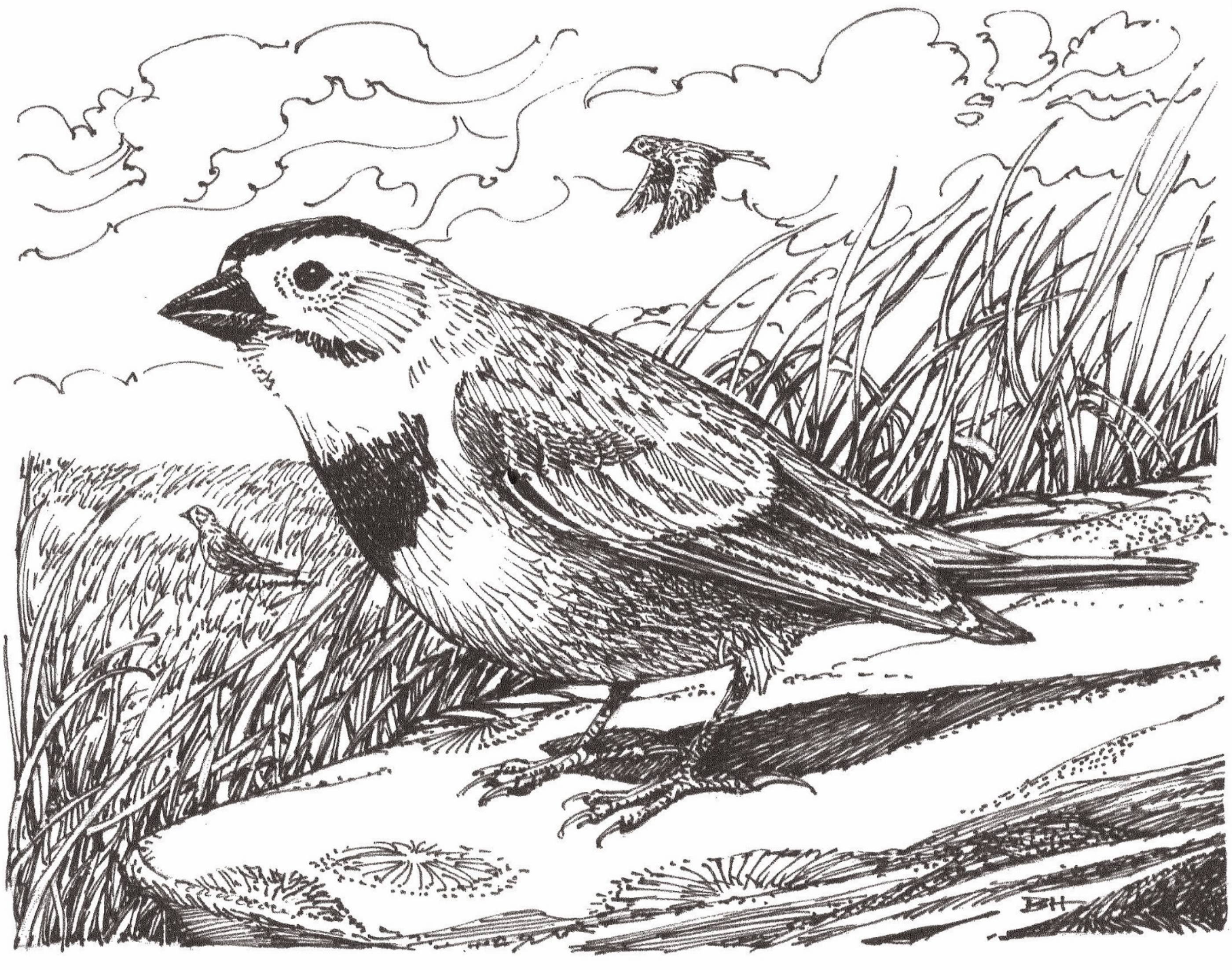
Status of the Thick-billed Longspur (*Rhynchophanes mccownii*) in Alberta

Alberta wildlife status report no. 72



alberta's species at risk program

Alberta Conservation Association

Alberta

Status of the Thick-billed Longspur (*Rhynchophanes mccownii*) in Alberta

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Prepared for Alberta Environment and Protected Areas and Alberta Conservation Association by: Dorothy Hill, Lorne Gould and Riah Kelly

Cover Illustration: Brian Huffman

Series Editors: Sue Peters and Robin Gutsell

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Preface

Every five years, Alberta Environment and Parks reviews the general status of wildlife species in Alberta. General status assessments have been conducted in 1991 (*The Status of Alberta Wildlife*), 1996 (*The Status of Alberta Wildlife*), 2000, 2005, 2010 and 2015 (available in a searchable database at https://extranet.gov.ab.ca/env/wild-species-status/default.aspx since 2000). The general status process assigns individual species "ranks" that reflect the perceived level of risk to populations that occur in the province. Such designations are determined from extensive consultations with professional and amateur biologists, and from a variety of readily available sources of population data. The 2015 general status assessments for vertebrates used the same methodology as assessments from 2000 to 2010, and adopted methodology from NatureServe (http://www.natureserve.org/) for invertebrates and plants. A key objective of general status assessment is to identify species that may be considered for more detailed status determinations.

The Alberta Wildlife Status Report Series is an extension of the general status exercise, and provides comprehensive current summaries of the biological status of selected wildlife species in Alberta. Priority is given to species that are considered at some level to be at risk or potentially at risk (e.g., general status of *At Risk* or *May Be At Risk*, NatureServe rank of S1, Committee on the Status of Endangered Wildlife in Canada [COSEWIC] rank of *Endangered/Threatened* at a national level) and species that are of uncertain status (e.g., general status of *Undetermined*).

Reports in this series are published and distributed by Alberta Conservation Association and Alberta Environment and Parks. They are intended to provide up-to-date information that will be useful to resource professionals for managing populations of species and their habitats in the province. The reports are also designed to provide detailed information that will assist Alberta's Endangered Species Conservation Committee in identifying species that may be formally designated as *Endangered* or *Threatened* under Alberta's *Wildlife Act*. To achieve these goals, the reports have been authored and/or reviewed by individuals with unique local expertise in the biology and management of each species.

Acknowledgements

The authors would like to thank Brenda Dale and Stephen Davis (Canadian Wildlife Service) for their insights and careful reviews of this report, Daniel Buell (Eastern Irrigation District) for providing access to Fish and Wildlife Management Information System (FWMIS) data, Amanda Rezansoff (Alberta Conservation Association) for preparing the Alberta range map, Amy Nixon (Ecosystems Biologist, B.C. Ministry of Forests, Lands, Natural Resource Operations and Rural Development) for review of the Climate Change section (see 7.0 Threats) of this report, the Cornell Laboratory of Ornithology and Barry Bermudez for granting permission to use the North America range map from the Birds of North America (http://birdsna.org) series, Jenny Wu (COSEWIC Secretariat) for granting permission to use the range map from the 2006 COSEWIC report, Darren Bender (University of Calgary, Dept. of Geography) for directing us to the recent graduate work of Ben McWilliams, Matthew Swallow (Mount Royal University) for clarifying soil classifications, Doug Collister (Accipiter Ecological Management) for access to and interpretation of technical reports, Adam Smith (Environment and Climate Change Canada) for as-yet unpublished trend analyses of Breeding Bird Survey data, Barry Robinson (Canadian Wildlife Service) and Peters Solymos (Alberta Biodiversity Monitoring Institute [ABMI]) for interpreting ABMI habitat modelling, and B. Robinson for making some of the population trend graphs, and Mount Royal University for library support and granting one of the authors (D. Hill) time to work on this project. William Wishart (retired, Alberta Fish and Wildlife) reviewed an earlier draft of this report. Finally, the authors would like to express their gratitude to Sue Peters (Alberta Conservation Association) and Robin Gutsell (Alberta Environment and Parks) for their thorough edits and tireless guidance throughout the writing of this report.

We also acknowledge and appreciate the dedication and efforts of the many volunteers who collect data and/or coordinate the Breeding Bird Survey each year.

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Executive Summary

Thick-billed longspur (*Rhynchophanes mccownii)* is considered *May Be At Risk* in Alberta, and is listed as *Threatened* in Canada and included on Schedule 1 of the *Species At Risk Act.* This species has experienced severe population decline and range contraction over the last century. The reasons for these declines are not well understood but have been attributed mainly to the loss of native grassland habitat through conversion to cropland on both the breeding and wintering grounds. Other factors possibly impacting thick-billed longspur populations include habitat degradation from oil, gas, and wind energy infrastructure, exposure to agricultural pesticides, and altered vegetation structure resulting from reduced fire frequency, loss of native grazers, and introduction of invasive plant species.

Alberta has approximately 12% of the thick-billed longspur global breeding population and 14% of its global breeding range. Recent short-term Breeding Bird Survey data (2009 to 2019) indicate an annual decline of 16.0% within Alberta, with a cumulative decline of approximately 82.5% within a decade. The short-term trend in Canada (2009 to 2019) has been -5.1% per year, with a cumulative decline over that period of 40.9%. There is no reason to believe that this decline will not continue.

Thick-billed longspur is the only species in the genus *Rhynchophanes* and one of six passerine bird species endemic to the North American grasslands. It uses short-grass, semi-arid habitats on both the breeding and wintering grounds and is detected more frequently and in greater densities in landscapes with a greater proportion of native grasslands. Within Alberta, about 57% of native grassland habitat has been converted to other land uses and grasslands are considered Alberta's most human-altered landscape. The largest expanses of remaining native grasslands are in the Dry Mixedgrass Natural Subregion, which is the core area of thick-billed longspur distribution in the province.

Thick-billed longspur is strongly associated with short-grass species such as blue grama grass (*Bouteloua gracilis*). However, vegetation structure, rather than plant community composition, is likely a key factor in their habitat selection; thus, thick-billed longspurs will use heavily grazed tame pastures or cultivated lands with similar structure to short-grass prairie (i.e., 24%–38% exposed ground, vegetation 5 cm high, and minimal litter). Nonetheless, when thick-billed longspurs use cultivated fields they often select those near or adjacent to native grassland habitat. It has been suggested that thick-billed longspur breeding success is lower in intensely tilled fields, a suggestion that requires further research.

Less than 2% of Alberta's remaining native grasslands are protected. Remnant patches of habitat continue to be lost to conversion to other land uses, and among the largest tracts of remaining

grassland in the province only 6% has at least a 2 km buffer from visible human infrastructure. Conserving the remaining native grassland habitat and preventing further degradation is essential to the long-term persistence of thick-billed longspurs in Alberta.

1.0 Introduction

Thick-billed longspur (*Rhynchophanes mccownii*; previously McCown's longspur), the only species in the genus *Rhynchophanes*, is one of six passerine bird species endemic to the North American grasslands (Mengel 1970). The current breeding range is restricted to five U.S. states and two Canadian provinces: Wyoming, Colorado, Nebraska, Montana, North Dakota, Saskatchewan, and Alberta (Sedgwick 2004; With 2010; Committee on the Status of Endangered Wildlife in Canada [COSEWIC] 2016). Wintering populations can be found on the arid grasslands of New Mexico, Arizona, the Oklahoma panhandle, western Texas, Chihuahua, Sonora, and northern Durango (With 2010; Macias-Duarte *et al.* 2011). Approximately 23% of the global breeding range is within Canada (Environment Canada 2014) and 13% is within Alberta (Partners in Flight 2021).

Thick-billed longspurs breed in sparsely vegetated grassland areas with short vegetation, exposed groundcover, and minimal litter (Sedgwick 2004; With 2010). A strong affiliation with short-grass species such as blue grama grass (*Bouteloua gracilis*) means that thick-billed longspurs are strongly associated with the locations and conditions that favour these drought-resistant grasses, including dry, south-exposed slopes; grassland disturbed by fire; moderately grazed, short-grass regions; and heavily grazed, mixed-grass regions (Sedgwick 2004; McWilliams 2015; Skagen *et al.* 2017; B. Dale pers. comm.). Each of these conditions reduces available soil moisture, often by the removal of surface litter (e.g., via fire) and the resulting increase in evapotranspiration, which results in a dominance of short-grass species (Smith and McDermid 2014). However, a combination of fire suppression and the elimination of native grazers such as prairie dogs (*Cynomys* spp.) and bison (*Bison bison*), which grazed more heavily and unevenly than most current grazing management regimes, is believed to have greatly reduced the extent of the short-grass prairie (Askins *et al.* 2007). In Alberta, range management has traditionally aimed to result in a dominance of the mid-grass species (Smith and McDermid 2014). Together, these factors have reduced the availability of short-grass habitat for thick-billed longspur.

Thick-billed longspur has experienced a severe population decline and breeding range contraction over the last century in North America (COSEWIC 2016). The most likely cause is loss of habitat on both the breeding and wintering grounds (COSEWIC 2016). Ongoing conversion of native grasslands to cropland is the leading factor resulting in habitat loss, but resource development, exposure to pesticides, a decrease in natural disturbances such as fires, consistent and moderate grazing regimes resulting in more homogenous habitat, and invasive species all contribute to further loss and degradation of habitat. Population decline has been quantified through Breeding Bird Survey (BBS) data on the breeding grounds, and Christmas Bird

Count (CBC) data on the wintering grounds (Sedgwick 2004; National Audubon Society 2018; Pool *et al.* 2014; COSEWIC 2016; Smith *et al*. 2019).

In Alberta, thick-billed longspur is currently considered *May Be At Risk** by Alberta Environment and Parks (2017b). The Canadian Endangered Species Conservation Council (2016) ranks the Alberta population as S3S4B, S3S4M (*Vulnerable/Apparently Secure* during breeding and migration) and the Saskatchewan population as S3B, S3M (*Vulnerable* during breeding and migration). The Committee on the Status of Endangered Wildlife in Canada recently uplisted the Canadian population to *Threatened* (COSEWIC 2016). In 2019, thick-billed longspur was reclassified under the *Species at Risk Act* from *Special Concern* to *Threatened*, Schedule 1 (Government of Canada 2019). This thick-billed longspur status report compiles and summarizes current literature and information on the species and will be used to update the status of the species in Alberta.

* See Appendix 1 for definitions of selected status designations

2.0 Taxonomy

Thick-billed longspur was previously included in the genus *Calcarius* (Chesser *et al.* 2010; COSEWIC 2016), as a result of a hybridization event between a thick-billed longspur and chestnut-collared longspur (*Calcarius ornatus*) described by Sibley and Pettingill (1955). However, recent molecular evidence has reclassified thick-billed longspur into its own genus, *Rhynchophanes* (Chesser *et al.* 2010; COSEWIC 2016). Historically, the species name was often spelled *maccowni*. Along with the buntings and other longspurs, thick-billed longspur has been reassigned to the family Calcaridae, a change from the former assignment of Emberizidae (sparrow family) (Chesser *et al.* 2010; COSEWIC 2016). Geographic variation between Thick-billed longspur populations, or any subspecies, have yet to be described (With 2010).

In 2020, the American Ornithological Society (AOS) renamed McCown's longspur to the "thick-billed longspur" (AOS 2020; Mendenhall 2020). This change was part of a larger push to rename all bird species named after people. Thick-billed longspur refers the relatively stout, conical bill that inspired the name *Rhynchophanes* Baird, 1858. The more prominent bill distinguishes both male and female *R. mccownii* from all other species of longspur (NACC 2020).

3.0 Distribution

3.1 Breeding Range: Alberta

Thick-billed longspurs are restricted to Alberta's Grassland Natural Region (Figure 1), an area that covers 95 565 km^2 of the province and comprises four subregions: Dry Mixedgrass, Mixedgrass, Foothills Fescue, and Northern Fescue (Natural Regions Committee 2006). The extent of occurrence of thick-billed longspur within Alberta is 63 287 km^2, which is 13% of the global breeding range (Partners in Flight 2021). Within the extent of occurrence, thick-billed longspurs occupy an area of 4191 km^2 (calculated by summing occupied 2-km by 2-km grid cells overlaid on a map of all thick-billed longspur locations in Alberta). Although its range stretches just north of the Town of Coronation and as far west as Pincher Creek (Alberta Biodiversity Monitoring Institute [ABMI] data), the majority of observations and breeding records are south of the Red Deer River and east of Lethbridge, including 95% of the observations entered in the Fish and Wildlife Management Information System (FWMIS) and eBird databases (Federation of Alberta Naturalists [FAN] 2007; COSEWIC 2016; Alberta Environment and Parks 2017a, eBird 2017) (Figure 1). This core area is approximately 49 000 km^2 and within the Dry Mixedgrass and the Mixedgrass natural subregions (Natural Regions Committee 2006). The westernmost extent of thick-billed longspur distribution in Alberta extends slightly into the Foothills Fescue Subregion and the northernmost distribution extends into the southern portion of the Northern Fescue Subregion of the Grassland Natural Region (Environment Canada 2014). Historical records documenting thick-billed longspurs in the grasslands at Calgary on June 19, 1897 (Macoun and Macoun 1909, pg. 492) suggest the Alberta breeding range was once more extensive.

No detectable change in the Alberta distribution was recorded between the publication of the first (1992) and second (2007) editions of the Breeding Bird Atlas of Alberta (FAN 2007). However, the 2007 atlas did not re-survey all of the 10-km by 10-km centroids (n = 594) that were surveyed in the Grassland Natural Region for the 1992 atlas (n = 377; 27% overlapped) (FAN 2007), which makes it difficult to assess changes.

There are no geographically distinct subpopulations of thick-billed longspurs in Alberta.

