 birds per 100 ha (2008-09, 2015); 5.1-9.5 birds per 100 ha (2008-09, 2015) in BCR 18	NA	NA	Bird Conservancy of the Rockies (2018)
			MT	2 birds per 100 ha mean (867 pts), 36 birds per 100 ha maximum	NA	NA	Lipsey (unpubl. data)
				Predicted abundance: 132.4 (2013) and 144.4 (2014) birds per 100 ha, rest-rotation; 53.2 (2013) and 58.0 (2014) birds per 100 ha, season-long	Grazing: Rest-rotation, Season-long	+ -	Golding and Dreitz (2017)
				1.3-3.5 birds per 100 ha (2010-12, 2014); 4.7-15.8 birds per 100 ha (2010-12, 2014) in BCR 11	NA	NA	Bird Conservancy of the Rockies (2018)
			SD	Male density with increasing percentage of grass within 800 m	Landscape: Grassland cover	+	Greer (2009)
			SK	79 birds per 100 ha	NA	NA	Maher (1973)
			WY	77 and 126 pairs per 100 ha average, 38 and 65 birds per 100 ha	NA	NA	Finzel (1964)
				1.4-4.1 birds per 100 ha (2012-13, 2015-16); 1.9-3.2 birds per 100 ha (2012-13, 2015-16) in BCR 10; 4.3-7.4 birds per 100 ha (2012-13, 2016) on BLM land	NA	NA	Bird Conservancy of the Rockies (2018)
Abundance	Migration	Density	-	None			
Abundance	Wintering - Ad	Density	w. TX	Average densities on different study plots: 62 birds per 100 ha (1979), 13 and 17 birds per 100 ha (1978, 1979, respectively)	NA	NA	Grzybowski (1980, 1982)
Reproduction	Breeding - Ad	Nest Success	CO	Fledging success: 75% (n=53) [c]	Predation	-	Strong (1971)
				Fledging success: 42% (n=34) [d]	Predation	-	Creighton and Baldwin (1974)
				Fledging success: 38% (n=76) [d]	Predation	-	With (1994), With (2010)

Population Parameter	Life Cycle Phase / Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Reproduction	Breeding - Ad	Nest Success	CO	22% nests by shrubs fledged 1+ young, 40-60% nests fledged 1+ young away from shrubs	Nest site: Near shrub Away from shrubs	- +	With (1994)
				77% nest failure near shrubs or cactus	Nest site: Near shrubs/cactus	-	
				Nesting success: Mayfield estimate, 42.3% (1997, n=16 nests), 27.0% (1998, n=23 nests), 28.3% (1999, n=10 nests), 75.0% (2001, n=8 nests)	Predation	-	Skagen unpubl. data in Sedgwick (2004)
				Overall nest survival: 0.202 ± 0.027 (SE)	NA	NA	Conrey et al. (2016)
				Increasing drought and storms	Climate: Drought, Storms	- -	
				Nesting success: 17.3% (2011, n=69 nests), 7.5% (2012, n=64 nests, drought year)	Climate: Drought	-	Skagen et al. (2018)
			MT	Apparent nest success: 100% (2017, n=1), 33% (2018, n=15)	NA	NA	Pulliam and USFWS (unpubl. data)
			SK	Fledging success: 45-54% (n=unknown) [d]	Not reported	NA	Felske (1971)
				Nesting success: 20% (n=5) [e]	Predation	-	Pipher (2011)
			WY	Fledging success: 77% (n=45) [c]	Predation	-	Mickey (1943)
				Nest predation 50-75% in heavy grazed pasture; Nest predation 42-60% in moderate grazed pasture	Grazing intensity: Heavy, Moderate	- +	With (1994)
Reproduction	Breeding - Ad	Productivity	CO	1.3 young fledged per nest (n=53 nests), 2.4 young fledged per successful nest (n=unknown) [e]	NA	NA	Strong (1971), Porter and Ryder (1974)
				1.1 young fledged per nest (n=77 nests), 2.7 young fledged per successful nest (n=31 nests) [e]	NA	NA	With (1994), Sedgwick (2004)
				Number of young fledged per successful nest: 2.6 (n=86)	Predation, Weather	- -	Conrey et al. (2016)

Population Parameter	Life Cycle Phase / Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Reproduction	Breeding - Ad	Productivity	CO	Number of young fledged per successful nest: 2.2 ± 0.88 (2011, n=26 nests), 2.2 ± 0.44 (2012, n=13 nests, drought year)	NA	NA	Skagen et al. (2018)
			SK	1.6 young fledged per nest (n=unknown), 2.0 young fledged per successful nest [e]	NA	NA	Felske (1971)
			WY	1.6 young fledged per nest (n=45 nests), 3.5 young fledged per successful nest (n=unknown) [e]	NA	NA	Mickey (1943)
Reproduction	Breeding - Ad	Brown-headed Cowbird (BHCO) Parasitism	ND	67% BHCO parasitism (n=3 nests)	Parasitism	-	Friedmann (1963)
			MT	0% BHCO parasitism (n=16 nests)	NA	NA	Pulliam and USFWS (unpubl. data)
			SK	0% BHCO parasitism (n=74 nests)	Parasitism	0	Maher (1973)
				0% BHCO parasitism (n=5 nests)	Parasitism	0	Pipher (2011)
			WY	0% BHCO parasitism (n=71 nests)	Parasitism	0	Mahoney and Chalfoun (2016)
Reproduction	Breeding - Ad	No. of Clutches	CO	Frequently double brooded	NA	NA	With (2010)
			SK	1.5-1.8 clutches per female per year	NA	NA	Maher (1973)
				1.3-1.4 clutches per female per year	NA	NA	Felske (1971)
Reproduction	Breeding - Ad	Clutch Size	CO	Average 3.1 eggs per clutch	NA	NA	Strong (1971), Porter and Ryder (1974), With (2010)
			MT, SK, WY	Average 3.4-3.6 eggs per clutch	NA	NA	DuBois (1935), Mickey (1943), Maher (1973)
			WY	Effect of wind turbines	Energy development: Wind turbines	0	Mahoney and Chalfoun (2016)

Population Parameter	Life Cycle Phase / Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Reproduction	Breeding - Ad	Daily Nest Survival	CO	0.930 ± 0.006 (n=339),	Climate	-	Conrey et al. (2016)
				0.923 ± 0.010 (SE) (2011), 0.889 ± 0.014 (SE) (2012, drought year)	Climate: Drought	-	Skagen et al. (2018)
			WY	Effect of wind turbines	Energy development: Wind turbines	0	Mahoney and Chalfoun (2016)
Reproduction	Breeding - Ad	Hatching Success	CO	54% (n=53 nests)	NA	NA	Strong (1971)
				70.9% (n=34 nests)	NA	NA	Creighton and Baldwin (1974)
				60.2% (n=36 nests) in heavily grazed pasture; 78% (n=25 nests) in moderate grazed pasture	Grazing intensity: Heavy Moderate	 - +	With (1994)
Survival	Breeding - Ad	Site Fidelity	SK	100% (2 of 2 adult males)	NA	NA	Ryder (1972)
Survival	Breeding - Fl	Natal Site Fidelity	CO	0% (0 of 74) returned	Unknown	NA	With (2010)
Survival	Breeding - Ad	Survival	-	None			
Survival	Breeding - Fl	Survival	-	None			
Survival	Migration	Survival	-	None			
Survival	Migration	Stopover Ecology	-	None			
Survival	Wintering	Site Fidelity	-	None			
Survival	Wintering	Survival	-	None			

[a] Ad– Adult, Fl –Fledgling

b Effect: = positive response, - = negative response, 0 = no effect, NA = not applicable.

c Fledging success (number fledglings per number of hatchlings) calculated by taking proportion of total young fledged across all nests (successful and unsuccessful), rather than the average proportion of young that fledged per nest.

