COSEWIC
Assessment and Status Report

on the

Lark Bunting
Calamospiza melanocorys

in Canada

THREATENED
2017

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Lark Bunting — Photo credit: Marcel Gahbauer, with permission.

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COSEWIC
Assessment Summary

Assessment Summary – April 2017

Common name
Lark Bunting

Scientific name
Calamospiza melanocorys

Status
Threatened

Reason for designation
This grassland songbird is at the northern edge of its range in the Canadian Prairies. It is nomadic, with breeding populations shifting considerably from year to year to track favourable conditions across the regional landscape, seeking peak abundance of grasshoppers. Population estimates therefore fluctuate substantially and complicate the estimation of short-term trends, but long-term data show a decline of 98% since 1970. Over most of the past decade, the trend has remained strongly negative. Conversion of grassland habitat and insecticide use are believed to be the primary threats to this species.

Occurrence
Alberta, Saskatchewan, Manitoba

Status history
Designated Threatened in April 2017.

COSEWIC
Executive Summary

Lark Bunting
Calamospiza melanocorys

Wildlife Species Description and Significance

Lark Bunting is a large chunky sparrow with a short tail and relatively large bill. Males have a distinctive black and white breeding plumage, but resemble females in the non-breeding season. Females are greyish-brown with black streaking on their upperparts and dark brown wings with a whitish patch. Juveniles are similar to females in pattern, but are buff-coloured with more streaking.

No subspecies have been described for the species and it is the only member of its genus. Lark Bunting is the state bird of Colorado.

Distribution

Lark Bunting is restricted to breeding in the grasslands of west-central North America, from the southern Canadian prairies through the Great Plains of the central US into northern Mexico. In Canada, Lark Buntings are found in southeastern Alberta, southern Saskatchewan, and southwestern Manitoba. Lark Buntings spend the non-breeding season in the southwest US and north-central Mexico.

Habitat

Lark Buntings occur in a variety of grassland habitats, including shortgrass and mixed-grass prairie, weedy fallow fields, pastures, and croplands. They prefer habitat with a combination of grass, shrubby vegetation and bare ground for nesting. Shrubs or tall grasses near the nest provide shading and concealment from predators. In Canada, the species appears to use managed agricultural areas such as hayfields, cultivated grasslands and roadside ditches, in addition to native grasslands. During the non-breeding season, Lark Buntings are found in flat open areas including plains, cropland, fields and desert flats.

Biology

Lark Buntings are believed to nest once per year, laying 3-5 eggs per clutch. The mean number of young fledged per nest ranges from 1.2 to 3.1 depending on habitat type.

Lark Buntings have evolved several adaptations to deal with the environmental instability that characterizes their grassland habitat. They are highly nomadic from year to year, a behaviour which appears to have evolved to track favourable habitat conditions across a changing landscape. Lark Buntings also time nesting to coincide with peak abundance of grasshoppers, a major component of their diet. Nest-site selection is linked to minimizing heat stress for eggs and nestlings, as well as for the dark-plumaged incubating male. Once chicks leave the nest, male and female parents divide the brood and continue parental care separately, a strategy that reduces predation and increases foraging efficiency, especially during droughts.

Lark Buntings are frequent hosts of Brown-headed Cowbirds but do not appear to have evolved any avoidance strategies against this brood parasite. Numerous predators feed on Lark Buntings, including owls, raptors, cats, Coyotes, ground squirrels, weasels, and snakes.

Lark Buntings evolved with American Bison and other large native herbivores on their breeding grounds, and depend to some degree on grazing to maintain their habitat, particularly in taller grasslands.

Population Sizes and Trends

The total global breeding population of Lark Buntings is estimated to be 10 million individuals, with approximately 160,000 individuals breeding in Canada. Between 1970 and 2014, Lark Buntings declined by approximately 3.2% per year across North America and 8.6% per year in Canada, amounting to cumulative losses of 77% and 98%, respectively. Rates of decline have accelerated more recently, with a 6% per year decline across North America and a 14% per year decline in Canada between 2005 and 2015; the species is projected to lose half of its overall remaining population over the next 16 years. However, the inter-annual variability in Lark Bunting distribution and abundance caused by the highly nomadic nature of the species may result in misleading snapshots of short-term regional population trends. An examination of rolling 10-year trends in Canada (in which one point per year represents the average annual percent change over the previous10-year period) shows a tendency toward strongly negative trends over both the short- (2005-2015) and long-term (1980-2015), although there is considerable variability over time. Interpolating from the long-term decline, the decline of the Canadian population over the past decade is estimated to be 59%.