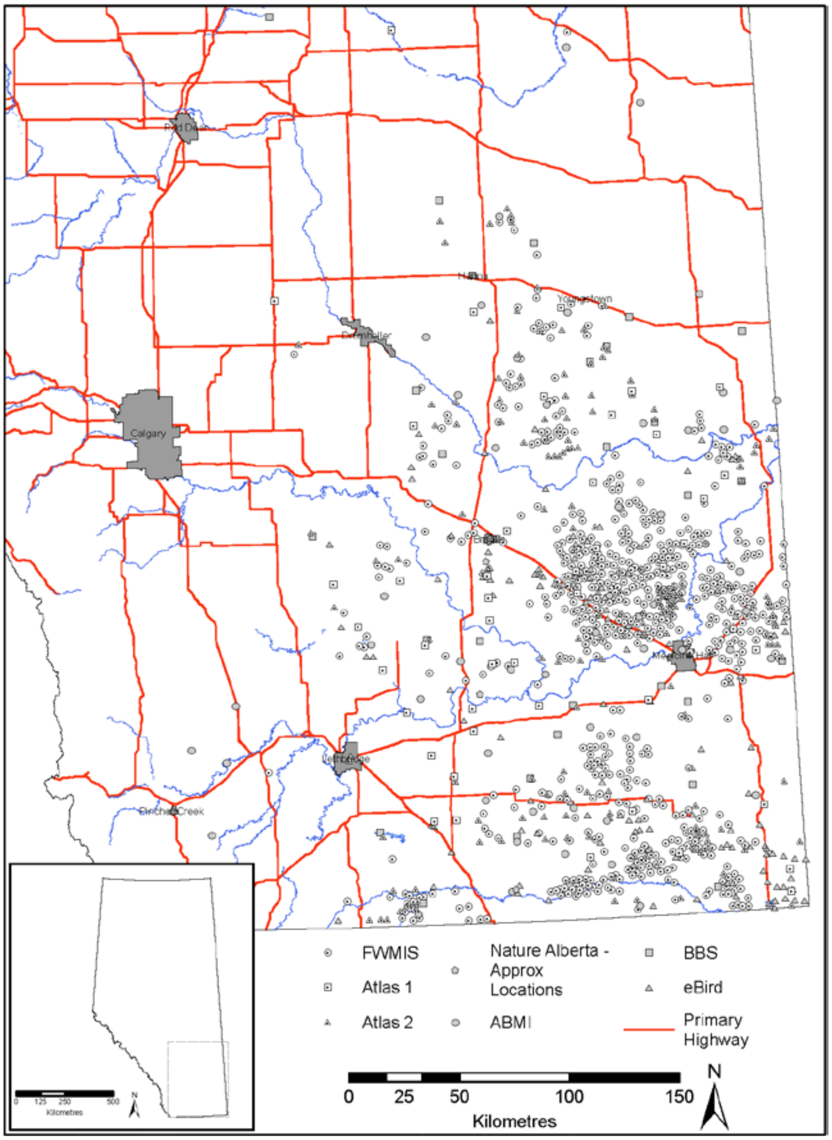

Figure 1. Thick-billed longspur observations in the province of Alberta, including locations from Fisheries and Wildlife Management Information System (FWMIS), Alberta Breeding Bird Atlas (1 and 2), Alberta Biodiversity Monitoring Institute (ABMI), eBird, Nature Alberta, and Alberta Bird Records, and route start locations from Breeding Bird Survey (BBS). See Appendix 2 for more details on data sources and survey methods. Note that observations of thick-billed longspur in close proximity during the same season may not necessarily represent different birds (i.e., the same bird could be recorded several times) in this figure. Observations in each database that occur within 2 km are represented by one point on the map.

3.2 Breeding Range: Other Areas

Range contraction during the 20th century has resulted in a disjunct breeding distribution (COSEWIC 2016), restricted to just five states and two provinces (Figure 2). The northern portion of the breeding distribution is centred in northeastern Montana and extends northward into southwestern Saskatchewan and southeastern Alberta and eastward to Bowman County (Rhame Prairie) in southwestern North Dakota (With 2010; COSEWIC 2016; North Dakota Fish and Game Department 2016). There have been no confirmed breeding records in South Dakota since 1910, even though territorial behaviour was recorded in 1993 (Sedgwick 2004, pg. 11). The southern portion of the breeding distribution is centred in central and eastern Wyoming and northeastern Colorado and extends into Kimball and Sioux counties in western Nebraska (Sedgwick 2004; With 2010; COSEWIC 2016; NatureServe 2020).

Despite its disjunct global breeding distribution (Figure 2), the population of thick-billed longspur does not meet the International Union for Conservation of Nature (IUCN) definition of “severely fragmented” (IUCN 2012). Fragmentation of a population increases extinction risk if most of its individuals are found in small and relatively isolated subpopulations. Population genetics data have not been collected to determine if the northern and southern breeding populations are genetically isolated.

Thick-billed longspur breeding range has been drastically reduced, with breeding populations extirpated from Minnesota, South Dakota, Oklahoma, southeastern Saskatchewan, most of North Dakota, and possibly Manitoba (Sedgwick 2004; Panella 2012; COSEWIC 2016; North Dakota Fish and Game Department 2016). There have no confirmed breeding records in Minnesota since 1900, South Dakota since 1910, and Oklahoma since 1914 (Sedgwick 2004; NatureServe 2020). Historical breeding records for Manitoba have not been confirmed (COSEWIC 2016), but Raine (1892) recorded small numbers of thick-billed longspurs amongst more abundant chestnut-collared longspurs “in the Red River valley towards Winnipeg” (pg. 53) in the summer of 1891. A male thick-billed longspur from Manitoba was collected during the breeding season for the National Museum of Canada on May 29, 1925 (Taverner 1927) but was never confirmed as a breeding record (COSEWIC 2016). Thick-billed longspur is now restricted to a single location in North Dakota (Rhame Prairie) and is in immediate danger of extirpation from that state (North Dakota Game and Fish Department 2016). Range contraction over the period 1905–1930 has been attributed to extensive habitat loss resulting from the conversion of large tracts of native grassland into cropland (Stewart 1975).

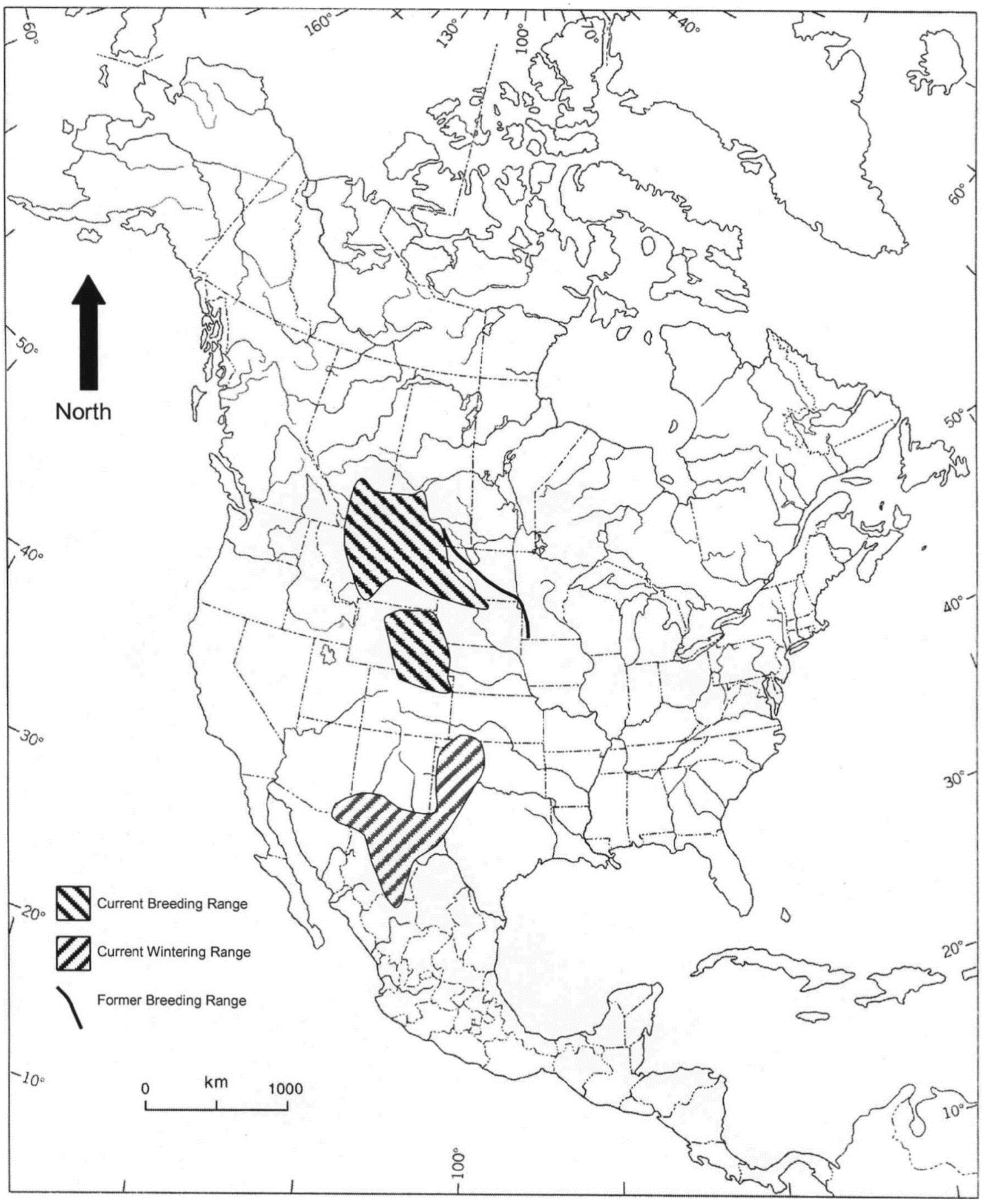

Figure 2. Breeding and wintering ranges of thick-billed longspur. Used with permission from COSEWIC (cited in COSEWIC 2016).

3.3 Wintering Range

Thick-billed longspurs overwinter in the grasslands and deserts of the southern U.S. and northern Mexico (With 2010) (Figure 2). In Mexico, they winter in the states of Chihuahua, Durango, and Sonora (Sedgwick 2004; Macias-Duarte *et al.* 2011) and were recorded in highest numbers in the Janos Biosphere Reserve in northwest Chihuahua during winter grassland bird surveys (Macias-Duarte *et al*. 2011). Thick-billed longspurs also winter in southeastern Arizona, New Mexico, southwestern Oklahoma, and western Mexico (Sedgwick 2004). Wintering populations are abundant in the panhandles of Texas and Oklahoma (Sedgwick 2004).

3.4 Search Effort

Breeding Bird Survey (BBS) data collected in Alberta's Grassland Natural Region between 1996 and 2015 were used to estimate survey search effort; information on search effort is not available from other databases. In 1996, the Grassland Bird Monitoring (GBM) routes were added to the BBS data in Alberta and Saskatchewan to address the sparse survey coverage of native grassland habitats on the existing BBS routes (Dale *et al.* 2005). GBM routes use the same systematic survey protocols of the Breeding Bird Survey but are intended to specifically target grassland bird species, including thick-billed longspur (Dale *et al.* 2005). Each 40-km long BBS or GBM route consists of 50 stops approximately 0.8 km apart; stops are pre-determined and specific stop locations are not chosen based on the surrounding habitat, although GBM route selection does consider habitat (Dale *et al.* 2005). Many of the BBS routes in Alberta's Grassland Natural Region are dominated by cropland, and therefore may inadequately survey population trends of grassland bird species (Dale *et al.* 2005).

Thick-billed longspurs were recorded on 27 routes in Alberta between 1996 and 2015 (USGS Patuxent Wildlife Center 2017). For this report, the assumption was made that if at least one thick-billed longspur was detected on a route during one survey then at least some of the route included appropriate thick-billed longspur breeding habitat. It was also assumed that all individuals detected during surveys were breeding individuals, as the survey protocols limit timing to the breeding season and record singing males. Not all routes were surveyed in each year over the 20-year interval examined; therefore, data obtained from the USGS Patuxent Wildlife Research Center were used to determine the number of years each route was surveyed, including years surveyed in which no thick-billed longspurs were recorded (USGS Patuxent Wildlife Research Center 2017). This information was available for 23 of the 27 routes. Search effort for each route was calculated as 50 stops multiplied by the number of years the route was surveyed. The number of times that at least one thick-billed longspurs was recorded at a stop was tallied for that route. For the total 23 BBS routes, thick-billed longspurs were recorded at 512 of 12 050 stops, or at 4.3% of the stops. A little more than 40% (210/512 stops) of the detections were on a single GBM route, illustrating the importance of targeting grassland birds using GBM routes. The USGS Patuxent Wildlife Center (2017) considers the Alberta BBS data for thick-billed longspur to have moderate precision and moderate abundance on routes.

4.0 Habitat

4.1 Breeding Habitat

Thick-billed longspur is endemic to the North American grasslands (Mengel 1970). Typical breeding habitat is sparsely vegetated, short-grass prairie populated by semi-arid, drought-tolerant grass species (e.g., blue grama grass) or heavily grazed, mixed-grass pasture (Askins *et. al.* 2007; With 2010). Preferred vegetation structure has 24%–38% exposed groundcover, minimal surface litter, and vegetation height of approximately 5 cm (Sedgwick 2004).

Certain combinations of fire, grazing, precipitation, topography, and soil type are associated with higher densities of breeding thick-billed longspurs (Dale et al. 1999; With 2010; Richardson 2012; McWilliams 2015; Wiens and Dale 2015; Skagen *et al.* 2017). For example, higher numbers of thick-billed longspurs are found on burn-grazed pastures compared to unburned-grazed pastures, but not during drought years (Skagen *et al.* 2017). Wiens and Dale (2015) found that thick-billed longspurs were 395% more likely to occur on upland-gravel ecosites than expected, and 344% more likely on upland-clayey ecosites in the Dry Mixedgrass Natural Subregion of Alberta; preferences for certain ecosites varied with precipitation conditions. In mixed-grass regions, thick-billed longspur prefer moderately grazed areas with less productive soils (B. Dale pers. comm.) and heavily grazed areas (With 2010) with richer soils. These conditions tend to result in a dominance of short-grass species over mid-grass species. However, the resulting vegetation structure, rather than plant composition or processes such as grazing or fire, is the likely basis of thick-billed longspur habitat selection (see Fisher and Davis 2010 for a review of grassland bird habitat selection). Thus, thick-billed longspurs will use cropland and grazed tame pastures as breeding habitat (Prescott and Wagner 1996; Martin and Forsyth 2003; Sedgwick 2004; Dale *et al.* 2005), because it has similar vegetation structure to their preferred short-grass native habitats.

Thick-billed longspurs are detected more frequently and in higher densities in landscapes with a larger proportion of native grassland. Even when thick-billed longspurs selected cultivated fields for breeding, the fields were situated within landscapes with a high proportion of native grassland habitat (Lipsey 2015). Habitat models of landscapes in northeastern Montana suggest that a 1492-km^2 quadrangle with 40% intact grassland will support approximately 3500 thick-billed longspurs, whereas the same area with only 15% intact grassland will support only 400 (Lipsey 2015). Larger tracts of native grassland (e.g., Suffield National Wildlife Area) have been associated with more frequent occurrence of thick-billed longspurs and other grassland endemic bird species (Dale et al. 1999; Davis 2004; Dale et al. 2005; McWilliams 2015).

Thick-billed longspurs are described as having a semi-colonial distribution (Greer and Anderson 1989) with spatially clumped territories (With 2010; Lipsey 2015). When controlled for search effort, a little more than 40% of all the thick-billed longspurs recorded on Breeding Bird Survey routes in Alberta were detected on a single route, which signifies a clumped distribution. Therefore, sociality likely also plays a role in habitat selection.

Thick-billed longspurs have been reported to be attracted to the bare ground exposed when infrastructure such as gas wells are sited within their habitat (e.g., Dillon Consulting Ltd. 2006); however, they often show displacement behaviour to the infrastructure itself. Kalyn Bogard and Davis (2014) found thick-billed longspur abundance increased with distance from gas wells in an area of high well density (>10 wells/259 ha). Similarly, relative abundance of thick-billed longspurs decreased with increasing sum of natural gas pipeline length (McWilliams 2015; see 7.4. Roads, Power Lines and Linear Disturbances in 7.0 Threats,). These studies suggest thick-billed longspurs are sensitive to incursions in their habitat.

4.2 Nest Site Attributes and Microhabitat

Multiple studies have found that vegetation structure plays an important role in breeding habitat selection for thick-billed longspur, particularly vegetation height and quantity of bare ground or exposed ground cover (clubmoss/lichen) (e.g., Sedgwick 2004; Bleho 2009; Henderson and Davis 2014; Kalyn Bogard and Davis 2014). Thick-billed longspurs are associated with interspersed shrub and cactus cover (e.g., *Opuntia polyacantha*) with 24%–38% bare or exposed ground, and 23%–66% short-grass vegetation and minimal litter (Sedgwick 2004). Average vegetation height around nest sites is 5 cm (Sedgwick 2004; With 2010). There is evidence that thick-billed longspurs avoid areas of taller, denser vegetation, such as oil and gas pipelines reclaimed with exotic crested wheatgrass (*Agropyron cristatum*; McWilliams 2015).

Thick-billed longspurs will nest in cultivated land that is structurally similar to preferred nesting habitat (e.g., grazed tame pastures, stubble fields, and intensely tilled fields with bare ground exposed; Felske 1971; Martin and Forsyth 2003; Dale *et al.* 2005). Their use of cultivated fields may be a recent phenomenon (since the second half of the 20^{th} century); localized historical studies did not report thick-billed longspurs breeding in cropped land (DuBois 1937; Mickey 1943). Recent use of cultivated land has been suggested as a response to the scarcity of suitable breeding habitat (Environment Canada 2014); however, the earlier studies were limited in their scope and search effort, so it is unknown how long thick-billed longspurs have used cultivated habitats (S. Davis pers. comm.). One study found that thick-billed longspurs were more attracted to intensely tilled fields over conservation tillage fields, despite having poorer breeding success in the intensely tilled fields (Martin and Forsyth 2003) (see 7.0 Threats). However, it should be noted that Martin and Forsyth (2003) assessed breeding success by indirect means (bird behaviour) and did not monitor nests.

4.3 Wintering Habitat

Migratory and wintering habitat of thick-billed longspurs is structurally similar to their breeding habitat (Pool *et al.* 2014). Their wintering habitat in the southwestern U.S. and northwestern Mexico is sparsely vegetated, desert grassland (With 2010). In the Janos Biosphere Reserve in northwest Chihuahua, Mexico, thick-billed longspurs are found in significant numbers associated with the heavily grazed habitat of the black-tailed prairie dog (*Cynomys ludovicianus*) complex (Macias-Duarte *et al.* 2011). They have also been observed using agricultural fields and dry lake beds in winter (With 2010).