[d] Fledging success (number fledglings per number of hatchlings) calculated by using number of fledglings per number of nestlings, thus excluding nests that failed before hatching.

[e] Nest that fledged at least one host or cowbird chick

Appendix J. Vital rates and demographic parameters for Baird’s Sparrow.

Vital rates, demographic information, and effects of habitat and landscape on abundance and density for Baird’s Sparrow.

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Breeding - Ad	Occurrence	AB	Effect of four grazing systems	Grazing system	0	Prescott and Wagner (1996)
			ND	Increase of shrub cover to 18%, Increase of shrub cover to 54%	Vegetation Structure: Shrub/Woodland Cover at 18%, at 54%	- (-50%) - (-90%)	Madden et al. (2000)
				Increase of woody cover to 10%	Vegetation Structure: Shrub/Woodland Cover	- (20%)	Grant et al. (2004)
			SK	Minimum patch size for occupancy, 25 ha	Landscape: Patch size	NA	Davis (2003a, 2004)
Abundance	Breeding - Ad	Abundance	AB	Increase of gas wells from 4 to 60 km^{-2}	Energy Development: Gas wells	- (-73%)	Linnen (2008), Dale et al. (2009)
				Within 350 m of wells and road infrastructure	Energy Development: Gas wells, Roads	- -	Linnen (2008)
				Near roads vs. off-road (0.01 vs. 0.15 birds per point count, respectively)	Roads: Roadside, Off-road	- +	Wellicome et al. (2014)
			Canada	Type of grazing management	Grazing: Ungrazed, Grazed	+ -	Bleho (2009)
			MB	Altered vegetation structure, Increase in gas well density	Energy development: Vegetation Structure, Gas wells	- -	Rodgers and Koper (2017)
			MT	Reduction in soil productivity	Soil productivity	-	Lipsey and Naugle (2017)
			ND	Effect of prescribed fire every 4-6 years in mesic grasslands	Fire	+	Madden et al. (1999), Winter (1999)
				Effect of moisture indices	Climate: Moisture levels	0	Niemuth et al (2008)
				Within 550 m of gas wells	Energy development: Gas wells	-	Dale et al. (2009), Thompson et al. (2015)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Breeding - Ad	Abundance	ND	Within year precipitation, Within year standardized temperature index	Climate: Precipitation, Temperature	+ -	Gorza et al. (2016)
			Badlands and Prairies BCR	Effect of prescribed fire, 1-2 yrs post-burn	Fire	-	Shaffer et al. (2018d)
				Effect of prescribed fire, 2-5 yrs post-burn	Fire	+	
			SD	Effect of percentage grass within 800m	Landscape: Patch size, Edge avoidance	+ +	Greer (2009)
			SK	Effect of wetlands or croplands within 1.6 km	Landscape: Wetlands, Cropland	0 0	McMaster et al. (1999)
				Reduced distance to two-track roads Reduced distance to paved roads	Roads: Two-track, Paved	+ -	Sutter et al. (2000)
				Increasing patch size	Landscape: Patch size	+	Davis (2004, 2006)
				Increasing gas well density, Altered vegetation structure	Energy development: Gas wells, Vegetation Structure	0 -	COSEWIC (2012)
				Proximity or density of gas wells, Altered vegetation structure	Energy development: Gas wells, Vegetation structure	0 -	Bogard (2013), Kalyn Bogard and Davis (2014)
				Effect of high density of gas wells	Energy development: Gas wells	0	Bogard and Davis (2014)
				Effect of percentage grass within 400 m	Landscape: Patch size	+	Davis et al. (2016)
				Effect of native vs. planted pasture	Grassland type: Native, Planted	+ (2x) -	
Abundance	Migration	Abundance	-	None			