Threats and Limiting Factors

Little is known about threats specific to the Canadian Lark Bunting population. Over much of the Great Plains, habitat loss, degradation, and fragmentation due to agriculture, urbanization and resource extraction are considered the primary threats to the species, along with effects of pesticides.

Grassland habitat is one of the most endangered ecosystems in North America. In Canada, over 70% of the prairie landscape has been degraded or lost since European

settlement due primarily to agriculture and urbanization, and much of the remainder is highly fragmented.

Although some Lark Buntings breed in agricultural landscapes, their success may be lower in these habitats due to plowing, mowing and pesticide application. Pesticides may be of serious concern to Lark Buntings not only through direct lethal effects, but also through depleting populations of prey such as grasshoppers.

Oil and gas development on the prairies has also contributed to habitat loss and fragmentation for Lark Buntings, and associated sensory disturbance is also a concern. An increase in wind and solar farms poses a growing threat. Associated power lines can facilitate the presence of avian predators and cowbirds that pose threats to Lark Bunting survival and productivity.

Climate change is predicted to be an increasing threat for Lark Buntings. Continued warming, coupled with more frequent and intense droughts and large storm events, is likely to negatively affect the species. Lark Buntings are expected to lay fewer eggs, and have lower egg and chick survival under these conditions, while flooding from extreme rainfall may also lead to greater adult mortality.

A number of limiting factors make Lark Buntings susceptible to decline. They rely heavily on the availability of vegetative cover to minimize thermal stress while nesting. They are sensitive to drought conditions, when their main food (grasshoppers) is less abundant, and they experience increased competition with other grassland bird species and a resultant lower rate of recruitment. Conversely, they are also vulnerable to heavy rainfall events on the breeding grounds, and to fluctuations in seed availability on their wintering grounds.

Protection, Status and Ranks

Lark Bunting is protected under the federal *Migratory Birds Convention Act (1994)* in Canada, under the federal *Migratory Bird Treaty Act* in the US and under the Convention for the Protection of Migratory Birds and Game Mammals in Mexico. Lark Bunting also receives provincial protection, under the *Alberta Wildlife Act*, the *Saskatchewan Wildlife Act*, and the *Manitoba Wildlife Act*. None of the preceding legislation has specific provisions for habitat protection.

Lark Bunting is classified as a species of least concern on the IUCN Red List. NatureServe designates it as globally secure and secure on the US breeding and non-breeding grounds, because it is common and widespread. In Canada, it is ranked by NatureServe as apparently secure to secure overall, recognizing that there is cause for long-term concern because of declines or other factors. It is considered secure in Alberta, apparently secure to secure in Saskatchewan, and critically imperilled in Manitoba.

Lark Bunting is designated a species of continental importance under the Partners in Flight North American Landbird Conservation Plan because it is a common bird in steep decline.

TECHNICAL SUMMARY

Calamospiza melanocorys

Lark Bunting

Bruant noir et blanc

Range of occurrence in Canada: Alberta, Saskatchewan, Manitoba

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines (2011) is being used)	Unknown but assumed to be 2 - 3 years
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Yes, observed
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Estimated to be 59% based on interpolation for the past ten years from the long-term (1970-2015) Canadian decline of 8.6% per year; this is consistent with a rolling 10-year trend of below -50% in six of the past nine years
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Unknown, but projected to continue declining based on threats assessment
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Unknown, but suspected to be declining
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	a. No b. Yes for US populations, but not for Canada (although may be similar) c. No
Are there extreme fluctuations in number of mature individuals?	No, although the Canadian population is at edge of the species' range, and given that Lark Buntings are highly nomadic, the number occurring within Canada may experience extreme fluctuations from year to year as birds cross the border with the USA, even though the global population is not cycling to a similar extent

Extent and Occupancy Information

Estimated extent of occurrence	124,500 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value).	Variable, but likely >2,000 km² in most years