4.4 Habitat Associations

Historically, the black-tailed prairie dog and Mexican prairie dog (*C. mexicanus*) were the primary grazers of the desert grasslands used as wintering habitat by thick-billed longspurs (Askins *et al.* 2007). Prairie dogs are landscape engineers, as they keep the vegetation consistently cropped and, along with other native grazers, keep woody vegetation in check (Askins *et al.* 2007), producing conditions that favour thick-billed longspur. Augustine and Baker (2012) found that thick-billed longspurs, as well as burrowing owls (*Athene cunicularia*) and mountain plovers (*Charadrius montanus*), occur in significantly higher densities on prairie dog colonies. Within parts of the thick-billed longspur breeding range, the black-tailed prairie dog, Richardson's ground squirrel (*Spermophilus richardsonii*), and other similar rodent species provide the same services.

Thick-billed longspurs have evolved with native grazers such as bison, and therefore can tolerate and benefit from the presence of grazing cattle (With 1994). However, depending on the soil type and other factors, the light to moderate grazing regimes currently used in Alberta may not produce the extremely sparse vegetation and patches of bare ground favoured by thick-billed longspurs. Thick-billed longspur is often associated with other species that also prefer heavily grazed native grasslands, such as burrowing owl and mountain plover. They often associate with horned larks both on the breeding (Mahoney and Chalfoun 2016) and wintering grounds (With 2010).

4.5 Habitat Trends

Native grasslands have been described as North America's most endangered ecosystem (Samson and Knopf 1996), and are Alberta's most human-altered landscape (Government of Alberta 2016a). As of 2016, it was estimated that about 57% of Alberta's Grassland Natural Region has been converted to some type of human footprint*, predominantly agriculture (ABMI

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* Human footprint is defined as the visible conversion of native ecosystems to temporary or permanent residential, recreational, agricultural, or industrial landscapes (ABMI 2018). ABMI defines six categories of human footprint:

2018). Although much of the loss occurred by the first half of the 20th century, conversion and degradation continue today. Large, intact tracts of native grassland of at least 200 ha (500 acres) have the greatest potential to support thick-billed longspurs and other species endemic to the North American grasslands (Natural Resources Conservation Service 1999; Lipsey 2015). Compared to cultivated land (i.e., cropland and tame pasture), Alberta's native grasslands support four times as many nests of all bird species, with an estimated 0.8 bird nests/ha versus 0.2 nests/ha (Zimmerling *et al.* 2013). However, despite 56% of Alberta's remaining native grassland habitat being on Crown land (Nernberg and Ingstrup 2005), only 2218 km^2 (1.4%) of Alberta's prairie region (Grassland and Parkland natural regions) is within protected areas (ABMI 2016). This lack of protection has resulted in continued loss (conversion) and degradation of Alberta's native grassland habitat. From 2012-2019 there was a cumulative increase of 23% in total plowed area in Alberta (World Wildlife Fund 2021). Plowed land was likely made up of grassland, shrubland, and wetland, but the specific amount of native grassland lost is unknown.

4.5.1 Habitat Conversion Trends

Starting in the late 1800s, large tracts of native grassland across the continent were plowed for conversion to cropland (Askins *et al.* 2007). By 1931, 24 million ha of Canadian grassland had been converted (Willms *et al.* 2011). The habitat loss that occurred in the late 19th century and early 20th century is believed responsible for the substantial contraction of the thick-billed longspur's breeding range between 1905 and 1930 (Stewart 1975 cited by Environment Canada 2014). Shrinking thick-billed longspur ranges on the breeding grounds during the early 20th century were mirrored on the wintering grounds with drastic population shifts being recorded in Arizona and Texas, and a sharp decline in numbers on the Texas panhandle by 1940 (Sedgwick 2004).

Conversion to cropland is still the most common loss of native grassland habitat from the landscape and is expected to continue with increasing global food demand (Lipsey *et al.* 2015). Between 1985 and 2001, Canada lost approximately 10% of its remaining native grasslands because of the conversion of smaller remnant patches to cropland (Watmough and Schmoll 2007). Between 1999 and 2016, an additional 2.5% of Alberta's Grassland Natural Region was converted to some type of human footprint (ABMI 2018). In Alberta's Grassland Natural Region, the agriculture footprint increased in area by 1.4% between 1999 and 2016 (ABMI 2018); the energy footprint similarly increased in area (by 1.2%) during that time, and other footprint types had minimal ($\leq$ 0.2%) increases (ABMI 2018).

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agriculture; forest harvest; mines, wells and other energy features; transportation; urban, rural, and industrial; and human-created waterbodies.

Loss of native grassland habitat is also occurring in thick-billed longspur breeding range in the U.S. Between 1982 and 1997, almost 93 000 km^2 of U.S. grasslands were lost (Samson *et al.* 2004). More recently, incentives to grow crops for biofuels are believed to be responsible for motivating the conversion of 5.7 million acres (2.3 million ha) of pasture, including an estimated 1.6 million acres (> 647 000 ha) of native grassland habitat converted to crops such as corn between 2008 and 2012 (Lark *et al.* 2015). Habitat conversion in the U.S. is occurring five times faster than implementation of U.S. grassland protection programs (Lipsey *et al.* 2015).

The fastest rate of habitat loss may be occurring on thick-billed longspur wintering grounds in northern Mexico. Between 2006 and 2011, Pool *et al.* (2014) documented an annual rate of conversion of 6.04% in the valley-bottom grasslands and shrublands of the Chihuahuan desert region. This loss of habitat accumulated to more than 69 000 ha and was the result of agricultural intensification through irrigation. At the current rate of conversion, Pool *et al.* (2014) estimated that all of the remaining valley-bottom grasslands in the Valles Centrales could be converted to cropland by 2025.

4.5.2 Habitat Degradation Trends

Loss of remnant patches of native habitat may reduce the connectivity of the grassland ecosystem at a landscape level (Natural Resources Conservation Service 1999). Moreover, with more cropland on the landscape, pesticide use has increased, which can degrade adjacent native grassland habitats. Between 2003 and 2013, pesticide sales in Alberta's Dry Mixedgrass Natural Subregion increased by approximately 50% (Alberta Environment and Parks 2015) (see 7.0 Threats).

Many incursions into Alberta's remaining tracts of native grassland habitat are related to oil and gas developments, but renewable energy developments (i.e., wind farms) are also being sited within thick-billed longspur breeding habitat (Alberta Environment and Parks 2017a). Introduction of infrastructure such as oil and gas wells, wind turbines, pipelines, power lines, and access roads, as well as increased traffic and anthropogenic noise, are degrading the remaining habitat. Even in the largest remaining tracts of native grassland habitat in Alberta (deemed "high value landscapes" by ABMI 2016), only 23% of that landscape has a buffer of at least 200 m from visible human footprint (ABMI 2016).

5.0 Biology

This section focuses primarily on aspects of the species' biology that are relevant to its conservation, management and status. Much of our knowledge of thick-billed longspur breeding biology is compiled in the Birds of North America species account (With 2010). Information in following subsections is attributed to, or summarized by, With (2010), unless otherwise noted by a citation.

5.1 Species Description and Longevity

Thick-billed longspur is a small, ground-dwelling passerine bird, approximately 15 cm in length. Weighing approximately 25 g, with males being slightly heavier, thick-billed longspurs are stocky and short-tailed. This sparrow-like species features an elongated hallux claw characteristic of all longspur species. It is distinguished from other longspur species, such as the chestnut-collared longspur, by a larger bill and black upside-down T-shaped marking on a white tail. Each longspur species has a diagnostic tail pattern, with thick-billed longspur being most extensively white. The grey-tinged breeding males have a black breast bib, moustache stripe, crown, and bill. Male wings have a dark malar stripe and prominent chestnut median coverts. Unlike the male thick-billed longspur, females feature a large reddish or light brown bill, and plain plumage. Females lack the black chest and crest markings of the males and have wings with less chestnut pigmentation. In fall and winter, the drab buff-brown feather tips of winter plumage may obscure the markings of both sexes. The muted winter plumage makes it difficult to distinguish thick-billed longspur from other longspur species during this season.

The lifespan of thick-billed longspur has not been well studied; therefore, generation time is estimated to be between two and three years, the same as for other similar small passerine bird species (COSEWIC 2016).

5.2 Breeding Biology

It is likely that thick-billed longspurs begin breeding at one year of age. In Alberta, birds begin arriving on the breeding grounds by mid- to late-April. Macoun and Macoun (1909) describe the first two individuals arriving at Medicine Hat on April 21, 1894 and by May 2 "they were in thousands…and numbers of males were in full song" (pg. 492). Males arrive approximately two weeks before females and establish territories for the breeding season. A single territory is 0.6 to 1.4 hectares (average 1.0 ha). Thick-billed longspurs have been described as semi-colonial on the breeding grounds and territories are clumped.

Males can be observed flying high above the ground in an aerial display, and then floating down towards the ground while singing. During these flight-songs, white plumage is exposed by spreading the wings back and tail wide. Males engage in aerial displays to maintain territories and court females. The distinct flight-song that accompanies the aerial display is described as "*see, see, see me, see me, hear me, hear me, see"*. At the end of the flight-song males often alight at the edge of their territory. They will also defend their territory by flying low along the territory boundary (Mickey 1943). Ground displays directed at females include males flashing a white wing lining or circling the female while singing.

If courtship is successful, the female will join that male in an established territory, becoming pair-bonded for the breeding season. Females create or select a depression on the ground and collect vegetation or animal hair for nest material. Egg laying for the first brood begins in May, and as early as April in the southern portion of the breeding range. The average clutch size is three eggs; however, clutch sizes of between two and five eggs have been observed. Females incubate the eggs for a period of 12 days, only leaving the nest to forage. Males do not participate in incubation but can be seen foraging and making flight displays near the nest. Females may initiate a second brood, depending on energy reserves and resources available, three weeks following the fledging of first brood.

Thick-billed longspurs will begin leaving the breeding grounds in August for the wintering grounds in the U.S. and Mexico, arriving in September through to November.

5.3 Diet and Foraging Behaviour

Thick-billed longspurs are primarily ground foragers, feeding on small arthropods and the seeds of grasses and forbs; they have also been observed flushing out larger insect prey to capture in flight. Insects are typically captured by stalking, which may be facilitated by habitat with sparse vegetation, but "hawking" (capturing prey in the air) and gleaning prey from vegetation are tactics used to a lesser extent.

Diet composition varies seasonally and geographically, depending on food availability. On the wintering grounds, thick-billed longspurs are almost entirely granivorous with a diet composed of seeds from grasses and forbs. During the breeding season, adults consume both seeds and insects, but the proportions vary with location and likely reflect availability (Sedgwick 2004). Nestlings are fed insect prey almost exclusively, with grasshoppers making up between 50% and 95% of the nestling diet in most locations (Maher 1973; Sedgwick 2004). Other items include larvae of moths, butterflies, and beetles (Maher 1973). Both the male and female feed and care for the young.

5.4 Predation and Brood Parasitism

The rate of predation on adult thick-billed longspurs on the breeding grounds is relatively low; however, as a ground-nesting species they are vulnerable to high rates of nest predation, which accounts for almost all of the nest failures at the nestling stage. Ground squirrels are the primary nest predators, including the thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), Richardson's ground squirrel, and white-tailed prairie dog (*C. leucurus*) (outside of Alberta). Other suspected predators include predatory and omnivorous mammals, birds, and snakes.

Predation during migration and on the wintering grounds has not been studied. Brood parasitism of thick-billed longspurs by brown-headed cowbirds (*Molothrus ater*) is rare, possibly because their nesting habitat lacks suitable perches for cowbirds. Macoun and Macoun (1909; pg. 492) reported finding a thick-billed longspur nest at Crane Lake, Saskatchewan in June of 1894 containing five eggs, "one of which belonged to a cowbird".

5.5 Nesting Success and Survival

Thick-billed longspur young are altricial, weighing approximately 2.0 grams at hatch and measuring around 3 cm. For a northern Colorado population, hatching success (percentage of young hatched/eggs laid in a nest) was 67.5%; fledging success (percentage of young fledged/young hatched in nest) was 56.6%, and overall reproductive success (percentage of young fledged/eggs laid in nest) was 33.7%. The average number of fledglings successfully leaving each nest is between 1.1 and 3.5. Young leave the nest when they have attained 70%–80% of their adult mass at about 10 days of age (Maher 1973). There are no data on lifetime reproductive success for thick-billed longspur.

Historical grassland reclamation efforts that used exotic plant species, such as crested wheatgrass, degraded thick-billed longspur habitat and possibly reduced nest success because it grows taller and denser than the preferred habitat. Infrastructure and shrub encroachment may increase rates of nest predation by providing cover for ground squirrels and perches for avian nest predators. In one study, nest predation rates for thick-billed longspur nests placed near shrubs were two to three times higher than for nests placed near other types of vegetation, such as cactus (With 1994).

Inclement weather can reduce nesting success. Weather-related deaths often only partially reduce brood size, rather than resulting in full nest failure. However, fewer thick-billed longspur nests successfully fledge any young during hot, dry breeding seasons; daily nest survival rates were significantly lower on days with extreme hot temperatures (≥35^0C), a lack of precipitation, or following a severe storm (Conrey *et al.* 2016).

5.6 First Year Survival and Breeding Site Fidelity

No data on first year survival rates of thick-billed longspur exist. Of 74 individuals banded as nestlings, none were recorded returning to their natal breeding sites in later years. It is unknown whether this indicates that immature birds emigrate to other breeding sites, have poor first year survival, or search effort was insufficient to detect them. Immature thick-billed longspurs form flocks with adults at the end of the breeding season and immature and adult birds migrate to the wintering grounds together.

Breeding site fidelity of mature adults is unknown because banding data are limited. Thick-billed longspurs have been described as dispersive or nomadic; they disappear and reappear at certain sites and exhibit highly variable abundances on the wintering grounds (Sedgwick 2004).

5.7 Dispersal and Flocking

During migration thick-billed longspurs are found in flocks. Flocks migrating to the wintering grounds form on the breeding grounds in early August. Flocking behaviour has also been observed on the wintering grounds, with chestnut-collared longspurs, Lapland longspurs, and Sprague's pipits (With 2010; Wulff et al.2016). Spring migration from the wintering grounds begins in February to April, and the spring flocks arrive in Alberta and Saskatchewan in late April or early May.

6.0 Population Size and Trends

Sources of data for population size, trends and observations in North America include the Breeding Bird Survey (BBS), Christmas Bird Count (CBC), and eBird. Alberta-specific data were available from FWMIS, ABMI, and Nature Alberta. See Appendix 2 for a summary of thick-billed longspur data sources used in this status report.

6.1 Population Estimates

6.1.1 Alberta

Alberta's current breeding population of thick-billed longspur has been estimated at 58 000 adults, which is approximately 22% of the estimated Canadian population (260 000 adults) and 7% of the estimated global population (840 000 adults) (Partners in Flight 2020). These estimates are based on the number of BBS point count detections and maximum detection distance (estimated maximum distance an observer can perceive a thick-billed longspur [Partners in Flight 2020]) for thick-billed longspur. The Partners in Flight method of estimating population size was criticized for some of its assumptions and for using methods designed to measure population trends to estimate population size (Thogmartin *et al.* 2006). This led to an update of the methods used by Partners in Flight, and current methods address these criticisms (Blancher *et al*. 2013).

6.1.2 Other Areas

Sedgwick (2004) summarized breeding densities of thick-billed longspurs from several projects conducted in the 1960s until the early 2000s (see Table 1). The wide range in observed breeding densities (range 25/km^2–623/km^2) is likely related to the clumped distribution of breeding territories (i.e., surveying within a clump will result in a higher breeding density and surveying between clumps will result in a lower breeding density).

Table 1. Breeding densities of thick-billed longspurs from various research studies between the early 1960s and early 2000s, as summarized in Sedgwick (2004). Note that estimates that were reported as number of pairs are likely based on numbers of singing males, and when these estimates are converted to number of birds (see birds/km^2 column), they might: 1) include singing males that do not have mates, and/or 2) leave out single birds that do not have territories.

Location	Year	Density (as reported)	Density (birds/ km^2)	Habitat/ Notes	Source
Wyoming	Early 1960s	76.6+15.0 pairs/100 acres	379 + 74	3-year average; Laramie Plains	Finzel 1964
Wyoming	Early 1960s	126 pairs/ 100 acres	623	3-year average; Cheyenne Plains	Finzel 1964
Saskatchewan	late 1960s	79 indiv/100 acres	195	Matador project	Maher 1973
Pawnee National Grassland (Colorado)	late 1960s	75.6 birds/ 100 acres	187	occupied, heavily-grazed pastures	Wiens 1970
Pawnee National Grassland (Colorado)	1969	46.9 pairs/ 100 acres	232	occupied, heavily-grazed pastures	Giezentanner 1970
Pawnee National Grassland (Colorado)	1969	13.6 pairs/ 100 acres	67	occupied, lightly-grazed pastures	Giezentanner 1970
Pawnee National Grassland (Colorado)	1969	11.7 pairs/ 100 acres	58	including all pastures (occupied and non-occupied)	Giezentanner 1970

Location	Year	Density (as reported)	Density (birds/ km^2)	Habitat/ Notes	Source
Pawnee National Grassland (Colorado)	1970	40.8 pairs/ 100 acres	202	occupied, lightly-grazed pastures	Giezentanner 1970
Pawnee National Grassland (Colorado)	1970	40.8 pairs/ 100 acres	202	including all pastures (occupied and non-occupied)	Giezentanner 1970
Pawnee National Grassland (Colorado)	1970	14.3 pairs/ 100 acres	71	including all pastures (occupied and non-occupied)	Giezentanner 1970
Pawnee National Grassland (Colorado)	1972	81.5 birds/ 100 acres	201	occupied, lightly-grazed pastures	Porter and Ryder 1974
Pawnee National Grassland (Colorado)	1997	0.904 + 0.58 birds/ha	90	data from 10 occupied sites	S.K. Skagen (pers. comm. in Sedgewick 2004)
Pawnee National Grassland (Colorado)	1998	0.704 + 0.53 birds/ha	70	data from 11 occupied sites	S.K. Skagen (pers. comm. in Sedgewick 2004)
Pawnee National Grassland (Colorado)	1999	1.09 + 0.54 birds/ha	109	data from 6 occupied sites	S.K. Skagen (pers. comm. in Sedgewick 2004)
Pawnee National Grassland (Colorado)	2002	24.8 birds/km^2	25	240 point counts on 80 sections	Hanni et al. 2003

6.2 Population Trends

6.2.1 Alberta

Short-term BBS data indicate a 16.0% annual decline (95% CI: -25.6, -7.1, n=27) for Alberta's population of thick-billed longspur from 2009 to 2019 (Figure 3); this equates to a cumulative 10-year population decline of approximately 83% with a 100% probability of decline. There is a 98% chance of a greater than 50% decline and a 100% chance of a greater than 30% decline during the short-term period (Smith *et al*. 2019).