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Wintering - Ad	Abundance	Pima Co., AZ	Effect of grazed vs. ungrazed pasture	Grazing: Grazed vs. ungrazed (1997), Grazed vs. ungrazed (1998, 1999)	+ - 0	Gordon (2000a)
				Effect of 1 and 2 years post-fire vs. no fire	Fire: Unburned, 1 year post-fire, 2 years post-fire	- 0 0	
			Chihuahua Desert, Mexico	Effect of increasing shrub cover	Vegetation structure: Shrub/Woodland Cover	-	Pool et al. (2012)
Abundance	Breeding - Ad	Territory size	MT	Territory size range 0.1-1.1 ha, mean 0.42 ha	NA	NA	Jones (2011)
			ND	Territory size range 0.8-2.25 ha	NA	NA	Winter (1999)
			SK	Territory size range 0.3-0.6 ha	NA	NA	Lein (1968)
			Unknown	Territory size range 0.4-0.8 ha	NA	NA	Lane (1968)
Abundance	Wintering - Ad	Territory Use	Pima Co., AZ	Average movement within home range, 113 m	NA	NA	Gordon (2000b)
Abundance	Breeding - Ad	Density	AB	Effect of roads	Roads	0	Ludlow et al. (2015)
				Effect of percentage of crested wheatgrass	Vegetation structure: Percentage cover, Crested wheatgrass	0	
			BCR 17 (Badlands and Prairies)	1.3-7.5 birds per 100 ha	NA	NA	Bird Conservancy of the Rockies (2018)
			MT	1.4-6.9 birds per 100 ha (2010, 2014-15); 2.2-28.0 birds per 100 ha (2014-17) in BCR 11; 8.9-69.6 birds per 100 ha (2014-17) on BLM land in BCR 11	NA	NA	Bird Conservancy of the Rockies (2018)
				4 birds per 100 ha mean (867 pts), 26 birds per 100 ha maximum	NA	NA	Lipsey (unpubl. data)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Breeding - Ad	Density	ND	Effect of drought years	Climate: Precipitation	-	George et al. (1992)
				Spring density is negatively related to previous winter snowfall	Climate: Snowfall	-	Ahlering et al. (2009)
				Effect of previous May-Sept minimum temperature, Effect of Oct-Apr snowfall	Climate: Temperature (min), Snowfall,	- -	
				Effect of May-Sept average temperature or maximum temperature, Effect of total precipitation	Climate: Temperature, Snowfall, Precipitation	0 0	
Abundance	Migration	Density	-	None			
Abundance	Wintering - Ad	Density	Sonoita, AZ and Sonora outside RGJV boundary	Average 12.6 (95% CRI 7.5-18.0 birds per 100 ha (2008-11); Average 16.8 birds per 100 ha (2008-12)	NA	NA	Pool et al. (2012) CEC (2013)
			Sulfur Springs, AZ	Average 1.6 birds per 100 ha (2007-13)	NA	NA	CEC (2013)
			Mimms Ranch, Marfa, TX	Average 1.4 birds per 100 ha (2009-11)	NA	NA	Bird Conservancy of the Rockies (2018)
			Mimms Ranch, Marfa, TX	4.4-50.1 birds per 100 ha (2014-17)	NA	NA	
			New Mexico Bootheel, NM	Average 1.4 birds per 100 ha (2011-12)	NA	NA	CEC (2013)
			w. TX	Average densities on different study plots: 14 and 20 birds per 100 ha (1977)	NA	NA	Grzybowski (1980)
			Alto Conchos, Chihuahua	Average 7.1 birds per 100 ha (2012-13)	NA	NA	CEC (2013)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Abundance	Wintering - Ad	Density	Cuchillas de la Zarca, Durango	Average 47.0 (95% CRI 40.2-54.7) birds per 100 ha (2007-11), maximum density 69.9 birds per 100 ha (2011); Average 47.3 birds/100 ha (2007-12)	NA	NA	Pool et al. (2012) CEC (2013)
			Janos, Chihuahua	Average 6.7 birds per 100 ha (2007-12)	NA	NA	CEC (2013)
			Lagunas del Este, Chihuahua	Average 4.2 birds per 100 ha (2009-12)	NA	NA	
			Llano Las Amapolas, Chihuahua	Average 26.6 birds per 100 ha (2011-12)	NA	NA	
			Malpaís, Durango	Average 9.6 birds per 100 ha (2010-13)	NA	NA	
			Mapimí, Chihuahua and Durango	Average 1.1 birds per 100 ha (2007-12)	NA	NA	
			Otero Mesa, NM	Average 1.5 birds per 100 ha (2011-12)	NA	NA	
			Valles Centrales, Chihuahua	Average 7.8 birds per 100 ha (2007-13)	NA	NA	
			Valle Colombia, Coahuila	Average 3.8 birds per 100 ha (2007-13)	NA	NA	CEC (2013)
Reproduction	Breeding - Ad	Nest Success	AB	Nesting success: 31% (n=35) [c]	Predation, Vegetation Structure, Increasing Temperature	- - -	Ludlow et al. (2014)
				Effect of percentage of crested wheatgrass	Vegetation structure: Percentage cover crested wheatgrass	0	Ludlow et al. (2015)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Reproduction	Breeding - Ad	Nest Success	AB	Effect of gas wells	Energy development: Gas wells	0	Ludlow et al. (2015)
				Number of young fledged from successful nests near trails to gas wells	Roads	-	
			Canada	Effect of moderately grazed pasture vs. ungrazed pasture	Grazing: Moderately grazed Ungrazed	+ 0	Bleho et al. (2014)
			MB	Nesting success: 54% (n=74) [c], 37% Mayfield estimate	Predation	-	Davis and Sealy (1998)
			MT	Nesting success: 32.8% (n=51), Mayfield estimate	Predation, Weather	- -	Jones et al. (2010)
				Apparent nest success: 38% (2017, n=8), 25% (2018, n=12)	NA	NA	Pulliam and USFWS (unpubl. data)
			MT and ND	Nest survival: 30-54% (logistic exposure method)	Grassland condition, Predation	- -	Bernath-Plaisted et al. (2018)
			SK	Nesting success: 26% (n=167) [c]	Parasitism, Predation	- -	Davis and Sealy (1998)
				Nesting success: 21% (n=168), Mayfield estimate	Predation	-	Davis unpubl. data in Green et al. (2002)
				Nesting success: 31% (n=65) [c]	Predation, Vegetation structure	- -	Davis (2003)
				Nesting success: 75% (n=32) [c]	Predation	-	Pipher (2011)
				Nesting success: 26% (n=23) [c]	Predation	-	Gaudet (2013)
				Number of fledged young with increased distance from trails	Energy Development: Trails	-	
				Nesting success: 43% (n=8, grazed) [c], 17% (n=23, ungrazed) [c]	Grazing: Grazed, Ungrazed, Predation	0 - -	Lusk and Koper (2013)
				Effect of prairie type: native prairie vs. planted pasture	Grassland Type: Native Planted	+ -	Davis et al. (2016)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Reproduction	Breeding - Ad	Productivity	AB	1.1 host young fledged per nest (n=35), 3.6 host young fledged per successful nest (n=11) [d]	NA	NA	Ludlow et al. (2014)
			MT	1.5 young fledged per nest (n=90), 3.4 young fledged per successful nest (n=40)	NA	NA	Jones et al. (2010)
			SK	0.9 host young fledged per nest (n=167), 3.4 host young fledged per successful nest (n=43)	Predation	-	Davis (2003b)
				1.9 young fledged per nest (n=11), 3.5 young fledged per successful nest on grazed sites (n=6); 0.7 young fledged per nest (n=27), 3.3 young fledged per successful nest on ungrazed sites (n=6)	Grazing: Grazed Ungrazed	0 -	Lusk (2009)
				1.1 young fledged per nest (n=23), 3.5 young fledged per successful nest (n=6)	NA	NA	Gaudet (2013)
				0.9-1.4 fewer young fledged per successful nest in planted pasture and hayfields	Grassland Type: Planted pasture, Hayfields	- -	Shaffer et al. (2018d)
Reproduction	Breeding - Ad	Brown-headed Cowbird (BHCO) Parasitism	AB	17% BHCO parasitism (n=35 nests)	Parasitism	-	Ludlow et al. (2014)
			MB	15% BHCO parasitism (n=13 nests)	Parasitism	-	De Smet and Conrad (1991)
				16% BHCO parasitism (n=68 nests)	Parasitism	-	De Smet (1992)
				36% BHCO parasitism (n=76 nests)	Parasitism	-	Davis and Sealy (1998)
				BHCO parasitism resulted in reduction of average 1.4 fledglings per successful nest	Parasitism	-	Davis and Sealy (2000)
			MT	4% BHCO parasitism (n=89 nests)	Parasitism	-	Jones et al. (2010)

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Reproduction	Breeding - Ad	Brown-headed Cowbird (BHCO) Parasitism	MT	0% BHCO parasitism (n=20 nests)	NA	NA	Pulliam and USFWS (unpubl. data)
			ND	27% BHCO parasitism (n=11 nests)	Parasitism	-	Granfors et al. (2001)
			SK	0% BHCO parasitism (n=11 nests)	NA	0	Maher (1973)
				21% BHCO parasitism (n=182 nests)	Parasitism	-	Davis (2003)
				5% BHCO parasitism (n=39 nests)	Parasitism	-	Lusk (2009)
				0% BHCO parasitism (n=32 nests)	NA	0	Pipher (2011)
				0% BHCO parasitism (n=23 nests)	NA	0	Gaudet (2013)
Reproduction	Breeding - Ad	No. of Clutches	MT, MB, SK	Double-broods regularly	NA	NA	Green et al. (2002)
Reproduction	Breeding - Ad	Clutch Size	-	Average 4-5 eggs per clutch, range 2-6	NA	NA	Green et al. (2002)
Reproduction	Breeding - Ad	Daily Nest Survival	AB	Effect of temperature	Temperature: Below Average, Intermediate, Above Average	 - + -	Ludlow et al. (2014)
				Effect of proximity to gas wells	Energy Development: Gas Wells	0	Ludlow et al. (2015)
			SK	Effect of grassland type	Grassland Type: Native, Planted, Hayfields	 + + -	Shaffer et al. (2018d)
Survival	Breeding - Ad	Site Fidelity	MT	5.1% of 117 adults returned between 2016 and 2017	Unknown	NA	Jones et al. (2007)
			AB, ND, MT	8% return rate of adults with geolocators	Unknown	NA	Bernath-Plaisted et al. (2018)
Survival	Breeding - Fl	Survival	MT, ND	Juvenile survival in first month post-fledging	Predation	- (low)	A. Panjabi, M. Correll (unpubl. data)
Survival	Breeding - Fl	Natal Site Fidelity	-	None			
Survival	Migration	Survival	-	None			