Is the 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?	a. Probably not b. No
Number of "locations"* (use plausible range to reflect uncertainty if appropriate)	Unknown because of the species' broad distribution, high dispersal ability and highly nomadic behaviour, but likely >10
Is there an [observed, inferred, or projected] decline in extent of occurrence?	Yes, observed decline due to loss and degradation of breeding habitat and contraction of northern limits of range
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	Yes, inferred decline due to loss and degradation of breeding habitat
Is there an [observed, inferred, or projected] decline in number of subpopulations?	n/a (no subpopulations are described)
Is there an [observed, inferred, or projected] decline in number of "locations"*?	Unknown
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat?	Yes, inferred decline in area, extent and quality of habitat due to agriculture, urbanization and oil and gas development
Are there extreme fluctuations in number of subpopulations?	n/a (no subpopulations are described)
Are there extreme fluctuations in number of "locations"*?	Unknown, but due to significant nomadic shifts in distribution, there may be extreme fluctuations in some years
Are there extreme fluctuations in extent of occurrence?	Lark Buntings exhibit irruptive movements at the periphery of their range, with numbers fluctuating annually, occasionally to an extreme degree
Are there extreme fluctuations in index of area of occupancy?	Lark Buntings exhibit irruptive movements at the periphery of their range, with numbers and area of occupancy fluctuating annually, occasionally to an extreme degree

Number of Mature Individuals (in each subpopulation)

Subpopulations (give plausible ranges)	**N Mature Individuals**
Canadian population	Estimated at 160,000 (range 50,000 – 500,000)

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years]?	Not calculated

* See Definitions and Abbreviations on COSEWIC website and IUCN (Feb 2014) for more information on this term

Threats (direct, from highest impact to least, as per IUCN Threats Calculator)

Was a threats calculator completed for this species? Yes, on June 9, 2016, by Andrea Smith, Marcel Gahbauer, Jon McCracken, Joanna James, Kristiina Ovaska, Gord Court, Jeff Keith, Bill Watkins, Ken De Smet, Louise Blight, Scott Wilson, Susan Skagen, Kim Borg

Overall threat of high-medium, based on:

i. Agriculture, especially conversion of grassland and livestock practices (high-low)
ii. Pollution, specifically pesticide use (medium-low)

Additional threats identified with low impacts were: Residential and commercial development, Energy production and mining, Transportation and service corridors, Invasive and other problematic species and genes, and Climate change and severe weather

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	Much larger populations in adjacent North Dakota and Montana show declining trends over last 40 years
Is immigration known or possible?	Yes
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Probably currently but could be limited in the future if availability of suitable habitat continues to deteriorate (see following item)
Are conditions deteriorating in Canada?[+]	Yes, habitat being lost, degraded or fragmented in parts of Canadian range
Are conditions for the source population deteriorating?[+]	Unknown, but habitat likely being lost, degraded or fragmented in parts of US range
Is the Canadian population considered to be a sink?[+]	No
Is rescue from outside populations likely?	Possible, but unpredictable due to highly nomadic nature of species from year to year, and ultimately limited by declines in US portion of breeding range

Data Sensitive Species

Is this a data sensitive species? No

Status History

COSEWIC: Designated Threatened in April 2017.

Status and Reasons for Designation:

Status:	**Alpha-numeric codes:**
Threatened	Meets Endangered, A2b, but designated Threatened, A2b, because the species is not at imminent risk of extirpation

[+] See Table 3 (Guidelines for modifying status assessment based on rescue effect)

Reasons for designation:
This grassland songbird is at the northern edge of its range in the Canadian Prairies. It is nomadic, with breeding populations shifting considerably from year to year to track favourable conditions across the regional landscape, seeking peak abundance of grasshoppers. Population estimates therefore fluctuate substantially and complicate the estimation of short-term trends, but long-term data show a decline of 98% since 1970. Over most of the past decade, the trend has remained strongly negative. Conversion of grassland habitat and insecticide use are believed to be the primary threats to this species.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Qualifies as Endangered under A2b, given a 59% decline in population size over the past 10 years.
Criterion B (Small Distribution Range and Decline or Fluctuation): Does not apply, as IAO and EOO both greatly exceed thresholds.
Criterion C (Small and Declining Number of Mature Individuals): Does not apply, as average population is much larger than 10,000.
Criterion D (Very Small or Restricted Population): Does not apply, as average population is much larger than 1,000.
Criterion E (Quantitative Analysis): Not conducted.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2017)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

Environment and Climate Change Canada
Canadian Wildlife Service
Environnement et Changement climatique Canada
Service canadien de la faune
Canada

The Canadian Wildlife Service, Environment and Climate Change Canada, provides full administrative and financial support to the COSEWIC Secretariat.