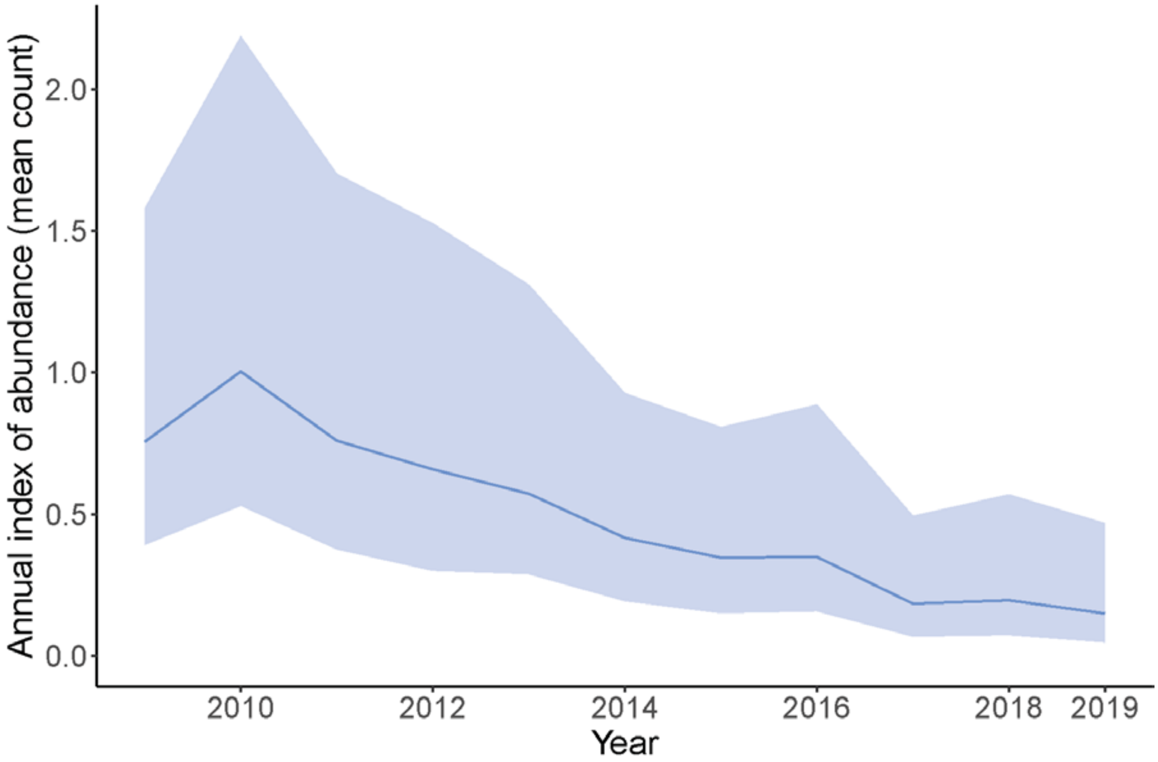

Figure 3. Breeding Bird Survey annual index of abundance for thick-billed longspur in Alberta from 2009–2019 (short-term). The shaded area represents the 95% credible region (Smith et al. 2019).

Long-term BBS data indicate a 9.5% annual decline for Alberta (95% CI: -12.1, -6.9, n=33) from 1970 to 2019, with a cumulative decline of approximately 99% (Figure 4). The probability of a 50% decline or greater is 100% (Smith *et al*. 2019). It is worth noting that this steep decline has been documented despite increased search effort in grassland habitat because of the Grassland Bird Monitoring data that have been incorporated into the BBS as of 1996. Also adding credence to this steep, long-term decline is the historical account from Macoun and Macoun (1909) of "thousands" of thick-billed longspurs arriving on a single day in May to breeding habitat near Medicine Hat, Alberta in 1894. For context, fewer than one thousand thick-billed longspurs have been recorded on the BBS routes in Alberta over the past 20 years. In 2017, an avid lifelong birder (Gus Yaki) led a group of birders on a round-trip walk across Alberta's grasslands (Calgary Herald 2017); only two thick-billed longspurs were observed (D. Hill pers. comm. with G. Yaki). This anecdotal information adds valuable context to the trend values calculated using BBS data.

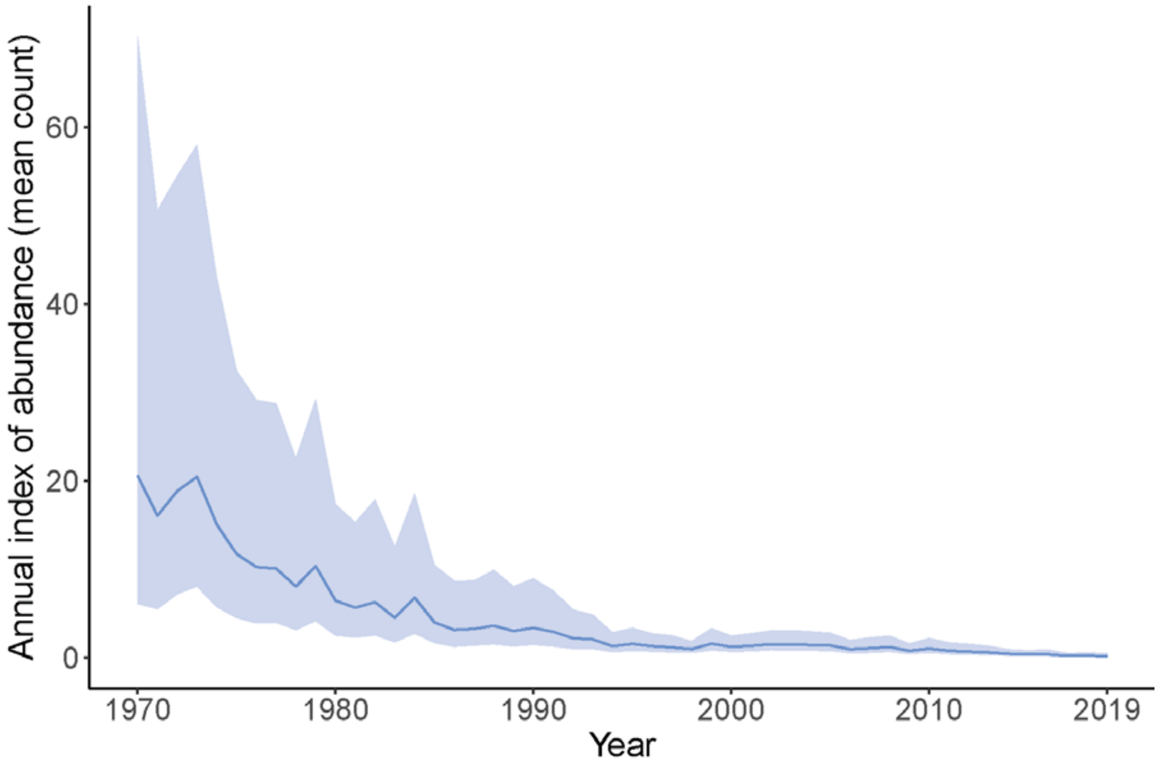

Figure 4. Breeding Bird Survey annual index of abundance for thick-billed longspur for Alberta from 1970 to 2019 (long-term). The shaded area represents the 95% credible region (Smith et al. 2019).

Breeding populations of thick-billed longspur appear to fluctuate somewhat from year to year (e.g., Figure 3), but do not fluctuate by greater than one order of magnitude. Some fluctuation is likely a result of year-to-year changes in environmental conditions in native grassland habitats (Winter *et al.* 2005).

6.2.2 Other Areas

A declining short-term (2009–2019) trend was also found in Canada of -5.1% per year (95% CI: -12.6, 3.5, n=45), which is equivalent to a decline over that period of 41% with a 90% chance of decline (Figure 5). For the Canadian population, the probability of a short-term decrease of greater than 50% is 55%, and the probability of a decrease of greater than 30% is 34% (Smith *et al.* 2019). The short-term (2009–2019) decline in Saskatchewan (-3.2; 95% CI: -11.8, -5.8, n=18, with a 77% probability of decline) is also substantial, although it is less steep than in Alberta. The trend in the same period in Montana has been positive (10.0, 95% CI: 1.1, 19.7, n=29, with a 1% probability of decline) (Smith *et al*. 2019).

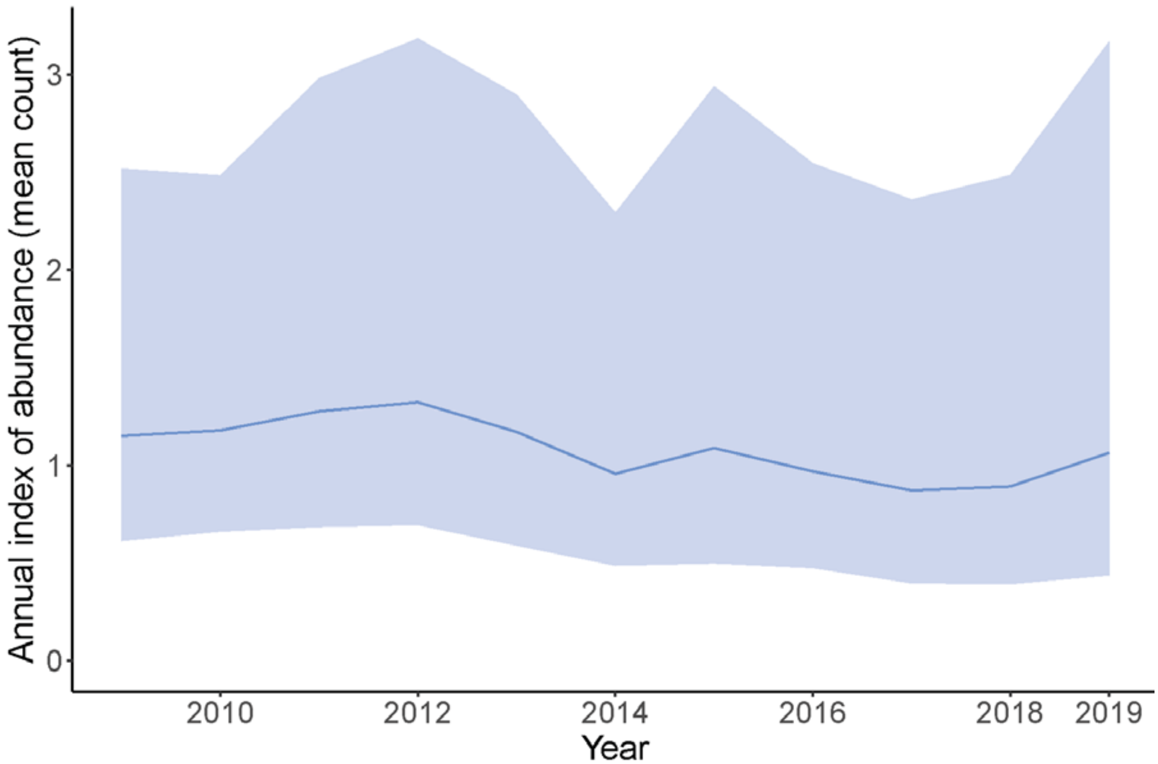

Figure 5. Breeding Bird Survey annual index of abundance for thick-billed longspur in Canada from 2009–2019 (short-term). The shaded area represents the 95% credible region (Smith *et al*. 2019).

Long-term BBS for Canada from 1970–2019 show a decline of 6.2% per year (95% CI: -9.2, -3.1, n=58), which is a cumulative decline over that period of 96%. There is a 100% chance of greater than a 50% decline over the long term (Figure 6) (Smith *et al.* 2019). Long-term trend (1970–2019) in Saskatchewan is of decline (-5.2% per year, 95% CI: -8.9, -1.6, n=25, with a 100%

probability of decline during that period). Over the same period in Montana, thick-billed longspurs increased by 1.2% per year (95% CI: -1.3, 3.9, n=34, with a 17% probability of decline) (Smith *et al.* 2019).

Overall, long-term declines across Canada and the United States have resulted in a cumulative estimated range-wide loss of thick-billed longspurs of 71% from 1970 to 2019 (-2.5% per year, 95% CI: -4.7, -0.4, n=139, with a 100% probability of decline over that period; Smith et al. 2019). In the short term, however, the continental trend has been positive (5.7%/year; 95% CI: -0.4, 13.2, n=127, with a 0% probability of decline) (Smith *et al*. 2019). Since trends in the U.S. are positive (0.9%/year and 8.7%/year, for short and long term, respectively), it appears that the decline is occurring mostly in Canada, and, recently, is particularly steep within Alberta.

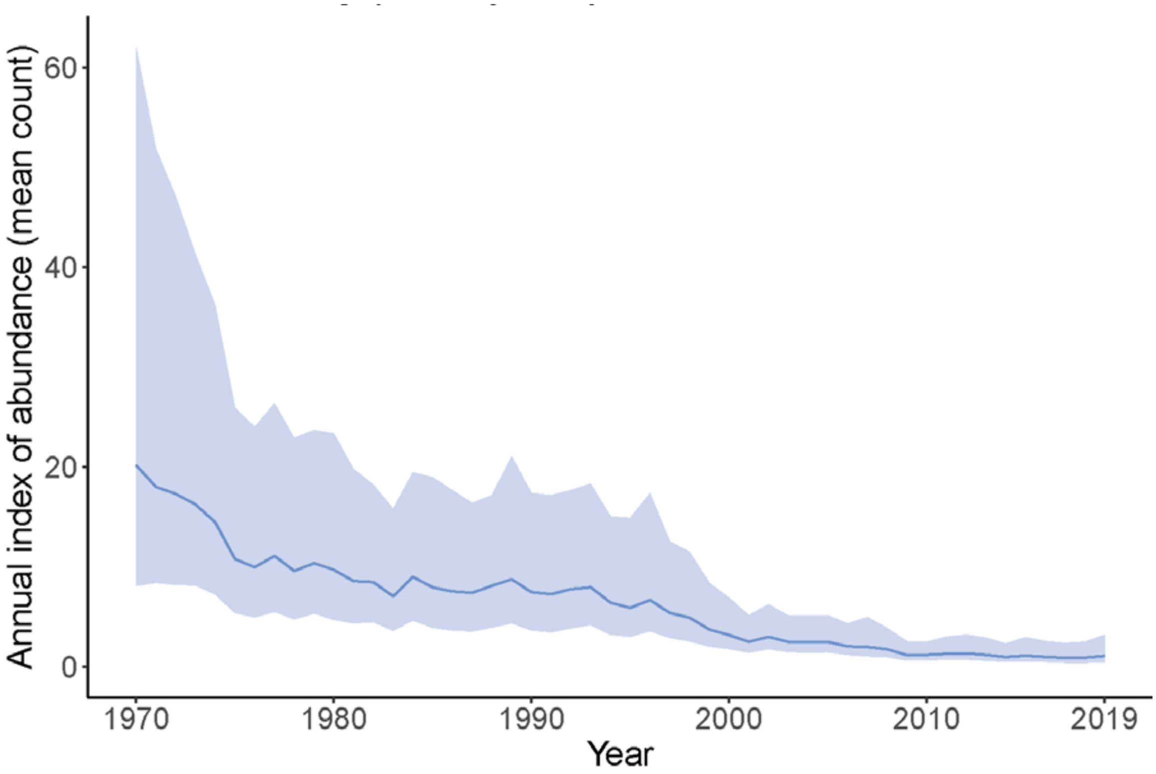

Figure 6. Breeding Bird Survey annual index of abundance for thick-billed longspur for Canada from 1970 to 2019 (long-term). The shaded area represents the 95% credible region (Smith *et al*. 2019).

Christmas Bird Count (CBC) data are collected on a one-day annual count of all the birds in a 15-mile-diameter circle within two weeks of Christmas (National Audubon Society 2018). The earliest CBC data that included thick-billed longspur observations were collected in 1922. CBC data were obtained from 1943 to 2016 for thick-billed longspur winter range abundance and are presented in Figure 7 (National Audubon Society 2018). Initially, the number of birds per party hour was very low, possibly because there were few surveyors (e.g., 5 or fewer observers until 1955) likely covering urban areas and not necessarily in good quality thick-billed longspur habitat (National Audubon Society 2018). However, as survey effort increased (e.g., 16 observers in 1956) the number of birds per party hour seemed to increase, possibly because of better coverage of thick-billed longspur wintering habitat. Density of observations peaked in 1968 (0.0625 birds/party hour) followed by a steep decline to 1973 (0.0097 birds/party hour). After 1973, density was low but relatively stable (National Audubon Society 2018). However, CBC results should be cautiously interpreted because, unlike BBS surveys, effort is coarsely controlled and varies year to year (COSEWIC 2016). Thick-billed longspur numbers on the wintering grounds have been noted to fluctuate greatly from year to year, presumably because of fluctuating weather patterns and conditions (Sedgwick 2004) (Figure 7).

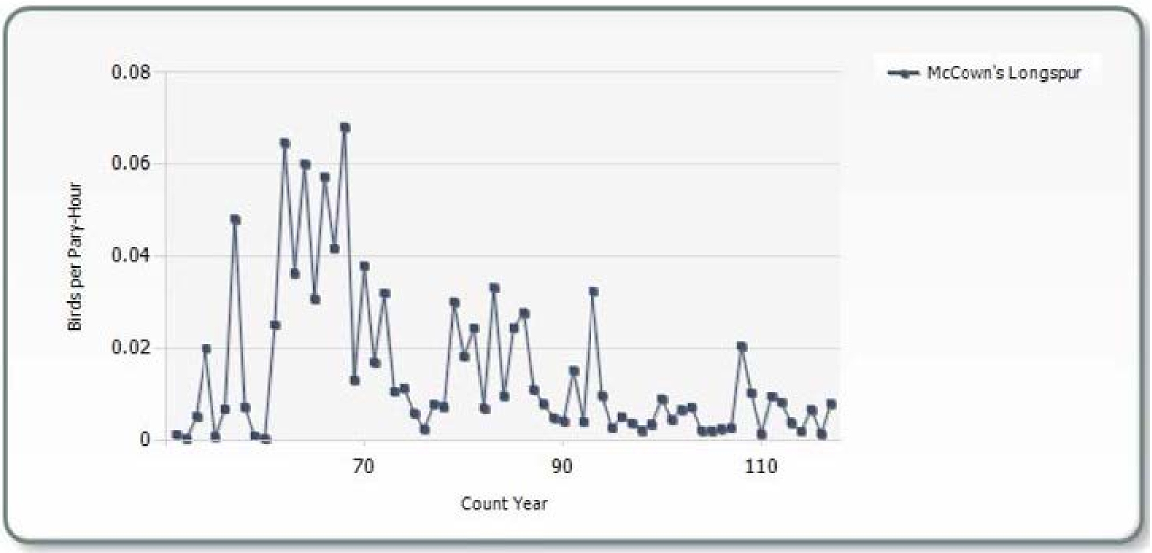

Figure 7. Number of thick-billed longspurs recorded per party hour on Christmas Bird counts from 1943 to 2016 (Count Years 44–117) in North America (National Audubon Society 2018).