Population Parameter	Life Cycle Phase/ Age Class [a]	Parameter	Region	Estimate	Covariate	Effect [b]	Reference
Survival	Migration	Stopover Ecology	-	None			
Survival	Wintering – Ad	Site Fidelity	Chihuahua	<1% (2 out of 257)	NA	NA	A. Panjabi, E. Strasser (unpubl. data)
Survival	Wintering - Ad	Survival	Janos, Chihuahua	Effect of increasing shrub cover and decreasing temps	Vegetation structure: Shrub cover; Climate: Temperature	- -	Macías-Duarte et al. (2017)
			Marfa, TX	73-100% over two winters (2015/16 - 2016/17)	Predation	-	Strasser et al. (2018)
			Cuchillas de la Zarca, Durango	9-87% over four winters (2013/14 - 2016/17)	Predation	-	
			Janos, Chihuahua	30-100% over 3 four-month winter periods	Predation	-	
			Valle Colombia, Coahuila	83-100% over three winters (2014/15 - 2016/17)	Predation	-	

[a] Ad– Adult, Fl –Fledgling

[b] Effect: = positive response, - = negative response, 0 = no effect, NA = not applicable.

[c] Nest success = raw % of nests that were successful

[d] Nest that fledged at least one host or cowbird chick

[e] NA = Not Applicable, Covariate is baseline information or otherwise measured against a stressor

Appendix K. Response to management by Sprague's Pipit.

Responses to management type, i.e., cattle grazing, unless otherwise noted, fire, and mowing/haying, by Sprague's Pipit breeding in the grasslands of the Northern Great Plains.

Management Type	Response to Management [a]	Region	Grassland Type	Reference
Grazing				
Early summer	+	AB	Mixed-grass	Prescott and Wagner (1996)
After 15 July	+			
Season long	-			
Early season (late Apr – Mid-June)	-		Tame	
Heavy	-		Mixed-grass	Owens and Myres (1973)
Season long	0	MB	Mixed-grass	Ranellucci (2010), Ranellucci et al. (2012)
Twice-over rotation				
Various levels of grazing	0	MT		Lipsey and Naugle (2017)
Moderate	+	ND		Kantrud (1981)
Heavy	+			
Unburned, idle	- (absent)			Madden (1996)
2 years post burn	+ (max abundance)			
Season long	0			Schneider (1998)
Twice-over rotation				
Grazing and Fire: Burned and rotational grazed	0			Danley et al. (2004)
Burned				
Grazed by: Cattle	+			Lueders et al. (2006)
Bison	-			
Moderate	0	SK		Bleho (2009)
Ungrazed				
Grazing and Fire: 1 year post burn, grazed or ungrazed	-			White (2009)
2 years post burn	-			
Light/Moderate grazing, different stocking rates	0 [c]			Lusk (2009), Lusk and Koper (2013), Pipher et al. (2016)
Ungrazed	+ [c, d]			Pipher et al. (2016)
Moderate	+			
Light	-			
2-3 years vs 15 years	0 [c]			

Management Type	Response to Management [a]	Region	Grassland Type	Reference
Ungrazed	+ (max abundance)	SK	Mixed-grass	Sliwinski (2011)
Heavy	- (lowest abundance)			
Grazing and Fire: Unburned, ungrazed	+ (max abundance)			Richardson et al. (2014)
Unburned, grazed	+			
Burned (1-5 years post burn), grazed	-			
Burned (1-5 years post burn), ungrazed	-			
Mowing/Haying				
Year 1 post haying	- (avoided until vegetation recovered)	AB	Mixed-grass	Owens and Myres (1973), Dale et al. (1997)
1 year post haying	- (avoided)	ND		Kantrud (1981)
Moderate/heavy grazing	+			
Light grazing	-			
Unhayed	+ (maximum) [a, c]	SK		Dale et al. (1997)
Annually hayed	+ [a] - 3 weeks post mowing [c]			
Periodic hayed	- [a]			
Idle cultivated hayland	- [a], + [c]			
Late July mowing	+ (suitable for nesting next season)	SK	Mixed-grass	Fisher and Davis (2011a)
Fire				
Years since burn: 1, 2, 7, 40 years	0	MB	Mixed-grass	Champagne (2011)
Unburned, idle	- (absent)	ND		Madden (1996)
2 years post burn	+ (max abundance)			
Burned 4 times in 15 years	+ (max abundance)			Madden et al. (1999)
Burned 1-2 times in 15 years	+			
Unburned	-			

Management Type	Response to Management [a]	Region	Grassland Type	Reference
Burned and rotational grazed Burned	0 0	ND	Mixed-grass	Danley et al. (2004)
Fall	+ [b]	SK		Pylypec (1991)

[a] = Grazing effects on abundance: + increase, - decrease, 0 = no effect, S = similar, as reported by authors. Effects refer to abundance, unless otherwise noted above.

[b] = Density returned to level of unburned areas (fescue pasture) after 2 years.

[c] = Grazing effects on nesting success

[d] = Effect only found in one year of a two year study.

Appendix L. Response to management by Chestnut-collared Longspur.

Responses to management type, i.e., cattle grazing, unless otherwise noted, fire, and mowing/haying, by Chestnut-collared Longspur breeding in the grasslands of the Northern Great Plains.

Management Type	Response to Management [a]	Region	Grassland Type	Reference
Grazing				
Heavy	+	AB	Mixed-grass	Owens and Myres (1973)
Season long Twice-over rotation	+ -			Ranellucci (2010), Ranellucci et al. (2012)
Light/Moderate Summer grazing	+	CO	Shortgrass	Giezentanner (1970)
Heavy	0			Ryder (1980)
Rest-rotation Season-long	0 0	MT	Mixed-grass	Golding and Dreitz (2017)
Grazing and Mowing: 1 year post haying Moderate/heavy grazing Light grazing	- + (max) -	ND		Kantrud (1981)
Grazing and Fire: Burned 4 times in 15 yrs Graze: Season long Ungrazed (long term)	+ - -			Madden et al. (1999)
Heavy/Extreme Light/Moderate	+ -			Salo et al. (2004)
Grazing and Fire: 1 yr post burn Unburned, Ungrazed Burned, Grazed Burned, Ungrazed Unburned, Grazed	+ - S S S	SK		White (2009)
2-3 yrs >15 yrs	+ -			Pipher et al. (2016)
Grazing: Cattle/Bison grazing Moderate	S +			Sliwinski (2011)
Grazed Ungrazed	+ (3x greater) -			Lusk (2009), Bleho (2009)

Management Type	Response to Management [a]	Region	Grassland Type	Reference
Grazing and Fire: Grazing Burn (1-4 yrs post burn) Burned, Grazed Burned, Ungrazed	 + + - -	SK	Mixed-grass	Richardson et al. (2014)
Mowing/Haying				
Grazing and Mowing: 1 year post haying Moderate/heavy grazing Light grazing	 - + (max) -	ND	Mixed-grass	Kantrud (1981)
Fire				
Grazing and Fire: Burned 4 times in 15 yrs Graze: Season long Ungrazed (long term)	 + - -	ND	Mixed-grass	Madden et al. (1999)
Spring	+ short term	SD		Huber and Stouter (1984)
1 yr post burn 2 yrs post burn	- + (abundance equal to ungrazed)	SK		Maher (1973)
Grazing and Fire: Grazing Burn (1-4 yrs post burn) Burned, Grazed Burned, Ungrazed	 + + - -			Richardson et al. (2014)

[a] = Grazing effects on abundance: + increase, - decrease, 0 = no effect, S = similar, as reported by authors. Effects refer to abundance, unless otherwise noted above.