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific Name: *Calamospiza melanocorys* (Stejneger 1885)
English Name: Lark Bunting
French Name: Bruant noir et blanc

Class: Aves
Order: Passeriformes
Family: Emberizidae
Genus: *Calamospiza*
Species: *Calamospiza melanocorys*

No geographic variation or subspecies have been described for this species (Shane 2000; AOU 2014). Lark Bunting belongs to a monotypic genus with no close allies (Patten and Fugate 1998; Shane 2000).

Morphological Description

Lark Bunting is a large chunky sparrow with a short tail and relatively large bluish-grey bill (Neudorf *et al*. 2006). Adults are sexually dimorphic. Males in their alternate (breeding) plumage are black with white wing patches. Females are greyish-brown with black streaking on their upper body and dark brown wings with a white wing patch tinged with buff (Shane 2000; Neudorf *et al.* 2006). In their basic (non-breeding) plumage, males resemble females except that their wing patches are larger and brighter buff, they have rustier colouration on their head and back, and their abdomen feathers are black with white edgings. Juveniles are also similar to females, but with a more buffy appearance overall and more extensive streaking on their underparts (Shane 2000; Neudorf *et al.* 2006).

The male Lark Bunting most closely resembles the male Bobolink (*Dolichonyx oryzivorus*), but lacks the Bobolink's white back patches, buffy nape and whitish rump. Lark Bunting females and basic plumage males can be distinguished from female Chestnut-collared Longspur (*Calcarius ornatus*) and McCown's Longspur (*Rhynchophanes mccownii*) by extensive streaking on their underparts, which is minimal or absent on longspurs (Shane 2000).

Population Spatial Structure and Variability

No information is available on the population structure of Lark Bunting in Canada.

Designatable Units

No subspecies or varieties of Lark Bunting have been identified in Canada, nor any discrete or evolutionarily significant populations described.

Special Significance

No Aboriginal Traditional Knowledge is currently available for Lark Bunting.

Lark Bunting is the only species in the genus *Calamospiza*, which has no closely related allies (Shane 2000). It is one of six grassland passerine species endemic to the Great Plains of North America, where it is among the most abundant and least philopatric birds (Mengel 1970; Shane 2000). Male Lark Buntings exhibit an unusual molt pattern among sparrows, in which they change from a cryptic basic plumage to a drastically different bold alternate plumage (Shane 2000). Lark Bunting is the state bird of Colorado.

DISTRIBUTION

Global Range

Lark Bunting is endemic to the grasslands of west-central North America (Figure 1). It breeds from the southern Canadian prairies through the Great Plains of the central US into northern Mexico. In the US, Lark Bunting breeding distribution extends as far east as South Dakota through Oklahoma (Dechant *et al*. 2002; NatureServe 2015). The species historically bred in Minnesota and Iowa as well, but its breeding range has contracted westward, likely due to habitat loss, degradation, and fragmentation (Finch *et al.* 1987). Lark Buntings overwinter in the southwest US (California, Arizona, New Mexico, and Texas) and north-central Mexico.