6.3 Rescue Potential

Rescue potential refers to the possibility that thick-billed longspurs from adjacent jurisdictions will immigrate and reproduce successfully in Alberta and, therefore, mitigate a population decline or extirpation. Alberta is immediately adjacent to jurisdictions (Saskatchewan and Montana) with populations of thick-billed longspurs that could move into Alberta. However, there is some concern for this species in Saskatchewan (ranked S3B,S3M; CESCC 2016) and Montana (*Priority 2* [requires monitoring]; Montana Partners in Flight 2000); BBS analysis indicates it is declining in Saskatchewan, although not in Montana (see 2.2 Other Areas subsection in 2.0 Population Trends).

Declines in thick-billed longspur numbers in Alberta are thought to be caused primarily by declines in the quantity/quality of breeding habitat (see 7.0 Threats). This suggests that potential immigrants to Alberta might not find vacant suitable habitat. Therefore, rescue would be unlikely.

7.0 Threats

This section focuses on threats that have an anthropogenic origin, as well as on other naturally occurring factors that are amplified because of human activities and result in increased pressures on the thick-billed longspur population. Threats are presented in general order of importance and follow the lexicon of Salafsky *et al.* (2008). Although this section examines each threat separately, the effects are cumulative and typically do not occur in isolation of other threats.

Conversion and degradation of native grassland habitat are considered the principal stresses causing declines in thick-billed longspur abundance and distribution (Environment Canada 2014). For example, both Dale *et al.* (2005) and Wellicome *et al.* (2014) found that thick-billed longspurs were more than twice as abundant on survey routes in landscapes with a higher proportion of native grassland. Willms *et al.* (2011) distinguished between primary and secondary effects of industrial developments on native grassland habitats. The primary effects decrease the *quantity* of habitat through direct loss (i.e., when vegetation is removed, and soil is disturbed). The secondary effects degrade the *quality* of the remaining habitat through road traffic, introduction of invasive species, fragmentation of habitat, anthropogenic noise, pollution, and changes in wildlife abundances as a result of displacement (avoidance) or attraction to infrastructure, linear disturbances, or edge habitat.

As a measure of the primary effects of each threat on the quantity of habitat, ABMI's measure of human footprint (ABMI 2018) in the Grassland Natural Region is used. The proportion of the Grassland Natural Region that is affected by each threat is used as a proxy for the proportion of thick-billed longspur Alberta range that is being affected. Thick-billed longspur extent of occurrence (93 469 km^2) is fully within the Grassland Natural Region and similar in size to the Grassland Natural Region area of 95 565 km^2. So this approach to estimating the effects of each threat seems reasonable.

Some of the information presented in this section is based on modelling done by the Alberta Biodiversity Monitoring Institute (ABMI and Boreal Avian Modelling Project [BAM] 2019). The ABMI calculated the effects of different industrial sectors (agriculture, forestry, energy, rural/urban development, transportation) by predicting the abundance of thick-billed longspur in the current landbase versus a reference landbase in which each industrial sector's footprint has been back-filled with the vegetation or soil that would have been present before the footprint was made. The resulting "under-footprint sector effect" is the effect of the sector within the areas that have been disturbed by that sector, and the "regional sector effect" is the total effect of the sector on the species' relative abundance across the region, incorporating the area of the footprint, the under-footprint effect and the habitat types that the sector affects. It should be noted that cumulative effects of multiple land uses were not taken into account for this sector comparison (ABMI and

BAM 2019), which could underestimate land use sector impacts on thick-billed longspur abundance. The alteration of land from one anthropogenic land use to another was also not included (such as urbanization of farmland). ABMI models sector effects for the thick-billed longspur in what they refer to as the "Prairie Region" (Parkland and Grassland natural regions) (ABMI and BAM 2019).

7.1 Agriculture

7.1.1 Primary Effects: Direct Habitat Loss

Land use classified as agriculture is the most prevalent human footprint in Alberta's Grassland Natural Region (49.6% out of a total human footprint of 57.1%; ABMI 2018). Although ABMI's sector effects analysis appears to show that agriculture has a positive effect on thick-billed longspur abundance in the prairie region (+12.2% compared to reference conditions), the species is vulnerable to conversion of native grassland to cultivation (ABMI and BAM 2019). The ABMI and BAM (2019) model result suggesting a positive effect from agriculture may be a statistical artifact due to sampling bias. Non-productive soil types are rare across the Alberta landscape, so the ABMI data set contains much fewer samples from non-productive soils relative to productive soil with an agricultural footprint, which are more common and widespread. This sampling bias could lead to biased parameter estimates, which may explain the counter-intuitive result that thick-billed longspur are more abundant in areas with an agricultural footprint. Research shows thick-billed longspur occasionally use some agricultural land, such as small-grain stubble and fallow fields, but whether these habitats can be used for successful breeding is unknown (Somershoe 2018). The ABMI and BAM (2019) method defines agriculture footprint as areas of cultivation, including crops and tame pasture, and confined feeding operations and other high-density livestock areas. Agriculture footprint does not include cattle grazing on native grasslands. Although much habitat loss occurred in the first half of the 20th century, conversion of native grassland to crops or tame pastures continues today, typically on small remnant patches of habitat (Watmough and Schmoll 2007).

Starting in the late 1800s and continuing until the early 1930s, large tracts of native grassland habitat were plowed for conversion to cropland (Askins *et al.* 2007; Willms *et al.* 2011). Stimulated by the *Homestead Act* of 1872, which required settlers to "improve" the land (i.e., convert to crops), Alberta's human population increased from 73 000 in 1901 to 374 000 in 1911 (Willms *et al.* 2011). By 1931, approximately 24 million ha of native grassland habitat had been converted across Canada (Willms *et al.* 2011). Although historical breeding population records do not exist for the thick-billed longspur, severe contractions in its breeding range were documented between 1905 and 1930 (Stewart 1975 cited in Environment Canada 2014). It seems plausible that this range contraction resulted from the habitat loss attributable to agriculture that occurred during this time.

Loss of native grassland habitat continues today, typically involving the conversion of remnant patches of habitat to cropland or tame pasture (Watmough and Schmoll 2007). Between 1985 and 2001, loss of these remnant patches accumulated to 10% of the total remaining native grassland habitat in Canada (Watmough and Schmoll 2007). In Alberta, an additional 1.4% of native grassland was converted to agriculture between 1999 and 2016 in the Grassland Natural Region (ABMI 2018). In addition to cumulative habitat loss, conversion of these smaller patches of native vegetation may reduce the connectivity of the grassland ecosystem at a landscape level (Natural Resources Conservation Service 1999).

In the U.S, risk of cropland conversion in the northern Great Plains is expected to increase with global food demand, and the current rates of conversion are already five times higher than implementation rates of U.S. grassland protection programs (Lipsey *et al.* 2015). Loss of habitat to agriculture is also a major threat on thick-billed longspur wintering grounds (Pool *et al.* 2014). Using remote sensing data of the Chihuahuan desert region of northern Mexico, Pool *et al.* (2014) found an annual rate of conversion to cropland of 6.04% between 2006 and 2011, resulting in an accumulated loss of 69 668 hectares of valley-bottom grasslands and shrublands. At this rate of conversion, all the remaining valley-bottom grasslands in the 2.7 million hectares of desert shrublands, mountains and grassland valleys of the Valles Centrales could be converted to cropland by 2025 (Pool *et al.* 2014).

7.1.2 Secondary Effects: Habitat Degradation

Thick-billed longspurs coevolved with native grazers and they depend on grazing to create and maintain suitable breeding habitat. Alberta's remaining native grasslands are primarily used for cattle grazing (Nernberg and Ingstrup 2005); over half (55%) of the Dry Mixedgrass Natural Subregion is used for grazing (Natural Regions Committee 2006). Cattle grazing can be compatible with breeding thick-billed longspurs, provided some of the resulting habitat matches the longspurs' preferred short-grass vegetation with some exposed ground. However, range management in Alberta favours moderate, homogenous grazing to ensure sustainable year-after-year grazing and maintenance of soils and surface litter (see 9.0 Recent Management and Research for current stocking rates). This management practice results in mixed-grass pastures dominated by mid-grass species, such as needle-and-thread grass (*Hesperostipa comata)*. These mid-grass species have 3-4 times as much above-ground biomass compared to short-grass species, so they are more economically beneficial for cattle production compared to the short-grasses (Smith and McDermid 2014). Dominance of the short-grass vegetation preferred by thick-billed longspurs typically only occurs on unproductive soils that are poor for agriculture (B.

Dale pers. comm.), dry south-facing slopes, during droughts, following fires (Smith and McDermid 2014), or in pastures large enough that uneven grazing occurs (B. Dale pers. comm.).

Compared to cattle grazing, historical grazing pressure by native grazers such as bison and prairie dogs is believed to have been more intense but intermittent, resulting in a more heterogenous grassland landscape than is seen currently (Askins *et al.* 2007; Bleho 2009). Moreover, it is speculated that much of the area currently considered mixed-grass region was historically short-grass prairie, because the intense grazing and more frequent fires gave a competitive advantage to short-grass species, such as blue grama grass (Askins *et al.* 2007). Today, mixed-grass pastures in Alberta dominated by short-grass species are often viewed by range managers as a sign of overgrazing (Smith and McDermid 2014).

Thick-billed longspurs will use cropland as breeding habitat if it has similar vegetation structure to their preferred habitat (With 2010), and especially if it is located near or adjacent to native grasslands (Lipsey 2015). It has been suggested that thick-billed longspur use of cultivated fields is a relatively recent phenomenon in response to a lack of habitat with suitable vegetation structure (see COSEWIC 2016). However, historical use of cultivated fields by longspurs is poorly documented. The authors of one historical text reported seeing an abundance of thick-billed longspurs on “burnt prairie and land that had been broken” near Indian Head, Saskatchewan on June 1, 1892 (pg. 492; Macoun and Macoun 1909). Selection of cultivated fields as breeding habitat may affect breeding success through factors such as greater exposure to pesticides (see 7.3. Pesticides, below). One study suggested that thick-billed longspur breeding success is lower in intensely tilled fields compared to conservation-tillage fields (Martin and Forsyth 2003), but further research is required to confirm this result.

7.2 Energy Production

Although the area occupied by energy sector development is relatively small in the Grassland Natural Region (2.5% out of a total human footprint of 57.1%; ABMI 2018), native grassland conversion for this footprint type continues (see section 7.2.1.1). The ABMI (2018) defines the energy footprint as areas where vegetation or soil has been disturbed by the creation of mine sites, peat mines, pipelines, seismic lines, transmission lines, well sites and wind-generation facilities. The impact of energy development in Alberta on thick-billed longspur abundance is slightly negative (under-footprint sector effect -5.5% and regional sector effect is -0.1%; ABMI and BAM 2019). It should be noted that the ABMI analysis only includes direct effects of this sector; no indirect effects of energy development such as noise or the potential introduction of non-native vegetation were included in the analysis (but are discussed below).

7.2.1 Petroleum and Natural Gas

7.2.1.1 Primary Effects: Direct Habitat Loss

Petroleum and natural gas (hereinafter, oil and gas) developments result in direct loss of habitat for grassland birds. In 2018, 4173 oil and gas wells were drilled in Alberta (Statista 2020). The average area of habitat lost per well site is typically 23.1 m^2–42.3 m^2 (Rodgers and Koper 2017), but the total disturbance surface area has been estimated as 860 m^2 per well site (Hamilton *et al.* 201l). Linear disturbances (roads, pipelines) increase by approximately 1 km for every new well (Riley *et al.* 2012). As of 2020, Alberta had an estimated 162 500 active wells, 97 000 inactive wells, and 71 000 abandoned wells (Government of Alberta 2020), an unknown proportion of which have been reclaimed. However, since 2017 there has been an effort to increase reclamation rates (Government of Alberta 2020).

The cumulative effects of oil and gas development on native grasslands have become a source of concern (Nasen *et al.* 2011). Despite a government requirement to reclaim well sites after decommissioning, between 1999 and 2016, energy development was the second leading cause (after agriculture) of habitat loss to human footprint within Alberta's Grassland Natural Region, with an increase in area of 1.2% (ABMI 2018). This timeframe corresponds to a time of rapid expansion of oil and gas development in southern Alberta (ABMI 2018). Conventional natural gas wells, which are prominent in the Grassland Natural Region, are typically drilled at higher densities than are oil wells (Bernath-Plaisted and Koper 2016). Gas well densities in Alberta native grassland sites were reported as 3.5/km^2 (Hamilton *et al.* 2011), 5.9/km^2 (Bernath-Plaisted and Koper 2016), 6/km^2 (Riley *et al.* 2012), and 6.2/km^2 (EnCana 2007; Hamilton *et al.* 2011), with an estimated footprint of 5%–12% of the landscape (Riley *et al.* 2012). One of the largest remaining tracts of native grassland in Alberta (Canadian Forces Base [CFB] Suffield) has had more than 14 000 wells drilled since 1974 (Willms *et al.* 2011), with well density as high as 6.2/km^2 (EnCana 2007). This accumulates to an estimated 32 ha to 59 ha of direct habitat loss (based on Rodgers and Koper 2017), an estimated surface disturbance area of 1204 ha (based on Hamilton *et al.* 2011), and an estimated increase of 14 000 km of roads and pipelines in CFB Suffield (based on Riley *et al.* 2012) to service the wells.

7.2.1.2 Secondary Effects: Habitat Degradation

Oil and gas development can change the relative abundance and distribution of the bird community within a native grassland, because of displacement (avoidance) or attraction to infrastructure, linear disturbances, or edge habitat (Willms *et al.* 2011). Although thick-billed longspurs appear to be attracted to the bare ground exposed when this infrastructure is developed within their habitat (e.g., Dillon Consulting Ltd. 2006; Kalyn Bogard and Davis 2014), there is evidence that they show displacement behaviour to the infrastructure itself. In southwestern Saskatchewan, Kalyn Bogard and Davis (2014) found greater quantities of both thick-billed longspurs and the sparse vegetation and exposed bare ground the species favours in pastures with high well density (10–25 wells/1.6 km^2) compared to pastures with low well density (0–4 wells/1.6 km^2). However, within these high well-density pastures, thick-billed longspurs were twice as abundant 700 m from the nearest well compared to 0 m (i.e., at the well site) (Kalyn Bogard 2011), suggesting they were avoiding the infrastructure. Similarly, Linnen (2008) found that thick-billed longspurs tended to avoid areas within 300 m of oil developments, although this trend was not statistically significant ($p = 0.06$).

Well sites and their associated roads and infrastructure may facilitate nest predator access and ability to find nests. In a study in southern Alberta, birds nesting in pastures containing oil and gas infrastructure experienced higher rates of nest predation compared to those nesting on control sites (Bernath-Plaisted and Koper 2016). Moreover, when the infrastructure was connected to the power grid with power lines, nest predation rates were higher than when the power source was a generator. Bernath-Plaisted and Koper (2016) suggested that both the power lines and the infrastructure itself were being used as perches by avian nest predators.

7.2.2 Renewable Energy: Wind Energy

Wind energy developments in Alberta are concentrated in the Grassland Natural Region (Alberta Wilderness Association 2017). As of December 2016, Alberta had 901 turbines at 38 wind farms, with an installed capacity of 1479 MW (Canadian Wind Energy Association 2017). At least 4000 MW is expected to be installed within the next 15 years (Canadian Wind Energy Association 2017). With an average turbine capacity of 1.49 MW (Canadian Wind Energy Association 2017), this increase in capacity will require the installation of more than 2650 new wind turbines in the province. Land required for wind farms (including spacing between turbines) is approximately 25 ha/MW installed capacity (4 MW/km^2) (Denholm *et al.* 2009). Thus, an increase of 4000 MW over the next 15 years is estimated to require an additional 1000 km^2 of land. Assuming most current and future wind farms are sited in the Grassland Natural Region, the area impacted by wind farms is expected to increase from 0.3% to 1.4% within the next 15 years.

Based on pre-construction survey data in Alberta's FWMIS database (Alberta Environment and Parks 2017a), an increasing number of wind energy projects are proposed in the Dry Mixedgrass Natural Subregion, which could increase the potential impacts on thick-billed longspur. These projects include some of Canada's largest recent/proposed wind energy developments, such as the 120 MW Peace Butte Wind Farm south of Medicine Hat (Government of Alberta 2017a; this project was put on hold in January 2019 [Alberta Utilities Commissioner 2019]), and the 201 MW Whitla Wind Farm 45 km southwest of Medicine Hat in operation since 2019 (Capital Power 2020). The Whitla Wind Farm, which was awarded a 20-year contract with the Alberta Electric System Operator (AESO) on December 13, 2017 (Capital Power 2020), listed thick-billed longspur as the third most commonly observed species during breeding bird surveys of the proposed development site (Stantec 2017).

7.2.2.1 Primary Effects: Direct Habitat Loss and Mortality from Collisions

Primary effects of wind energy developments on bird populations include mortality from collisions and direct habitat loss when wind turbines, roads, and power lines are installed (Government of Alberta 2017b). Zimmerling *et al.* (2013) calculated a mean 1.23 (+/- 0.72) ha of bird habitat loss per wind turbine in Canada. This estimate includes total habitat lost from turbine pads, substations, laydown areas, power lines and roads (Zimmerling *et al.* 2013). Because native grassland habitats support four times higher density of breeding bird nests compared to cultivated land, habitat loss from wind energy developments is more detrimental when turbines are sited in native habitats (Zimmerling *et al*. 2013). Based on 588 turbines installed at 26 wind farms (as of December 2011), Zimmerling *et al.* (2013) estimated that 75 300 ha of native grassland habitat (n = 5 wind farms) and 88 700 ha of cultivated land (n = 21 wind farms) had been lost as a result of wind energy developments in Alberta. Zimmerling et al. (2013) did not include the land needed for spacing between turbines in their calculations of habitat lost.