Appendix M. Response to management by McCown's Longspur.

Responses to management type, i.e., cattle grazing, unless otherwise noted, fire, and mowing/haying, by McCown's Longspur breeding in the grasslands of the Northern Great Plains.

Management Type	Response to Management [a]	Region	Grassland Type	Reference
Grazing				
Moderate to heavy	+	AB	Mixed-grass	Wershler et al. (1991)
Season long Early summer	+ +			Prescott et al. (1993)
Season long Early season	+ -	AB/SK	Mixed-grass Mixed-grass, with crested wheatgrass	Dale and McKeating (1996)
Heavy Moderate	+ +	CO, MT, ND, NE, WY	Mixed-grass	Kantrud and Kologiski (1982)
Summer Winter	+ -	CO	Shortgrass	Giezentanner and Ryder (1969), Giezentanner (1970), Wiens (1970)
Heavy Light	+ -			Giezentanner (1970)
Heavy	+			Ryder (1980)
Heavy Moderate	- nesting (lowest) - nesting			With (1994)
Rest-rotation Season-long	+ -	MT	Mixed-grass	Golding and Dreitz (2017)
Idle Heavy Light/Moderate	- (not used) + -	SK		Felske (1971)
Grazed Ungrazed	+ -			Bleho (2009)
Grazing and Fire: Grazing and/or burning	0			White (2009)
Heavy	+			Sliwinski (2011)
Grazing and Fire: Grazed Burned	+ [b] 0			Richardson (2012)
Fire				
Grazing and Fire: Grazing and/or burning	0	SK	Mixed-grass	White (2009)
Grazing and Fire: Grazed Burned	+ [b] 0	SK	Mixed-grass	Richardson (2012)

[a] = Grazing effects on abundance: + increase, - decrease, 0 = no effect, as reported by authors. Effects refer to abundance, unless otherwise noted above.
[b] = Grazing preferred regardless of burn history

Appendix N. Response to management by Baird's Sparrow.

Responses to management type, i.e., cattle grazing, unless otherwise noted as bison, fire, and mowing, by Baird's Sparrow breeding in the grasslands of the Northern Great Plains.

Management Type	Response to Management [a]	Region	Grassland Type	Reference
Grazing				
Heavy/ continuous	-	AB	Mixed-grass	Owens and Myres (1973)
Light/Moderate in wet years	+			Wershler et al. (1991)
Grazing and Mowing: Mowed and winter grazing	- (avoided)		Native hayfields	Mahon (1995)
Early-season tame Early-season native Deferred-grazed native Season-long native grazed	0 [b]		Mixed-grass	Prescott and Wagner (1996)
Heavy/ continuous	-	MB		De Smet and Conrad (1991)
Heavy/ continuous	-			Davis (1994)
Ungrazed Grazed	+ -			Bleho (2009)
Heavy/ Continuous Light/Moderate in wet years Mowed hayland	- + +	ND		Kantrud (1981)
Light/Moderate in wet years	+			Renken (1983)
Light/Moderate in wet years Rotational Season long Short duration	+ + - -			Messmer (1990)
Moderate	+			Salo et al. (2004)
Heavy/ Continuous Light/Moderate in wet years	- +	SK		Dale (1983)
Heavy/ continuous Light/ Moderate in wet years	- +			Anstey et al. (1995)
Light or Moderate	0[c]			Lusk (2009), Lusk and Koper (2013), Pipher et al. (2016)
Grazed Ungrazed	+ [d] -			Lusk (2009)

Management Type	Response to Management [a]	Region	Grassland Type	Reference
Ungrazed Moderate/Heavy Grazed (bison)	+ (max abundance) - - [e]	SK	Mixed-grass	Sliwinski (2011)
Grazing and Fire: Undisturbed Grazed/burned	 + - (lowest abundance)			Richardson et al. (2014)
Mowing/Haying				
Grazing and Mowing: Mowed and winter grazing	- (avoided)	AB	Native hayfields	Mahon (1995)
Native hayland Tame hayland	+ -	MB	Hayland	De Smet and Conrad (1991)
Native hayland Tame hayland	+ -	ND		Kantrud (1981)
Annual 3-8 year intervals	+ -	SK	Tame hayfields dominated by non-natives	Dale et al. (1997)
Unhayed Annually hayed Periodic hayed Idle cultivated hayland	+ (maximum) [a, c] + [a] - 3 weeks post mowing [c] - [a] - [a], + [c]	SK	Mixed grass	
Fire				
Burned 4x in 15 yrs Burned 1-2 times in 15 yrs Unburned	+ (max abundance) + - (absent)	ND	Mixed-grass	Madden et al. (1999)
4 times in 24 yrs No burn Twice in 24 yrs	+ (max abundance), but absent where no litter - (absent) -			Winter (1999)
Grazing and Fire: Undisturbed Grazed/burned	 + - (lowest abundance)	SK		Richardson et al. (2014)

Management Type	Response to Management [a]	Region	Grassland Type	Reference
1-2 years post burn 2-5 years post burn	- +	NGP [f]	Mixed-grass	Pylypec (1991), Winter (1994), Madden (1996), Johnson (1997), White (2009), Richardson (2012)

[a] = Grazing effects on abundance: + increase, - decrease, 0 = no effect, as reported by authors. Effects refer to abundance, unless otherwise noted above.

[b] = Occurrence

[c] = Grazing effects on nesting success or productivity

[d] = Grazing effects on number of young fledged per nest (all nests) and young fledged per successful nest

[e] = Grazing by bison caused significant local declines vs. cattle grazing

[f] = NGP is Northern Great Plains

Appendices O through R.

Appendices O-R are species accounts providing a broad overview of the life history of each species. The accounts provide information on identification, habitat preferences throughout the annual cycle, breeding biology, and general habitat management recommendations. These documents provide a concise, broad level overview of each of the Species as outreach information to various audiences, including but not limited to land owners and land managers.

Sprague's Pipit *(Anthus spragueii)*

Scott Somershoe

Sprague's Pipit

Introduction

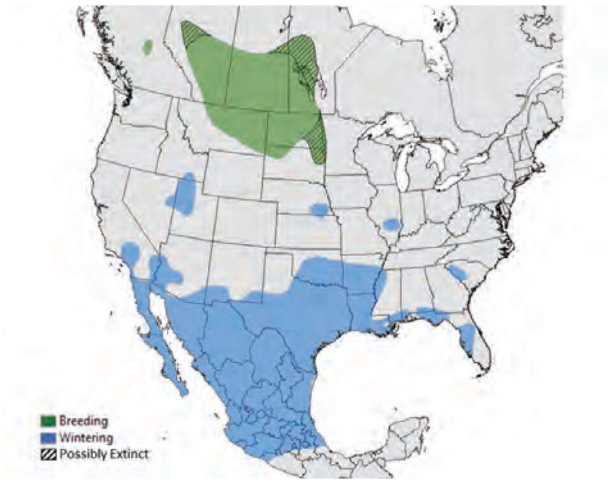
Sprague's Pipit is a grassland specialist that breeds in the mixed-grass prairies of the Northern Great Plains. They occur very locally in north and central South Dakota, extending through North Dakota and Montana, and north into the southern end of the boreal transition zone in Alberta and Saskatchewan. They also extend east into southwestern Manitoba and west to the Rocky Mountain foothills, although only locally common in central and western Montana. This species generally prefers native grasslands of intermediate height and sparse to intermediate vegetation density, low forb density, and minimal bare ground. Sprague's Pipit is most common in large patches of intact grassland.