Between 2006 and 2014, monitoring data from seven Alberta wind farms found a mean of 2.65 (± 0.75; n=301) non-raptor birds killed per turbine per year (Wind Energy Bird and Bat Monitoring Database 2016). These data are based on the numbers of bird carcasses found within a 50-m radius of the turbine base (Wind Energy Bird and Bat Monitoring Database 2016). Post-construction monitoring is conducted by wind energy companies or their consultants as a requirement of environmental assessments (Zimmerling *et al.* 2013). Zimmerling *et al.* (2013) included additional data in their analysis and corrected for variation in search effort and searcher efficiency, birds that fall outside of the 50-m search area, and removal of carcasses by scavengers. They estimated a mean mortality per turbine per year of 4.5 birds (including raptors) in Alberta and 8.2 (± 1.4, 95% CI) birds throughout Canada.

Rates of bird mortality at wind turbines vary between species. Bird species that fly at heights within the rotor sweep zones of wind turbines are at greater risk of collisions (Marques *et al.* 2014). Wulff *et al*. (2016) observed a mean flight height for three longspur species (including 19 thick-billed longspurs) of 27.2 m (range: 1.8 m – 271.9 m; n= 45). Twenty percent (95% CI: 10%–35%) of observed flights by longspurs were within the rotor sweep zone of 32 m – 124 m (Wulff *et al.* 2016), which would put them at risk of collision. Species that perform aerial song displays (such as the thick-billed longspur) may be at increased risk of collision, with displaying males suffering higher differential mortality (Morinha *et al.* 2014).

The horned lark (*Eremophila alpestris*), a species that is often associated with thick-billed longspurs in areas where they overlap (Mahoney and Chalfoun 2016), is by far the most common bird species killed at wind turbines in Alberta and makes up more than 28% of the non-raptor bird carcasses recovered (Wind Energy Bird and Bat Monitoring Database 2016). Wulff *et al.* (2016) observed a mean flight height for this species of 19.9 m (range: 1.7-372.2 m; n = 168) with 16% (95% CI: 10%–22%) of observed flights within the rotor sweep zone. These flight values overlap with those found for longspurs (Wulff *et al.* 2016) and suggest that the thick-billed longspur is as vulnerable to collision as is the horned lark. The most likely reason that thick-billed longspur mortalities have not yet been recorded at Alberta wind farms is because most of the existing projects are near or beyond its westernmost distribution in the province. However, as wind development projects are completed within the core area of the thick-billed longspur distribution, the likelihood of mortalities will increase.

The power lines necessary for connecting the wind farms to the electricity grid may also pose a mortality hazard. Martin (2018) conducted mortality surveys during the 2016 breeding season in a native grassland in southern Alberta and estimated an annual mortality rate (for all bird species) of 16.43 bird deaths/km of transmission line. A similar estimate of 17.14 deaths/km of transmission line was estimated the following year during spring migration mortality surveys (Martin 2018).

7.2.2.2 Secondary Effects: Habitat Degradation

Secondary effects of wind energy development include degraded habitat quality through the introduction of invasive species, habitat fragmentation, edge effects, anthropogenic noise, and changes in wildlife abundance and distribution as a result of avoidance of, or attraction to, infrastructure (Bradley and Neville 2011; Government of Alberta 2017a). Wind farms can also attract predators via the bird and bat carcasses that result from collisions, which can then increase nest predation rates.

Few studies have tried to quantify the secondary effects of wind farms on thick-billed longspurs. Although one study in Wyoming did not find any differences in thick-billed longspur reproductive success in habitats with wind farms compared to reference sites, it should be noted that all of the reference nests were monitored in one year (2012, n = 22) and 75% of the wind farm nests were monitored in another year (2011, n = 21 and 2012, n = 7) (Mahoney and Chalfoun 2016; Appendix 7). Environmental conditions in native grassland habitats tend to fluctuate from year-to-year, affecting the abundance, phenology, and nesting success of grassland birds (Winter *et al.* 2005). Indeed, Mahoney and Chalfoun (2016) noted that during their study thick-billed longspur nest initiation was two weeks earlier in 2012 compared to 2011, reflecting inter-annual variation in weather conditions. Undoubtedly, the relationship between thick-billed longspur reproductive success and wind energy could vary among years; reference site data and wind farm site data need to be collected in the same year to allow for comparison, and longer-term studies are needed before conclusions can be drawn (Shaffer and Buhl 2015).

Leddy *et al.* (1999) found significantly lower densities of breeding grassland birds within 80 m of wind turbines compared to densities at 180 m or more away from turbines (distance ≤ 80 m: 58.2–128 males/100 ha; distance ≥ 180 m: 261.0–312.5 males/100 ha; $p \leq 0.05$). Bird densities increased linearly with increasing distance away from turbines (Leddy *et al*. 1999). At 180 m there was no significant difference in bird density compared to reference sites with no wind turbines (Leddy *et al.* 1999). Shaffer and Buhl (2015) used a BACI (before-after-control-impact) design to study the effects of wind developments on grassland birds over a nine-year period in North and South Dakota. Similar to the results from studies examining secondary effects of oil and gas infrastructure, seven species exhibited significant displacement (avoidance) behaviour, while two others were attracted to the infrastructure (Shaffer and Buhl 2015). Chestnut-collared longspur, a grassland endemic species, returned to the turbine site one year following installment, but in the subsequent year showed a mean displacement of 300 m from the nearest wind turbine (Shaffer and Buhl 2015). This delayed displacement was sustained for the remainder of the study and would not have been detected without using a BACI experimental design (Shaffer and Buhl 2015). The average distance between thick-billed longspur nests and nearest wind turbine on wind farms in Wyoming was 264 m (+/- 20 m SE) (Mahoney and Chalfoun 2016), which is similar to the 300-m displacement distance Shaffer and Buhl (2015) recorded for chestnut-collared longspur.

7.3 Pesticides

Pesticides are used throughout the breeding range of thick-billed longspur within Alberta (Alberta Environment and Parks 2015). However, their application in native grasslands is limited; therefore, thick-billed longspur are most likely to be exposed to pesticides when they are in or adjacent to cultivated fields. Pesticides can negatively affect thick-billed longspurs through direct poisoning (ingestion of treated insects or seeds), or through a reduction in the quantity of available insect prey.

The effects of aerial application of two pesticides on breeding thick-billed longspurs were examined at the Pawnee National Grassland in Colorado (McEwen and Ells 1975). Each pesticide was applied on two replicate 15.6-ha plots on June 14, 1972; two replicate 15.6-ha control plots were untreated (McEwen and Ells 1975). Application of the insecticide toxaphene (chlorinated camphene, combined chlorine content 67 to 69 percent) at a rate of 1.12 kg/ha resulted in direct poisoning and death of thick-billed longspur nestlings (McEwen and Ells 1972). Within 17 days of application there was a 30% reduction in bird population size (all species, including thick-billed longspur) on the toxaphene plots, whereas control plots had stable populations (McEwen and Ells 1975). Some of the decrease in bird numbers on the toxaphene plots was attributed to emigration following nest failure (McEwen and Ells 1975). Bird populations on plots treated with aerial application of the organophosphate insecticide malathion (95% 0,0-

dimethyl phosphorodithothioate of diethyl mercaptosuccinate) sprayed at the rate 560 g/ha did not produce a similar reduction in bird population size (McEwen and Ells 1975).

No studies have examined the effects of pesticides on insect prey availability for thick-billed longspurs. However, studies on chestnut-collared longspurs in Alberta found that aerial application of the pyrethroid Decis-5 for grasshopper control resulted in a decrease in the proportion of grasshoppers in the nestling longspur diet and in an increase in the length of foraging trips made by the adult longspurs, possibly to find alternate prey for their nestlings (Martin *et al.* 1998; Martin *et al.* 2000). Nestling mass, nestling survival, fledging success, clutch size, and total biomass of food delivered to nestlings were not affected, but hatching success was lower (Martin *et al.* 1998). Chestnut-collared longspur nestlings exposed to the carbofuran Furadan 480F (liquid), another insecticide used to control grasshopper populations, had a significant reduction in brain acetylcholinesterase activity compared to control nestlings (Martin *et al.* 2000).

Thick-billed longspur pesticide exposure can also include the ingestion of pesticide-treated seeds and granules (Environment Canada 2006). Non-lethal doses of the neonicotinoid, imidacloprid, and the organophosphate, chlorpyrifos, were found to impair the migratory abilities of seed-eating white-crowned sparrows (*Zonotrichia leucophrys;* Eng *et al.* 2017). In Canada, imidacloprid is used as a common treatment for canola, corn, and soybean seeds; chlorpyrifos is often applied to crops as granules, which can be mistaken for grit by birds (Eng *et al.* 2017). Dose equivalents as low as four canola seeds treated with imidacloprid or eight chlorphyrifos granules were enough to impair the sparrows' migratory orientation (Eng *et al.* 2017). The sparrows that ingested the imidacloprid also experienced significant loss of body mass and fat stores (Eng *et al.* 2017). Of the pesticides used in granular and seed treatments, imidacloprid is ranked as the most reproductively toxic (Environment Canada 2006) and has been correlated with declines in bird populations in the Netherlands (Hallmann *et al.* 2014).

In 2017, total land planted with canola in Alberta was 2.8 million ha (6.9 million acres), an increase of 16.5% over 2016 (Statistics Canada 2017); the majority would have used seeds treated with imidacloprid or another pesticide. Seeds comprise the majority of the adult thick-billed longspur diet (With 2010), putting them at risk of consuming treated seeds and granules. A re-evaluation decision (PRVD2018-12) of imidacloprid by Canada's Pest Management Regulatory Agency in 2018 resulted in the planned phase-out the use of imidacloprid in orchards and berry farms but will still allow it as a commercial seed treatment in Canada (Health Canada 2018). Use of chlopyrifos in Canada has been under review; as of January 2020, the proposed decision is to limit its use to non-agricultural applications because environmental risks from agricultural uses were found to be unacceptable (Government of Canada 2020).

Pesticide sales in Alberta increased from 2003 to 2013, including those areas within the provincial breeding range of thick-billed longspur (Alberta Environment and Parks 2015). The assumption is made that the location of pesticide sales can be used as a proxy for where the pesticides are being applied. In 2013, more than 42% of all the pesticides sold in Alberta were distributed for sale within the Grassland Natural Region, totaling 6 523 917 kg ai (measured as kilograms of active ingredient) (Alberta Environment and Parks 2015). Within this region, the greatest volume of sales (the best available measure of pesticide use) was in the Dry Mixedgrass Natural Subregion with 2 697 137 kg ai sold, representing almost 18% of the provincial total. This is an increase from the 2 284 842 kg ai distributed for sale in the subregion during 2008, and the 1 831 323.8 kg ai distributed for sale in 2003. In addition to an increase in the total amount of pesticide distributed, the intensity of total pesticide use has increased from 0.76 kg/ha in 1988 to 1.33 kg/ha in 2013 (Alberta-wide density, based on sales). The most common pesticides sold in Alberta by volume in 2013 were herbicides and their adjuvants, accounting for 94% of agricultural sales, 88% of domestic sales, and 87% of commercial sales (Alberta Environment and Parks 2015). Insecticides accounted for 1% of agricultural sales, 9% of domestic sales, and 5% of commercial sales (Alberta Environment and Parks 2015). The increase in pesticide use within Alberta has the potential to increase thick-billed longspur exposure to pesticides.

7.4 Roads, Power Lines, and Other Linear Disturbances

7.4.1 Primary Effects: Direct Habitat Loss and Mortality from Collisions

Martin (2018) conducted mortality surveys underneath power lines and along a primary highway that bisected a native grassland in southern Alberta during the 2016 breeding season and estimated annual mortality rates (all bird species) of 16.43 bird deaths/km of transmission line and 10.00 deaths/km of road as a result of collisions.

The ABMI (2018) estimates that, as of 2016, 2.7% of the Grassland Natural Region was occupied by transportation footprint, and native grassland conversion for this footprint type continues (an additional 0.25% between 1999 and 2016). The ABMI (2018) defines the transportation footprint as railways, roadways, and trails with hard surfaces (e.g., concrete, asphalt, gravel), roads or trails without gravel or pavement, and the vegetation strips beside these transportation features. Note that human footprint associated with linear disturbances for energy development (i.e., pipelines, seismic lines) are included in ABMI's energy footprint estimate (see 7.2. Energy Production).

Transportation footprint had a small negative regional effect on thick-billed longspur abundance in the prairie region (-0.5% compared to reference conditions), although within the areas that transportation occurs, the under-footprint sector effect has the largest effect (-24.5% compared to reference conditions) among sectors (ABMI and BAM 2019). In other words, where it occurs, transportation has a relatively large effect, but because it covers only a small area, its cumulative footprint in the region is relatively small. Modelling results predicted that thick-billed longspur numbers would decrease with soft linear disturbances, such as pipelines, as well as with hard linear disturbances, such as roads (ABMI and BAM 2019).

McWilliams (2015) found that the relative abundance of thick-billed longspurs decreased with increasing sum of natural gas pipeline length at CFB Suffield, Alberta. The taller, denser, crested wheatgrass used for reclamation along the pipelines may have contributed to thick-billed longspurs avoiding areas with pipelines (McWilliams 2015).

7.4.2 Secondary Effects: Habitat Degradation

Roads, power lines, and other linear disturbances can result in direct mortality of birds from collisions (vehicles and power lines), as well as secondary effects from habitat loss, habitat degradation, habitat fragmentation, and disturbance to wildlife resulting in avoidance or attraction. Bernath-Plaisted and Koper (2016) suggested that areas near power lines could be ecological sinks because of increased nest predation rates; they found that nesting success was lower near power grid-connected well sites compared to those powered by generators, and suggested that the power lines connecting the power grid sites may have attracted predators and caused this difference. DeGregorio *et al.* (2014) found that predation by corvids (*Corvus sp*. and *Cyanocitta cristata*), racers (*Coluber constrictor*), and coachwhips (*Masticophis flagellum*), and parasitism by brown-headed cowbirds increased with proximity to power lines.

7.5 Invasive Species

Multiple studies have found that vegetation structure appears to play an important role in breeding habitat selection by thick-billed longspurs, particularly with regards to vegetation height and quantity of bare or exposed ground (e.g., Sedgwick 2004; Bleho 2009; Henderson and Davis 2014; Kalyn Bogard and Davis 2014). Invasive plant species, such as crested wheatgrass and smooth brome (*Bromus inermis*), grow taller and denser than the short grasses typical of the thick-billed longspur's preferred habitat (e.g., blue grama grass) and render the habitat unsuitable for breeding. As noted earlier, McWilliams (2015) found thick-billed longspur abundance decreased with increasing length of natural gas pipeline in CFB Suffield; the author suggested that the birds were avoiding the crested wheatgrass that had been planted along the pipeline during reclamation. Considering that invasive plants such as crested wheatgrass are increasingly common in Alberta's grasslands, avoidance could result in the loss of a significant amount of habitat.

Introduction of invasive plant species during wind farm construction is highly likely because of the necessary soil disturbance, removal of native vegetation during construction, and increased human access to the site (Bradley and Neville 2011).

7.6 Climate Change

Climate change vulnerability assessments include a species' sensitivity (e.g., environmental tolerances, habitat specialization), exposure (how much change the species is likely to experience) and adaptive capacity (e.g., dispersal abilities, habitat connectivity to allow movement, existence of climate refugia) (Stein and Glick 2011).

The breeding range of thick-billed longspur became hotter and drier during the 20th century (Millett *et al.* 2009), a trend that is predicted to continue to at least 2050 (Sauchyn et al. 2009). Analysis of data collected in Colorado between 1997 and 2012 found that thick-billed longspur nest success (fledging at least one offspring) was lower in hotter and drier breeding seasons (Conrey *et al.* 2016). Moreover, the daily nest survival rates within any given breeding season were significantly lower on days with extreme hot temperatures (≥35^{0}C), a lack of precipitation, or a severe storm (Conrey *et al.* 2016). The negative effects of drought conditions on nest success were more pronounced for both thick-billed longspurs and horned larks than they were for chestnut-collared longspurs, lark buntings (*Calamospiza melanocorys*), and western meadowlarks (*Sturnella neglecta*); Conrey *et al.* (2016) suggested that the sparse vegetation typical of both thick-billed longspur and horned lark nesting habitat offers little protection and makes these species more vulnerable to extreme weather events.

Comparing current geographic range stability to potential range expansion under different climate change scenarios, Langham *et al.* (2015) listed thick-billed longspur as one of 126 bird species that will lose geographic range without sufficient accompanying range expansion. This is because thick-billed longspurs are losing suitable grassland habitat at a rate faster than the predicted northward expansion of the grasslands. Langham *et al.* (2015) classified thick-billed longspur as a climate-endangered species and predicted that by 2080 virtually no suitable breeding habitat will remain (see S1 Appendix, Range Size Changes). Similarly, of fifteen grassland bird species examined, Nixon *et al.* (2016) predicted that by the end of the 21st century thick-billed longspur will experience the largest proportional decline in suitable climate area, both within North America (-83%±7%) and within Alberta (-57%±29%). They based these predictions on bioclimatic niche models that incorporated survey data (BBS, eBird, ABMI, research projects) and climate data for each species, and concluded that thick-billed longspur is likely very vulnerable to climate change.

In contrast, ABMI's Climate Change Vulnerability Index (CCVI), which provides a broad overview of how species may be affected by climate change by the 2050s, resulted in a "Lower Vulnerability" rank for thick-billed longspur (ABMI 2014; Shank and Nixon 2014). This ranking was based on thick-billed longspur's dietary breadth, dispersal capabilities, and assumptions that the species would be tolerant to drought (A. Nixon pers. comm.); ABMI's CCVI assessment (ABMI 2014) was completed before publication of Conrey *et al.*'s (2016) study showing thick-billed longspurs have poorer nest success during drought conditions and before COSEWIC (2016) upgraded the status of thick-billed longspur to *Threatened*. Collectively, the overall interpretation of these various assessments is that thick-billed longspur has a relatively high climate change risk (A. Nixon pers. comm.).

Alberta has the potential of being a climate refugium for thick-billed longspurs, given that the province is at the northern extent of the species' distribution (A. Nixon pers. comm.). However, because climate-driven northward expansion of the grasslands is unlikely to be rapid enough to provide adequate suitable habitat (Langham *et al.* 2015), active habitat management may be necessary to ensure such a refugium exists.

7.7 Locations

Threats are considered relative to thick-billed longspur "locations," which are geographically or ecologically distinct areas vulnerable to a single plausible threatening event, either natural (e.g., disease outbreak) or anthropogenic (e.g., habitat destruction) (as defined by IUCN 2012). The most imminent threat to thick-billed longspur is habitat loss and degradation, which is occurring throughout the species' breeding and wintering range (COSEWIC 2016). Conversion (loss) and degradation of native grassland habitat, primarily from agriculture and energy development (and associated threats such as pesticides and invasive species), as well as linear disturbances and climate change, are considered the principal threats to thick-billed longspur. These threats tend to be widespread, but each threat acts at a relatively small scale when it occurs. Therefore, although the exact number of locations for thick-billed longspur is unknown, it is likely to be a relatively large number.

8.0 Status Designations

Thick-billed longspur is protected in Alberta as a non-game species under the provincial *Wildlife Act*. Alberta currently considers thick-billed longspur as *May Be At Risk* (Alberta Environment and Parks 2017b). In Canada, including Alberta, thick-billed longspurs are protected under the federal *Migratory Birds Convention Act* (1994), which protects birds as well as their nests and eggs. In December 2007, thick-billed longspur was listed as *Special Concern* in Schedule 1 under the *Species at Risk Act* (SARA); subsequently, a required management plan was developed by Environment Canada (see Environment Canada 2014). In 2016, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) uplisted thick-billed longspur to *Threatened* (COSEWIC 2016), and it was listed as *Threatened* under SARA in 2016.

The Canadian Endangered Species Conservation Council ranks wild species nationally in Canada, as well as in each province and territory. Based on this system, in 2015 thick-billed longspur was ranked as S3/S4B, S3/S4M in Alberta (*Vulnerable/Apparently Secure* during breeding and migrating), and S3B, S3M (*Vulnerable* during breeding and migrating) in Saskatchewan, with a rounded national rank of N3/N4B, N3/N4M (*Vulnerable/Apparently Secure* during breeding and migrating), in Canada. In British Columbia, Manitoba, and Ontario it is SNA (*Accidental*) (Canadian Endangered Species Conservation Council 2016).

Thick-billed longspur is among the USFWS "Birds of Conservation Concern", making it a candidate for listing under the U.S. *Endangered Species Act* (COSEWIC 2016). Thick-billed longspur is listed as a *Sensitive* species by the Montana State Office of the Bureau of Land Management and is listed as a *Species of Greatest Conservation Need* by Montana Fish, Wildlife, and Parks (Montana Natural Heritage Program 2018). Other U.S. rankings at the state level include Priority 1 in Wyoming (Cerovski *et al.* 2001), Priority 3 in North Dakota (North Dakota Game and Fish Department, n.d.), Priority 2 in Montana (Montana Partners in Flight 2000), Priority species in Colorado (Beidleman 2000), and Priority 1 in Nebraska (Panella 2012). Thick-billed longspur is likely extirpated from South Dakota (NatureServe 2020) as no breeding records have been confirmed since 1910 (Sedgwick 2004). A Priority I Species (also known as Priority Species) (e.g., Colorado) indicates that conservation action or implementation of conservation plans, such as active habitat management, is required for the species (Montana Partners in Flight 2000). Priority 2 indicates that the species requires close monitoring, while Priority 3 indicates that the species is of local concern (Montana Partners in Flight 2000). Thick-billed longspur NatureServe rankings vary from SX (*Extirpated*) to S2 (*Imperiled*) for state breeding populations and from S2 (*Imperiled*) to S4 (*Apparently Secure*) for state migratory populations (Table 1, NatureServe 2020). The national NatureServe ranking in the United States is N4 (*Apparently Secure*) for both breeding and migratory populations (NatureServe 2020).

At a regional level, thick-billed longspur is a Criteria I Priority species in the Northern Mixed-Grass Prairie (physiographic area 37) and appears on the Partners in Flight Yellow Watch List of species in decline with moderate to high threats (Fitzgerald *et al.* 1999; Rosenberg *et al.* 2016). Globally, thick-billed longspurs are listed as G4 (*Apparently Secure*) (NatureServe 2020), and by the International Union for Conservation of Nature (IUCN) as *Least Concern* (LC) but with a decreasing trend (IUCN 2020).

9.0 Recent Management and Research in Alberta

Few studies focus specifically on thick-billed longspurs; within Alberta, information on thick-billed longspurs typically is collected during studies on the broader grassland bird community. The data collected are often incompatible with statistical analyses because of low sample sizes and/or high variance in the number of thick-billed longspurs detected. This has resulted in a paucity of Alberta-based research on the species. Studies focusing specifically on thick-billed longspurs and their responses to habitat variables in Alberta are needed to aid in management planning.

9.1 Energy Production

The Government of Alberta has mandated that wind farms should be sited to avoid native grasslands and, preferentially, built in non-native, disturbed sites (Government of Alberta 2016b). This directive is important for thick-billed longspur because native grasslands within Alberta support a higher density of nests compared to cultivated lands (Zimmerling *et. al.* 2013). However, because thick-billed longspurs are often detected in cropland (Martin and Forsyth 2003; Dale *et al.* 2005), additional measures to avoid constructing wind farms in areas used by this species may be necessary. Best management practices in other jurisdictions (e.g., Nebraska) include discouraging wind energy developments in areas known to be thick-billed longspur "hotspots" (Panella 2012). Pre-planning to avoid wildlife habitat and migration routes is the most cost-effective, proven mitigation for the wind energy industry (Marques *et al. 2*014). Data that have been entered into FWMIS show that thick-billed longspurs have been recorded on several pre-construction surveys for planned wind farm projects in southeastern Alberta (Alberta Environment and Parks 2017a). For example, thick-billed longspurs were the third most commonly recorded species on the proposed site of the Whitla Wind farm southwest of Medicine Hat (Stantec 2017).

Oil and gas wells and their associated activities and infrastructure are considered high-level disturbances, requiring a minimum setback of 200 m (range: 200 m–500 m) from thick-billed longspur nests (Environment Canada 2009). Prior to these guidelines, many developments used setbacks of 100 m (e.g., Encana 2007, pp. 5–24). Nonetheless, the current guidelines have limitations. Preconstruction surveys typically do not record nest locations and instead survey for presence of adult longspurs (i.e., singing males), so there is no nest location identified from which to set back the infrastructure. In addition, thick-billed longspurs do not have permanent nest sites and construct new nests for each breeding attempt (With 2010). Nonetheless, location of a singing male could be used as a proxy for a nest location. Because average territory size has been recorded as 1 ha (With 2010) and male thick-billed longspurs typically defend their territories by singing while flying along the edge of their territory boundaries or alighting at the territory edge following a flight-song (Mickey 1943), current guidelines for setback distance still may not be sufficient to avoid nest disturbance. Furthermore, protecting individual nests of grassland songbirds may not translate into effective grassland habitat protection at a landscape scale.

9.2 Fire Management

Patch-burn grazing on a portion of the landscape has been recommended as a possible management tool to enhance thick-billed longspur reproductive success (Skagen *et al.* 2017). At a shortgrass steppe site in eastern Colorado, prescribed patch burning (16.25 ha patch in 65 ha pastures) was applied to replicate pastures during the autumn (October or November), followed by moderate grazing (0.6 AUM/ha) from 15 May through 1 October the next year in a 4-year rotation cycle (Skagen *et al.* 2017). In a breeding season of average precipitation, thick-billed longspur nest density was highest in the most recently burned patches; in contrast, during a breeding season of drought, nest density was more than five times higher in the unburned patches (Skagen *et al.* 2017). Because it is not possible to predict accurately the next year's precipitation levels, Skagen *et al.* (2017) recommended using patch-burn grazing on only a portion of the landscape to ensure habitat heterogeneity and breeding site choice.

CFB Suffield National Wildlife Area is the only location in Alberta where regular/prescribed burning occurs. Most fires start because of defence training activities that use live ammunition (Dale *et al.* 1999; McWilliams 2015). The majority of these fires occur in August and September (Smith and McDermid 2014), and most burned sites are later grazed (Dale *et al.* 1999). Since 1972, the locations and extent of area burned have been tracked; in some locations, the fire frequency in CFB Suffield exceeds the estimated fire return interval of 6–25 years for the northern mixed-grass prairies (Dale *et al.* 1999; McWilliams 2015). Dale *et al.* (1999) found that thick-billed longspurs were most frequent in the upland habitats of Suffield's South Block, which had a history of more frequent fires than the North Block. Likewise, McWilliams (2015) found greater relative abundance of thick-billed longspurs in the areas of CFB Suffield most affected by fire. This suggests that prescribed burning, timed appropriately to avoid harming nests, could be used as a management tool to enhance thick-billed longspur breeding habitat in Alberta.

9.3 Grazing and Mowing

Grazing, alone or in combination with prescribed fire, could be used as an effective management tool to create and/or maintain thick-billed longspur breeding habitat (Dechant *et al.* 1999; Skagen *et al.* 2017). Because thick-billed longspurs are strongly associated with short-grass species, grazing regimes and conditions that increase the dominance of short-grass species over mid-grass species or result in similar vegetation structure to the short-grasses, would likely result in increased available breeding habitat for thick-billed longspurs. However, the concept of using heterogenous grazing regimes to engineer habitat for grassland bird management is relatively new (Derner *et al.* 2009).

Depending on the plant community and soil type, sustainable cattle stocking recommendations in Alberta are 0.22 AUM/ha to 0.50 AUM/ha for the Dry Mixedgrass Natural Subregion and 0.60 AUM/ha to 1.00 AUM/ha for the Mixedgrass Natural Subregion (Bailey *et al.* 2010). The grazing season is typically from mid-May through mid-October although some locations, such as CFB Suffield National Wildlife Area, do not allow spring grazing (Bailey *et al.* 2010). These stocking rates aim to optimize litter levels and soil health and to avoid the exposure of bare ground (Willms *et al.* 2011). Mid-grass species, such as needle-and-thread grass, are economically beneficial to the agricultural community because the above-ground biomass of these grasses is three to four times greater than that of the short-grasses (Smith and McDermid 2014). Thus, maintaining mid-grass dominance over short-grasses is often a desired outcome of domestic grazing regimes in Alberta (Smith and McDermid 2014), and may be at odds with the habitat requirements of some species including thick-billed longspurs (and mountain plovers; see also Derner *et al.* 2009).

On poor soils (i.e., low productivity for agriculture), during droughts, and following fires, the moderate grazing regimes used in Alberta will result in the vegetation structure preferred by thick-billed longspurs (Dale *et al.* 1999; Skagen *et al.* 2017). However, during wetter breeding seasons the same grazing regimes result in vegetation that is too tall and too dense for the species (e.g., Prescott and Wagner 1996). Large native pastures with limited water resources (e.g., at CFB Suffield) are more likely to result in a mosaic of grazing pressures and vegetation heights, even when moderately grazed, because cattle will spend more time grazing close to water sources and less time in other locations (Dale *et al.*1999). Although this uneven grazing typically is viewed negatively by range managers (Derner *et al.* 2009), the resulting heterogeneity may benefit thick-billed longspurs and other grassland species (Dale *et al.* 1999; Bleho 2009). Thick-billed longspurs are more commonly detected in larger tracts of native grasslands, and grazing heterogeneity may be one of the reasons for this.

At a site in eastern Montana, Golding and Drietz (2017) found that thick-billed longspurs were more abundant on rest-rotation grazed pastures than on season-long grazed pastures; this was opposite to what they had predicted, as season-long grazing generally results in shorter vegetation than does rest-rotation. However, CFB Suffield uses rest-rotation grazing in large pastures with few rotations and supports populations of thick-billed longspurs (Dale *et al.* 1999). In Alberta's Dry Mixedgrass Natural Subregion, Prescott and Wagner (1996) found thick-billed longspurs were more common (95.8% and 100% of transect points surveyed in 1993 and 1995, respectively) and occurred at higher densities (mean 1.88 and 3.5 birds per 100-m radius point count in 1993 and 1995, respectively) in native pastures that were continuously grazed (season-long) compared to either deferred rotationally grazed (1993: 12.5%, 0.13 birds/point count; 1995: 0%, 0 birds/point count) or early-season grazed (1993: 53.3%, 0.60 birds/point count; 1995: 33.3%, 0.63 per point count). The continuously grazed pastures had lower mean surface litter depth (8.93 ± 0.40 mm) than the deferred (11.14 ± 0.44 mm) or early-season grazed pastures (12.03 ± 0.63 mm; Prescott and Wagner 1996). Removal of surface litter results in higher surface soil temperatures and increased rates of evapotranspiration, favouring drought-tolerant short-grass species like blue grama grass (Smith and McDermid 2014). Smith and McDermid (2014) have suggested that surface litter removal is the primary influence of fires on the grassland plant community, but litter can also be removed with more intense grazing. Thick-billed longspur use of tame pastures dropped substantially between 1993 (87.5%, 1.38 birds per point count) and 1995 (4.2%, 0.04 birds per point count) during Prescott and Wagner’s (1996) study; the authors suggested increased precipitation and plant growth in 1995 as a possible reason. Prescott and Wagner (1996) did not record thick-billed longspur breeding success.

The rapid response of thick-billed longspurs to changes in the seasonal breeding conditions during Prescott and Wagner’s (1996) study suggests that longspurs may respond quickly to grazing management that results in the short vegetation structure preferred by this species. More Alberta research is needed on how stocking rates and grazing regimes affect thick-billed longspur breeding densities and success, and how these interact with fire, soil type, and precipitation.

10.0 Synthesis

The Alberta population of thick-billed longspurs is estimated at 70 000 adults, which is approximately 54% of the Canadian population and 12% of the global population. Long-term (1970–2018) and short-term (2008–2018) BBS data indicate the Alberta population is declining at annual rates of 9.3% and 15.3%, with a cumulative long-term decline of 99% and cumulative short-term decline of 81% of the population.

Historical and continuing loss of suitable grassland habitat on both the breeding and wintering grounds is the most likely cause for declines in the population of thick-billed longspur within Alberta. It is a grassland endemic species that requires short, sparse vegetation with patches of exposed groundcover. In addition to the loss of native grassland habitat primarily to agriculture (but also energy production and roads), other factors contributing to a decrease in preferred breeding habitat for thick-billed longspurs include more homogenous grazing regimes, declines in native grazers, and fire suppression. Although longspurs generally benefit from grazing, current grazing regimes may not be creating suitable breeding habitat. In addition, the hotter, drier conditions and increase in extreme weather events makes thick-billed longspur vulnerable to climate change. Habitat loss likely has contributed to a disjunct North American breeding range (see Figure 2); genetic research to determine if populations in disjunct areas have become genetically isolated would be insightful.

Thick-billed longspurs are more frequently detected and, when detected, found in higher densities, in landscapes with greater quantities of uncultivated native grasslands. In the absence of suitable habitat, longspurs may be nesting on cultivated land where they could be exposed to pesticides and increased mortality from cropping practises and predation. Alberta's remaining native grasslands, most of which are within the Dry Mixedgrass Natural Subregion, have experienced an increasing number of industrial incursions, particularly from the energy sector. Even within Alberta's largest remaining uncultivated native grasslands, only 23% of the landscape has a buffer of at least 200 m from visible infrastructure. There is some evidence that thick-billed longspurs exhibit displacement or avoidance behaviour in response to oil and gas wells and pipelines. Further study (preferably using before-after-control-impact experimental design) is needed to determine if thick-billed longspur also shows displacement in response to wind turbines. Establishment of more Heritage Rangeland Natural Areas, which restrict surface disturbance, would help conserve thick-billed longspur habitat. Initiatives such as the Transboundary Grassland Workshops with Saskatchewan and Montana will aid in conserving landscape-level expanses of grassland habitat and improve ecosystem connectivity.

A combination of conserving Alberta's remaining uncultivated native grasslands and active management, using heterogenous grazing regimes and/or controlled burns (timed appropriately to avoid harming nests) on a subset of those grasslands, may be beneficial for maintaining Alberta’s thick-billed longspur population in the future. Active management should be undertaken cautiously, as intense grazing can increase the potential of invasion into native grasslands by non-native plants. Nonetheless, active habitat management for thick-billed longspur has the potential to benefit other at-risk species with similar habitat requirements, such as the burrowing owl and mountain plover.

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Appendices

Appendix 1: Definitions of Legal Designations and Status Ranks

A. Alberta Species at Risk Formal Status Designations (Alberta Environment and Parks 2020)

These status designations are recommended by Alberta's Endangered Species Conservation Committee and approved by the Minister of Environment and Parks. Those in bold have legal meaning when designated under Alberta's *Wildlife Act*.

Designation	Definition
Endangered	A species facing imminent extirpation or extinction.
Threatened	A species likely to become endangered if limiting factors are not reversed.
Special Concern	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Data Deficient	A species for which there is insufficient scientific information to support status designation.

B. Canada Species at Risk Formal Status Designations (after Government of Canada 2014; COSEWIC 2020)

These status designations are assigned by the Committee on the Status of Endangered Wildlife in Canada. Those in bold have legal meaning when designated under Canada's *Species at Risk Act*.

Designation	Definition
Extinct	A wildlife species that no longer exists.
Extirpated	A wildlife species that no longer exists in the wild in Canada, but exists elsewhere.
Endangered	A wildlife species facing imminent extirpation or extinction.
Threatened	A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
Special Concern	A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
Not at Risk	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient	A category that applies when the available information is insufficient (a) to resolve a wildlife species' eligibility for assessment, or (b) to permit an assessment of the wildlife species' risk of extinction.

C. United States *Endangered Species Act* Designations (US Fish and Wildlife Service 2005)

Designation	Definition
Endangered	Any species that is in danger of extinction throughout all or a significant portion of its range.
Threatened	Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

D. General Status of Alberta Wild Species Ranks (Government of Alberta 2011)

Used in 2000, 2005, 2010 and 2015 general status exercises.