Michael Todd

Sprague's Pipit

Identification

Sprague's Pipit is a sparrow-sized songbird (length: 5 inches [15 cm], wing span: 7.8 inches [20 cm], weight: 0.9 oz [25 g]) with a thick, two-tone bill, pale pink-orange legs, heavily streaked brownish back, and pale area around eyes which gives it a blank look. It wears a "necklace" of fine streaks and has extensive white on outer tail feathers which is visible in flight.



Sprague's Pipit Distribution Map (BirdLife International and NatureServe 2012).

Adult plumage: Adult males and females have similar plumage during the breeding and winter seasons.

Immature birds: Young are similar to adult, but with spotting instead of streaking on the upper breast.

Scott Somershoe

A male Sprague's Pipit establishes and maintains its territory and courts a female by performing elaborate aerial displays above its territory.

Breeding Biology

Flight Display

During the display, the male flies up from the ground about 150-300 ft, singing a descending series of tinkling double notes. He remains nearly still while singing, moving his wings rapidly, and then glides around in an undulating manner. The display is repeated multiple times, often lasting a half an hour to three hours. At the end of the display, the male plummets straight down and levels off just before dropping to the ground. Females are much less visible as they do not perform with males during displays.

Reproduction

Sprague's Pipits arrive on the breeding grounds typically from mid-April through mid-May. Pair formation begins shortly after arrival on the breeding grounds and eggs are laid from mid-May through early August.

Nest: A nest woven of fine grasses is placed in a depression on the ground. The nests are either a relatively exposed oven-like nest with an opening on the side, in the side of a clump of grass with a side entrance, or well concealed from above by a tuft of grass.

Clutch Size and Incubation: Typical clutch size is 4-6 eggs that are pale whitish with brown blotches. Instead of approaching the nest directly, the adult birds land several feet away and walk to the nest.

Nestlings: Young pipits are altricial and downy, featherless at the time of hatching and unable to open their eyes or care for themselves. Young periodically leave the nest as early as 10-11 days after hatching, before they are able to fly well.

Diet: Primarily insects during the breeding season with the addition of seeds collected from the ground during the winter.

Fun Fact: They perform the longest known flight display of any bird, with males often remaining airborne for half an hour or more.

Sprague's Pipit habitat.

Sprague's Pipit (center of image) utilize a variety of habitats in winter, but prefer relatively shrub free grasslands with variable grass heights.

Habitat

Breeding

Sprague's Pipit almost exclusively prefers native prairie in the breeding season and is only rarely found in cultivated fields, areas replanted with or invaded by non-native grassland species, and tame pastures. They breed in intermediate-statured grasslands (less than 20 inches) with sparse to intermediate grass cover (18-50%), moderate litter cover, and minimal bare ground. In mixed-grass prairie, dominant vegetation consists of wheatgrasses and needlegrasses. The amount of residual vegetation from the previous year is a strong predictor of Sprague's Pipit nest sites. They avoid areas with woody vegetation and deep litter.

Migration

Little is known about this species' habitat use during migration. They have been observed in habitat closely resembling their wintering and breeding habitat, which includes pastures, prairie dog towns, fallow cropland, short mixed grasslands, and heavily grazed tallgrass habitats.

Winter Habitat

Sprague's Pipit is considered a grassland specialist on the winter grounds. They primarily occupy areas with high grass cover and few shrubs. They also use sparsely vegetated grasslands, cultivated lands, and those that have been recently burned, grazed, or mowed.

Note: Although Sprague's Pipits will use non-native replanted grasslands, their abundance in these areas is lower than in native grasslands.


Scott Somershoe

Typical Sprague's Pipit breeding habitat with taller grass, clumps of bunch grasses, and little bare ground.

Management Recommendations

Sprague's Pipit needs large tracts of intact native grassland free of woody vegetation for breeding. They prefer grassland with no shrub or tree cover within 300 feet of patches at least 70 acres. Management consists of protecting, maintaining, and restoring native mixed-grass prairie in suitably large expanses. Grazing, fire, and mowing are the most common management techniques used in grasslands to create or restore suitable habitat or to prevent further degradation. Restoration of cropland to native vegetation is also beneficial. Sprague's Pipit prefers lightly to moderately grazed prairie, depending on precipitation and grass growth rates. The species is tolerant of most grazing regimes and rotational grazing may be an appropriate method of management. A burn rotation may maintain habitat conditions preferred by Sprague's Pipit.

Chestnut-collared Longspur *(Calcarius ornatus)*

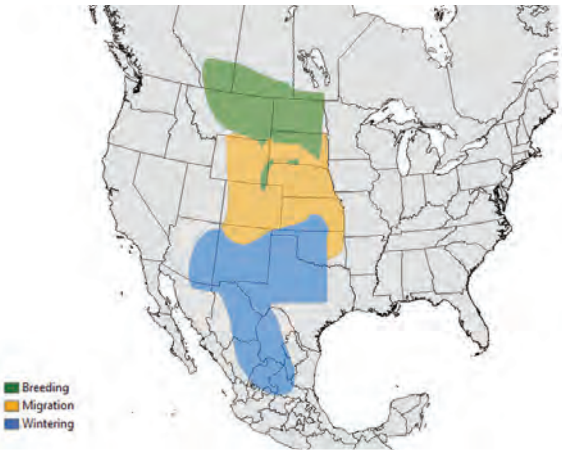
Scott Somershoe

Scott Somershoe

(Left) Adult breeding plumage male; (Right) Female breeding plumage.

Introduction

This colorful songbird is a native-grassland specialist that prefers grazed grasslands. Where common, they can reach high densities and can easily be the most common bird species seen and heard as they frequently display in flight and sing during the peak in nesting, usually May-early July.



Chestnut-collared Longspur Distribution Map (BirdLife International and NatureServe 2012).

Identification

Chestnut-collared longspurs are relatively small and sparrow-like (length: 6 inches [15 cm], wing span: 11 inches [28 cm], weight: 0.8-0.9 oz [22-26 g]). They have white outer tail feathers with a triangle of black feathers and completely black feathers at the center of the tail. Prominent chestnut-colored collar and black chest and belly is only present on males in breeding plumage. Some females exhibit slightly more muted chestnut collar in breeding plumage.

Adult Breeding Plumage

Male: Chestnut-colored nape and black chest and belly. Black eye stripe and variable amount of black on the crown. Variable amounts of white on face and throat with cream color on cheeks and throat.


Alan Schmierer / Flickr Creative Commons

Chestnut-collared Longspur, male (winter plumage).


Scott Somershoe

Chestnut-collared Longspur nest.

Female: grayish buff with dusky streaks on back and sides; sometimes with dull, obscure chestnut collar and dark feathers on breast and belly, sometimes similar to male. Both have distinctive triangular ("whale tail") pattern on tail.

Adult winter plumage: Adults have a light-brown and cream colored body with the diagnostic white outer tail feathers with a triangle of black feathers and completely black feathers at the center of the tail.

Immature birds: Similar to winter plumage adults.

Breeding Biology

Flight display: Male flies up and has a distinct undulating, up and down and more horizontal flight display. The species flight display is distinguished from the McCown's Longspur which flies up on an angle and then holds wings out while it slowly drops downward.

Reproduction: Typically arrive on breeding grounds in mid- to late April and attempt nesting from May-July. Breed in pairs, but extra-pair matings do occur. Both parents are needed to successfully raise young.

Nest: The nest is placed on the ground in a tea cup sized shallow, often scraped out, depression about 3-4 inches deep.

Clutch Size and Incubation: Typically 4 eggs and incubation lasting about 11 days, starting with laying of next to last egg.

Nestlings: Young longspurs are altricial, thus are featherless and unable to open their eyes and are unable to care for themselves. Both males and females feed young birds with the majority of food items brought to the nest being grasshoppers, beetles, and moths and butterflies. Young leave the nest, often by walking out or with short weak flight, at an average of 8-12 days.

Scott Somershoe

Chestnut-collared Longspur habitat.

Diet: Mostly seeds outside of breeding. During breeding season, eat primarily insects, especially grasshoppers and small caterpillars and moths.

Fun Fact: First collected by Townsend along the Platte River in Nebraska, where they no longer occur as a breeding species.

Habitat

Breeding: Typical breeding habitat is arid short- to mixed-grass prairie with flat to rolling topography, vegetation height <7.5-12 inches), and minimal litter accumulation. They will also use grazed, burned, or mowed tallgrass prairie.

Migration: Species has been observed in crop fields and shortgrass prairie habitats, similar to those that they use during the breeding and winter seasons.

Winter habitat: Winters primarily in the southern Great Plains and Chihuahuan Desert of southwestern U.S. and northern Mexico. Frequents short-grass prairie and desert grasslands with primarily low grasses and forbs, with most vegetation <20 inches high, but has also been observed using taller grasses. Negative association with shrub cover; >75% of individuals observed in areas with <1% shrub cover in desert grasslands of Arizona and New Mexico.

Scott Somershoe

Typical longspur breeding habitat. Note cattle in the background.

Management Recommendations

Chestnut-collared Longspurs prefer shortgrass or moderately grazed mixed-grass prairie with grass on average 6 inches tall with a mix of bare ground and club mosses. In drier areas or in dry years, they seek out wet meadows, while in wetter locales they prefer slightly higher and drier areas. They require disturbance to maintain shorter grass and low shrub density. They avoid idle pastures, especially with tame grass species. A twice-over grazing rotation may benefit this species.

McCown's Longspur *(Rhynchophanes mccownii)*

Scott Somershoe

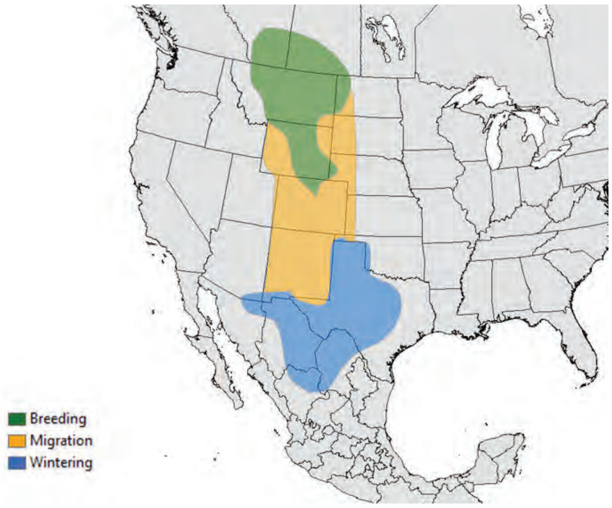
Male McCown's Longspur.

Aaron Maizlish / Flickr Creative Commons

McCown's Longspur immature female.

Introduction

McCown's Longspur is a grassland specialist that breeds in shortgrass and mixed grass prairie of the northern Great Plains from northern Colorado, north through eastern Wyoming and Montana, and into southern Alberta and Saskatchewan. This species prefers more heavily grazed prairie with extensive bare ground. They often nest in actively grazed pasture with short standing grass. Although locally common to abundant, McCown's Longspur has experienced an overall population decline of approximately 94% since the late 1960's.



McCown's Longspur Distribution Map (BirdLife International and NatureServe 2012).

Identification

McCown's Longspur is a sparrow-sized bird (length 6 inches [15 cm], wing span: 11 inches [28 cm], weight: 0.8-0.9 oz [22-26 g]) with a stout bill and a distinctive white tail marked by a black "T" (black center and tip) which is noticeable in flight when its tail is fanned.


Kevin Barnes

McCown's Longspur

Adult breeding plumage: Adult breeding males and females differ in plumage. A breeding male McCown's Longspur (below, left) is gray with a black bill, crown, malar stripe (stripe below the bill), and upper breast, and with blackish wash on lower breast and belly. The chestnut patch on the shoulder is distinct for this longspur. Breeding female is gray, lacking black plumage of male, have a pale bill, and back and wing feathers are tinged rusty.

Immature and juvenile birds: Immature males are similar to non-breeding adults. Young females, in their 1st winter, are similar to non-breeding adults and have unstreaked underparts, with breast slightly darker than belly and the bill is pinkish. Juveniles, birds that recently fledged from the nest, are more uniformly sandy in appearance, with streaked upper breast and white belly, but this plumage is held only briefly in late summer when they molt into the aforementioned immature plumage.

Fun Fact: The female is a "tight sitter" during incubation and usually does not flush from the nest unless she is in danger of being stepped on.

Notes: Local abundance of McCown's Longspurs can vary dramatically between years where they may be common to abundant one year, absent the next year, and common the next year.

Breeding Biology

Flight display: Male flies up about 30-40 ft, holds both wings outstretched, spreads out its white tail feathers, and floats downward while singing a soft tinkling song. Males will occasional teeter on the descent, but rarely flap their wings. Male may alight on ground following display, but more typically rises up again and repeats the display.

Reproduction: McCown's Longspurs begin courtship and territory establishment shortly after arrival on the breeding grounds between late March (Colorado) and early May (southern Canada). Pairs form quickly, but nesting is often delayed until May.

Nest: The nest is placed in a shallow depression in the ground and lined with grasses. McCown's Longspurs may place nests beside bunch grasses, cactus, shrubs, or cow pies; however some nests are placed in the open away from a vertical structure.

Clutch Size and Incubation: Typically 3-4 eggs with incubation lasting on average 12 days, starting with the laying of last egg. Only females incubate the eggs. Approximately 50% of females attempt to raise a second brood of young each year.

Nestlings: Young longspurs are featherless and unable to open their eyes or care for themselves. Both males and females feed young birds with grasshoppers, beetles, and moths and butterflies. Young leave the nest at an average of 9-10 days old. Parents tend to the young for about three weeks before the young are independent.

Diet: Adults primarily consume seeds during the breeding season, while feeding insects to the young.