Rank	Definition
At Risk	Any species known to be *At Risk* after formal detailed status assessment and legal designation as *Endangered* or *Threatened* in Alberta.
May Be At Risk	Any species that may be at risk of extinction or extirpation, and is therefore a candidate for detailed risk assessment.
Sensitive	Any species that is not at risk of extinction or extirpation but may require special attention or protection to prevent it from becoming at risk.
Secure	Any species that is not *At Risk*, *May Be At Risk* or *Sensitive*.
Undetermined	Any species for which insufficient information, knowledge or data is available to reliably evaluate its general status.
Not Assessed	Any species that has not been examined during this exercise.
Exotic/Alien	Any species that has been introduced as a result of human activities.
Extirpated/Extinct	Any species no longer thought to be present in Alberta (*Extirpated*) or no longer believed to be present anywhere in the world (*Extinct*).
Accidental/Vagrant	Any species occurring infrequently and unpredictably in Alberta, i.e., outside its usual range.

E. Conservation Status Ranks (after NatureServe 2017)

Global (G), national (N) and subnational (S) ranks.

Rank	Definition
G1/N1/S1	Critically Imperilled. At very high risk of extinction or extirpation because of very restricted range, very few populations or occurrences, very steep declines, very severe threats or other factors.
G2/N2/S2	Imperilled. At high risk of extinction or extirpation because of restricted range, few populations or occurrences, steep declines, severe threats or other factors.
G3/N3/S3	Vulnerable. At moderate risk of extinction or extirpation because of a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats or other factors.
G4/N4/S4	Apparently Secure. At fairly low risk of extinction or extirpation because of an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats or other factors.
G5/N5/S5	Secure. At very low or no risk of extinction or extirpation because of a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats.
GX/NX/SX	Presumed Extinct/Extirpated. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood of rediscovery.
GH/NH/SH	Possibly Extinct/Extirpated. Known from only historical occurrences but some hope of rediscovery.
G?/N?/S?	Inexact Numeric Rank. Denotes inexact numeric rank.
G#G#/N#N#/S#S#	Range Rank. A numeric range rank (e.g., G2G3, G1G3) is used to indicate the range of uncertainty about the exact status of a taxon or ecosystem type. Ranges cannot skip more than two ranks.
GU/NU/SU	Unrankable. Currently unrankable because of lack of information or substantially conflicting information about status or trends.

Rank	Definition
GNR/NNR/ SNR	Unranked. Conservation status not yet assessed.
GNA/NNA/ SNA	Not Applicable. A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

Appendix 2: Data-sources Summary Table

Data Source	Project Name	Type(s) of Location Data	Type(s) of Additional Information	Number of Obs.	Time span	Comments
FWMIS[1]	MULTISAR	UTM, Latitude and Longitude, ATS	Point Count, Area Search, Random,	2339	2006-2016	Includes Age Group, Sex, Health
	Other	UTM, Latitude and Longitude, ATS	Area Search, Breeding, Point Count, Playback, Random, Windfarm, Unique Design,	4015	1994-2016	Primarily in support of oil and gas development Many entries are BSOD legacy data

Data Source	Project Name	Type(s) of Location Data	Type(s) of Additional Information	Number of Obs.	Time span	Comments
ABMI[2]	Breeding Bird Survey	Latitude and Longitude	Audio recorded	347	2007-2015	Basic behaviour; data are divided in two rotations with duplication of some plots
BBS[3]	Breeding Bird Survey	Latitude and Longitude	Breeding bird survey	1245	1968-2015	
eBird[4]	Citizen Science	Latitude and Longitude	Observation	2581	1970-2016	Minimal Age Group, Sex data
Alberta Breeding Bird Atlas (2000-2005)[5]	Atlas	Latitude and Longitude	Breeding Bird Atlas Method	1834	2000-2005	Behavioural/Breeding Observation Data Codes
Alberta Breeding Bird Atlas (1987-1992)[5]		Latitude and Longitude	Breeding Bird Atlas Method		1987-1991	Behavioural/Breeding Observation Data Codes

Data Source	Project Name	Type(s) of Location Data	Type(s) of Additional Information	Num-ber of Obs.	Time span	Comments
Alberta Bird Records[6]	Multiple	Latitude and Longitude	Point Count, Breeding Bird Survey, Breeding Bird Atlas, General Survey, Single Species Survey, Incidental Observation	2315	1968-2006	Multiple data sources (BSOD, BBS, Breeding Bird Atlas)
Nature Alberta May Bird Count[7]	Citizen Science	Geo-graphic		349	2009-2016	

[1] The FWMIS database (AEP 2017a) contains data collected from multiple sources on location and abundance of wildlife species in Alberta. The FWMIS database contained 3428 records of 6 354 thick-billed longspurs from 1994 to 2016 and included project name, survey type, location (latitude-longitude, UTM, ATS), date, and total count (1-100 longspurs). The FWMIS database includes data from the Multiple Species At Risk (MULTISAR) program (AEP 2017a).

[2] ABMI has collected breeding bird data that includes observations of thick-billed longspurs since 2007. The ABMI data are collected from permanent sampling locations that will be replicated at approximately five-year intervals. Bird surveys were in a one kilometer square grid of nine point counts where all vocalizations were recorded for a 10-minute period at each site during June. The ABMI database had 347 observations between 2007 and 2015 (ABMI and BAM 2019). Data collected from 2007 to 2014 represent the first rotations of 57 permanent sites. Data from 2015 represent the second rotation of the permanent sites and had 23 observations of thick-billed longspurs from seven different sites. Starting in 2016 birds were surveyed using autonomous recording units (ARUs) (ABMI 2015).

[3] North American BBS data is collected along 40-km roadside routes that were selected through a stratified random design to cover the U.S. and southern Canada. BBS participants survey birds for three minutes at 50 stops along a specified route and time of day (Smith *et al.* 2019).

[4] eBird is an online database of typically incidental bird observations providing data on bird distribution and sometimes abundance. The eBird data contained 325 observations of 1-190 thick-billed longspurs from 1970 to 2016. Data includes

observer, date, start time, location and observation count. eBird also contains some information on effort such as number of observers, survey start time, duration of observation, distance traveled, and area covered (eBird 2017).

[5] The Nature Alberta database includes the data that was used for compiling the Alberta breeding bird atlases (e.g., Federation of Alberta Naturalists 2007). Data are collected by volunteers that searched for all breeding bird species within 10 km x10 km squares throughout the province. Each survey was for five years for two survey periods 1987-1992 and 2000-2005 (Federation of Alberta Naturalists 2007). The Nature Alberta database had 914 thick-billed longspur observations from 1968 to 2006. The database included observation, location, year collected, observer, observation start time, duration, and observation count.

[6] Alberta Bird Records is a compilation of data from multiple sources (see Comments column in table), likely including both duplicate and unique observations.

[7] Nature Alberta promotes an annual May Species Count, which occurs towards the end of May/early June (http://naturealberta.ca/programs/birds-biodiversity/citizen-science-database/). Nature Alberta has been compiling a database of bird sightings that includes more than 200 000 observations. All of their bird data are shared with Bird Studies Canada, and can be queried and downloaded from the Bird Studies Canada Nature Counts website.

Appendix 3: Technical Summary

A summary of information contained within this report and used by the Scientific Subcommittee of Alberta's Endangered Species Conservation Committee for the purpose of status assessment based on International Union for Conservation of Nature criteria. For definitions of terms used in this technical summary, go to: http://www.iucnredlist.org/technical-documents/categories-and-criteria and http://www.cosepac.gc.ca/eng/sct2/sct2_6_e.cfm.

Genus species: *Rhynchophanes mccownii*

Common name: Thick-billed longspur (McCown's longspur)

Range of occurrence in Alberta: Grassland Natural Region

Demographic information	
Generation time Generation time is not known for this species, but is estimated based on information from other similar small passerines. *See 5.0 Biology (5.1 Species Description and Longevity).*	2-3 yrs

Demographic information	
Is there an [observed, inferred or projected] continuing decline in number of mature individuals? Breeding Bird Survey data document a population decline. *See 6.0 Population Size and Trends (6.2 Population Trends).*	Yes, observed
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations] Extrapolating from 10-year (2009–2019) Alberta trend of 16.0% decline annually, estimated decline over the most recent five years (2014–2019) is 58%. This trend is expected to continue and therefore it is reasonable to predict a continuing decline of at least 30% within 5 years. *See 6.0 Population Size and Trends (6.2 Population Trends).*	58% estimated over 2014–2019; minimum of 30% predicted within 5 years
Estimated percent reduction in total number of mature individuals over the <u>last</u> [10 years or 3 generations]. BBS trends for 2009–2019 indicate annual decline by 16.0%, equivalent to a total decline of 83% over the most recent 10 years of analysis. *See 6.0 Population Size and Trends (6.2 Population Trends).*	81% (2009–2019)
[Observed, estimated, inferred, or suspected] percent reduction in total number of mature individuals over the <u>next</u> [10 years or 3 generations]. If population decline in Alberta continues for the next 10 years at the current annual rate of decline of 16.0%, this would project that a starting population in 2019 would be reduced by 83% by 2029; a decline by at least 50% is likely over the next 10 years. *See 6.0 Population Size and Trends (6.2 Population Trends).*	At least 50% suspected over 10 years

Demographic information	
[Observed, estimated, inferred, or suspected] percent reduction in total number of mature individuals over any [10-year or 3-generation] period, over a time period including both the past and the future. 16.0% annual decline during 2009–2019 for Alberta population, resulting in an estimated cumulative decline of 83% over that period; a decline by at least 50% over any 10-year period can be inferred. *See 6.0 Population Size and Trends (6.2 Population Trends).*	At least 50% inferred over 10 years
Are the causes of the decline clearly reversible and understood and ceased? The causes of decline are mostly understood but it is unknown if they are fully reversible; furthermore, the causes of decline have not ceased. *See 7.0 Threats*.	No
Are there extreme fluctuations in number of mature individuals? Christmas bird count data show fluctuations on wintering grounds, likely because of fluctuations in local conditions (i.e., weather). Breeding Bird Survey results also show fluctuation on breeding grounds; however, these fluctuations do not exceed one order of magnitude. *See 6.0 Population Size and Trends (6.2 Population Trends), and Figures 3, 4 and 7.*	No

Extent and Occupancy information	
Estimated extent of occurrence in Alberta Based on minimum convex polygon around observations from 2009-2019. *See 3.0 Distribution (3.1 Breeding Range: Alberta) and Figure 1.*	93 287 km²

Extent and Occupancy information	
Area of occupancy (AO) Within the extent of occurrence, thick-billed longspurs occupy an area of 4191 km^2 (calculated by summing occupied 2-km by 2-km grid cells overlaid on a map of Alberta). *See 3.0 Distribution (3.1 Breeding Range: Alberta).*	4191 km^2
Is the total population severely fragmented i.e., is >50% of its total area of occupancy in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse? Global breeding distribution is disjunct (north = Alberta, Saskatchewan, Montana, and North Dakota; south = Colorado, Wyoming, and Nebraska); however, the population does not meet the IUCN definition of “severely fragmented”. *See 3.0 Distribution, and Figures 1 and 2.*	No
Number of locations The number of locations for Alberta’s thick-billed longspur population is unknown; current threats act at a small scale, suggesting that the species likely exists in many locations. The clumped distribution of breeding territories may reduce the number of locations relative to a population that was more evenly spread across the landscape; however, the number of locations is likely still numerous. *See 7.0 Threats, 7.7 Locations.*	Unknown, likely numerous locations

Extent and Occupancy information	
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence? Historical decline in extent of occurrence in other parts of breeding range; extirpated from Minnesota, Manitoba, and likely from South Dakota and other regions. At risk of extirpation from North Dakota. Data are not sufficient to determine if a continuing decline in extent of occurrence within Alberta has occurred. Nevertheless, historical records documenting thick-billed longspurs in the grasslands around Calgary in 1897 (Macoun and Macoun 1909) suggest the Alberta breeding range was once more extensive. *See 3.0 Distribution (3.1 Breeding Range: Alberta, and 3.2 Breeding Range: Other Areas).*	Continuing decline unknown, but possible
Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy? Trend in area of occupancy has not been tracked but based on population decline, a decline is likely to have occurred. *See 3.0 Distribution (3.1 Breeding Range: Alberta) and 6.0 Population Size and Trends (6.2 Population Trends).*	Likely; inferred
Is there a [observed, inferred, or projected] continuing decline in number of subpopulations? Population not structured into separate subpopulations. *See 3.0 Distribution (3.1 Breeding Range: Alberta).*	Not applicable
Is there a [observed, inferred, or projected] continuing decline in number of locations? The number of locations is unknown, but decline is possible based on population decline. *See 7.0 Threats.*	Unknown, but possible based on projection

Extent and Occupancy information	
Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat? Remnant patches of native grassland habitat continue to be lost to conversion to other land uses. Habitat loss and degradation have occurred from energy infrastructure, exposure to agricultural pesticides, and altered vegetation structure resulting from reduced fire frequency, loss of native grazers, and introduction of invasive plant species. *See 4.0 Habitat (4.5 Habitat Trends) and 7.0 Threats.*	Yes; observed decline in area of habitat
Are there extreme fluctuations in number of subpopulations? Population not structured into separate subpopulations. *See 3.0 Distribution (3.1 Breeding Range: Alberta)*	Not applicable
Are there extreme fluctuations in number of locations? *See 7.0 Threats.*	No
Are there extreme fluctuations in extent of occurrence? *See 3.0 Distribution (3.1 Breeding Range: Alberta)*	No
Are there extreme fluctuations in index of area of occupancy? *See 3.0 Distribution (3.1 Breeding Range: Alberta).*	No

Number of Mature Individuals (in each population)	N Mature Individuals
Partners in Flight (2020) estimates the Alberta population at 58 000, the Saskatchewan population at 210 60 000, and the U.S. population at 580 000. *See 6.0 Population Size and Trends (6.1 Population Estimates).*	58 000

Quantitative Analysis	
Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years]. Langham et al. (2015) projected that virtually all suitable habitat would be lost by 2080 as a result of climate change. *See 7.0 Threats (7.6 Climate Change).*	Probability of extinction has not been quantified.

Threats

(Actual or imminent threats, to subpopulations or habitats. List from highest to least impact, as per IUCN Threats Calculator [http://www.iucnredlist.org/technical-documents/classification-schemes/threats-classification-scheme]. Rate immediacy, scope and severity.) *See 7.0 Threats section.*

Threats
Greatest threat is conversion of native grassland habitat to agricultural cropland and other land uses. As of 2016, 57% of Alberta's Grassland Natural Region has been converted to human footprint (agriculture, energy development, transportation and urban/industrial development), and this trend continues: between 1999 and 2016, an additional 2.5% was converted to human footprint (ABMI 2018). Recent loss of native grassland breeding habitat in the United States has been attributed to incentives to grow crops for biofuels. Conversion of habitat is occurring on the wintering grounds in the Chihuahuan desert at a rate of 6.04% annually.
Remaining habitat is increasingly degraded by incursions from the energy sector (oil & gas and wind energy) including construction of infrastructure, access roads, pipelines, and powerlines. There is some evidence that thick-billed longspur exhibit displacement from infrastructure, but are initially attracted to the bare ground exposed during construction. Expected increases in wind energy development could further degrade habitat if allowed to be sited within native grasslands, as well as potential increased mortality to the species from collisions.
Increasing pesticide use in southeastern Alberta to which thick-billed longspur could be exposed. Pesticide quantities sold in Dry Mixedgrass Natural Subregion increased by 50% between 2003 and 2013. Of particular concern is the increasing use of treated seeds (e.g., canola seeds) within Alberta, because seeds compose a large proportion of the adult thick-billed longspur diet.

Thick-billed longspurs depend on heterogenous grazing practices (or in combination with prescribed fire) to create suitable breeding habitat. Their preferred vegetation structure is sparse vegetation with 24%–38% exposed groundcover, with short (5 cm) vegetation, and minimal litter. Range management for cattle production often uses grazing regimes that result in denser, taller vegetation than is preferred by the species. Fire suppression has had a similar effect.
Exotic grass species (e.g., crested wheatgrass), which are taller and denser than the native shortgrass prairie grasses, were once used to reclaim pipelines and oil and gas well sites and are still used in tame pastures. These exotic grasses change the vegetation structure and render the habitat less suitable for thick-billed longspurs, unless intense grazing is applied.
Climate change projections suggest there will no suitable habitat for thick-billed longspurs by 2080. Thick-billed longspurs have poor reproductive success under drought conditions.

Rescue Effect (immigration from outside Alberta)	
Status of outside population(s)? Listed as *Threatened* in Canada; S3B,S3M (*Vulnerable*) in Saskatchewan, SNA (*Accidental*) in British Columbia, Manitoba, and Ontario. S3 in Montana, Nebraska and Wyoming; S2 in North Dakota and Colorado. Priority 1 in Wyoming and Nebraska; Priority 2 in Montana; Priority 3 in North Dakota; Priority species in Colorado. It is listed as a Species of Greatest Conservation Need by Montana Fish, Wildlife, and Parks and as a Sensitive Species by the Montana State Office of the Bureau of Land Management. *See 8.0 Status Designations.*	
Is immigration known or possible? Dispersal in and out of Alberta is likely, given that migratory birds are very mobile. *See 6.0 Population Size and Trends (6.3 Rescue Potential) and Figure 2.*	Yes
Would immigrants be adapted to survive in Alberta? Immigrants most likely from Saskatchewan or Montana (all part of northern breeding population). *See 3.0 Distribution (3.2 Breeding Range: Other Areas).*	Yes

Is there sufficient habitat for immigrants in Alberta? Loss of suitable habitat for this species in the Grassland Natural Region suggests habitat may be a limiting factor for immigrants into Alberta. However, not all potentially suitable habitat in Alberta has been surveyed. *See 4.0 Habitat (4.5 Habitat Trends), 3.0 Distribution (3.4 Search Effort), and 7.0 Threats.*	Unlikely
Is rescue from outside populations likely? *See 6.0 Population Size and Trends (6.3 Rescue Potential).*	No

Current Status
Provincial: *May Be At Risk* (The General Status of Alberta Wild Species 2015); not listed as a species at risk under Alberta's *Wildlife Act*; S3S4B,S3S4M (Canadian Endangered Species Conservation Council [CESCC]) in Alberta National: *Threatened* in Schedule 1 under the *Species at Risk Act* (SARA); *Threatened* (COSEWIC); N3N4B, N3N4M (CESCC) Elsewhere: Bird of Conservation Concern (making it a candidate for listing under the U.S. Endangered Species Act); NatureServe global rank: G4

Authors of Technical Summary: D. Hill, L. Gould, and R. Kelly

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