Habitat

Breeding: McCown's Longspur breeds in short-grass and mixed-grass prairie with open, arid, sandy soil with sparse vegetative cover. Nesting areas can be relatively bare, with as much as 50% exposed soils and an average vegetation height of only 2.5 inches (6.4 cm). Dominant vegetation consists of short-grasses like blue grama and buffalograss, which are interspersed with cacti and other grasses and forbs. They rarely use idled or deferred grassland. Generally, they prefer heavy and summer grazing over light or winter grazed pasture.


Scott Somershoe

McCown's Longspur habitat.

Migration: Little is known about habitat use in migration, but they use plowed crop fields and short-grass prairie habitats.

Winter: Winter habitat is similar to breeding habitat and consists of open, short grass prairie, heavily grazed pastures, plowed fields, desert grasslands, dry lake beds, and playas (shallow prairie wetlands).

Management Recommendations

McCown's Longspurs prefer areas of little litter and short, sparse vegetation with little forb cover and extensive areas of bare ground. Recommended management could include implementing timely cattle rotations and allowing for adequate resting periods for grass regrowth. Pasture that is already sparse and short from grazing, especially during drier periods, should not be overgrazed. In contrast, pastures that have vegetation taller than preferred for nesting by McCown's Longspur could be grazed more intensively to encourage use, particularly in years with above average precipitation. Appropriately implemented prescribed fire may also be beneficial to the species.

Baird's Sparrow *(Centronyx bairdii)*

Scott Somershoe

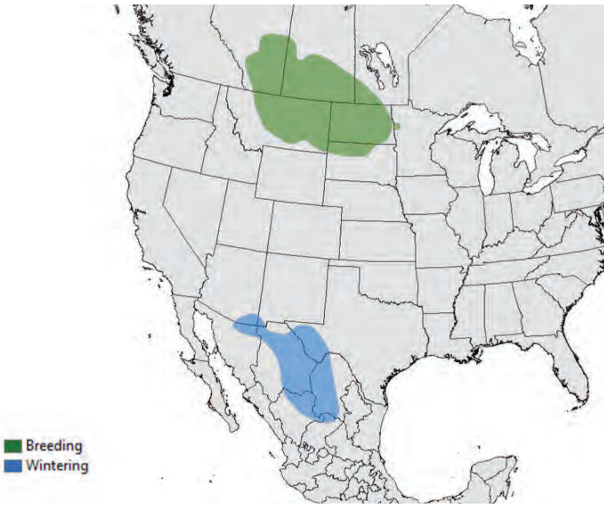
Baird's Sparrow

Scott Somershoe

Baird's Sparrow.

Introduction

The Baird's Sparrow is a grassland specialist that lives in prairies and grasslands throughout its full annual cycle, breeding in the northern Great Plains and migrating up to 2000 miles to overwinter in the Chihuahuan Desert. Over the last century, North America's grasslands have contracted due to agricultural and urban development, leaving less than 50% of the Baird's Sparrows historical habitat. This species is in decline throughout its range; however exact drivers of this decline are unknown. Baird's Sparrows show a preference for native grasses. They show a slight preference for shorter grassy areas within healthy mixed-grass prairie, perhaps to afford individual birds a clear view of the landscape for increased vigilance for predators.



Baird's Sparrow Distribution Map (BirdLife International and NatureServe 2012).

Identification

The Baird's Sparrow is a small brown songbird with dark brown streaks (length: 5.5 inches [12 cm], wing span: 8.7 inches [22 cm], weight: 0.6 oz [17.5 g]). The Baird's Sparrow is camouflaged well by its appearance in the surrounding grassland landscape; however males are often easily observable on territories during spring and

Kevin Barnes

Baird's Sparrow.

summer due to frequent singing. Adults have a deep yellow-ochre color prominent on head and brow, especially noticeable during the winter. Their head is characterized by a dark yellow stripe running down the center of the head and thin brown "whiskers" running down the sides of the neck. Their tail is notched at the end and has cream-white edges noticeable during flight. Their underbellies are whitish with sparse but dark streaking across breast.

Adult plumage: Adult males and females have similar plumage during the breeding and winter seasons.
Immature birds: Young are similar to adult, but underbelly has heavier streaking.

Breeding Biology

Reproduction: Baird's Sparrows arrive on the breeding grounds in late April through mid-May. Pair formation begins shortly after arrival. Eggs are laid from late May through late July.
Nest: Nests are constructed on the ground in a cup-like shape out of dead grasses. Nests are usually covered and accessed by the bird through an opening on the side.
Clutch Size and Incubation: Average clutch size is normally 4-5 eggs with one egg laid per day. Only females incubate the nest. Eggs are light brown with dark brown speckling.
Nestlings: Nestlings are similar in appearance to many songbird young; chicks hatch from eggs, featherless,


Scott Somershoe

Baird's Sparrow nest (entry hole is in center of the image at the base of the tall tuft of grass).

with eyes closed. Nestlings develop "pin" feathers 2 or 3 days after hatching. Eyes open on day 3-4, and nestlings fledge from the nest 8-11 days after hatching, before they are able to fly well.

Diet: Mainly insectivorous during the summer (small beetles, mosquitoes, and caterpillars) and granivorous (mainly grass seeds) during the winter.

Fun Fact: Early in the breeding season, Baird's Sparrows often scuttle along the ground instead of flying, slightly hunched over, and can often be mistaken for small rodents!

Habitat

Breeding: The Baird's Sparrow prefers mixed grass prairies in the northern Great Plains in Canada and the U.S. scattered with few, low shrubs and dead matter grass from previous years. Habitat during the breeding season includes rough fescue *(Festuca scabrella)*, sedge *(Carex obtusata)*, porcupine grass *(Stipa spartea)*, club moss *(Selaginella densa)*, spike oat *(Helictotrichon hookeri)*, pasture sage *(Artemisia frigida)*, June grass *(Koeleria pyramidata)*, needle grass *(Stipa comate)*, Canby's bluegrass *(Poa canbyi)*, graceful sedge *(Carex praegracilis)*, foxtail barley *(Hordeum jubatum)*, northern wheatgrass *(Agropyron dasystachyum)*, western wheatgrass *(A. smithii)*, and blue grama grass *(Bouteloua gracilis)*.


Scott Somershoe

Typical breeding habitat for Baird's Sparrow.

Migration: Little is known about habitat requirements for this species during migration.

Winter habitat: The Baird's Sparrow prefers mixed-height grasslands with extensive grass cover (>40%) and avg. height of 15 inches, with low shrub cover (<5%) within grassland landscapes of the Chihuahuan desert in the southwestern U.S. and Mexico.

Management Recommendations

Rangeland management involving seasonal grazing can encourage growth of healthy grasslands that will benefit cattle as well as provide habitat for the Baird's Sparrow and other grassland specialist songbirds. However, because of their requirement for tall dense grass, both for nesting in summer and for foraging and predator avoidance in winter, Baird's Sparrows are vulnerable to overgrazing, especially during droughts. Baird's Sparrows are also highly sensitive to shrub cover, thus efforts to reduce or reverse shrub encroachment should benefit the species, both on the breeding and wintering grounds. Programs protecting native prairie as well as agricultural incentive programs offer habitat protection for Baird's Sparrows.

U.S. Fish and Wildlife Service
Migratory Bird Program
Division of Bird Habitat Conservation, Region 6
PO Box 25486
Denver Federal Center
Denver, CO 80225-0486

Prairie Pothole Joint Venture
U.S. Fish and Wildlife Service
922 Bootlegger Trail
Great Falls, MT 59404

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