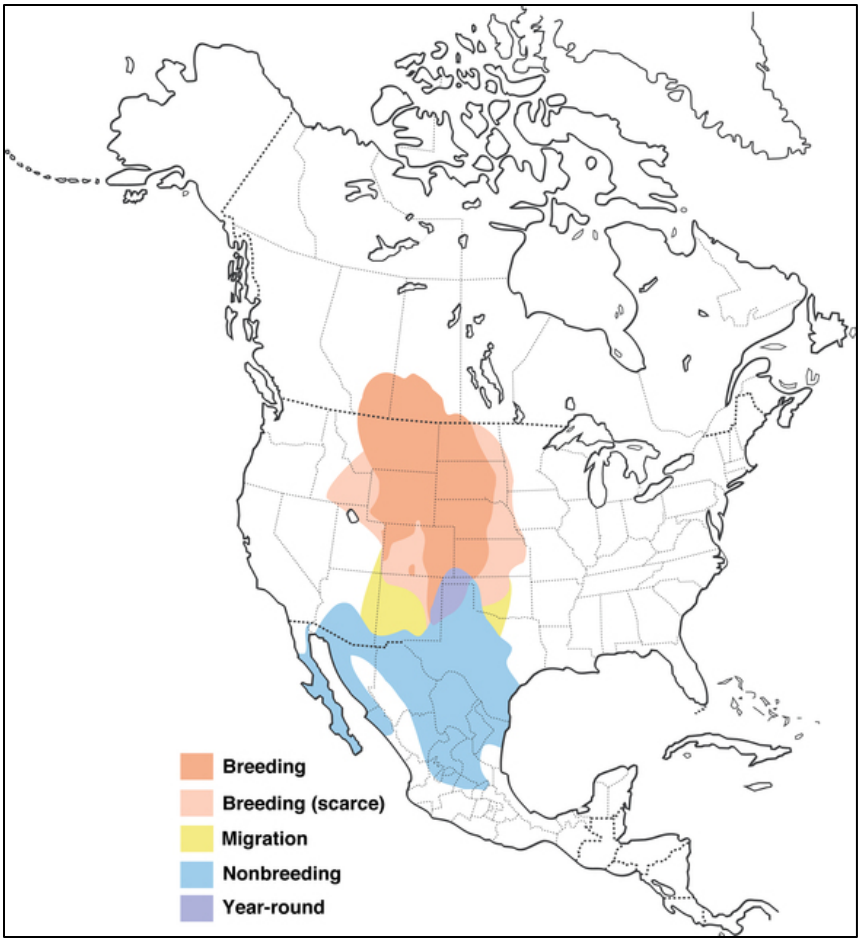

Figure 1. Distribution of Lark Bunting (from Shane 2000).

Canadian Range

In Canada, Lark Buntings occur during the breeding season from southeastern Alberta through southern Saskatchewan to southwestern Manitoba (Figure 1; Finch *et al.* 1987; Shane 2000). Their distribution lies within the Prairie Potholes Bird Conservation Region (BCR) 11 in the Prairie Ecozone (Environment Canada 2013).

Extent of Occurrence and Area of Occupancy

Based on Breeding Bird Survey data, extent of occurrence over the period 2005-2015 is approximately 124,500 km^2, compared to approximately 327,400 km^2 for 1968-2015. Area of occupancy is difficult to estimate given the high annual variability in distribution of the species. It is likely that in most years the area of occupancy exceeds 2,000 km^2, but possible that it is below this threshold in years when the population in Canada is particularly small.

Search Effort

Most information on Lark Bunting distribution and abundance in Canada comes from North American Breeding Bird Survey data, which are obtained through roadside point counts (Environment Canada 2014a). Additional information derives from provincial breeding bird atlases (Bird Studies Canada undated; Federation of Alberta Naturalists 2007; Saskatchewan Conservation Data Centre 2016), incidental observations made during targeted species at risk surveys (i.e., for Sage Thrashers, *Oreoscoptes montanus*, in Saskatchewan; Government of Saskatchewan Ministry of Environment 2011) and a large-scale biodiversity monitoring initiative (i.e., the Alberta Biodiversity Monitoring Institute; ABMI 2015).

HABITAT

Habitat Requirements

Lark Buntings breed in a variety of grassland and shrub-steppe habitats, including shortgrass and mixed-grass prairies, weedy fallow fields, legume haylands, pastures with native or introduced grasses, and minimum-tillage croplands (Finch *et al*. 1987; Shane 2000; Dechant *et al*. 2002). The species is typically associated with large expanses of contiguous grassland (greater than 10 km^2; Shane 2000; Dechant *et al*. 2002), but Skagen *et al.* (2005) found that daily survival rates of nests were greater in small (< 80 ha) compared with large (> 80 ha) grassland patches in Colorado, possibly because large mammalian predators avoided small habitat patches. No evidence of area sensitivity was found for the species in South Dakota grasslands (Johnson and Igl 2001).

Lark Buntings nest beneath or beside forbs, bunchgrasses, tall grasses or low shrubs, which likely provide protection from inclement weather and predators (With and Webb 1993; Dechant *et al*. 2002). Nest success increased with nest cover and vegetative structure in South Dakota and Colorado (Strong 1971; Pleszczynska 1978; Skagen and Yackel Adams 2010), probably because of shading from solar radiation (Pleszczynska 1978). In South Dakota, nests established early in the breeding season were more successful than nests established later in the season, because shading decreased as the summer progressed (Pleszczynska 1978). In Kansas, successful nests were situated adjacent to short grass (mean height 31 cm) and tall forbs (mean height 42 cm; Shane 1972, as cited in Dechant *et al*. 2002). Ideal nesting conditions comprise a dominant understory grass stratum (< 60 cm height), 10-30% canopy cover provided by taller vegetation (e.g., forbs or shrubs) and 10-15% bare ground (Dechant *et al*. 2002; Neudorf *et al*. 2006).

Lark Buntings generally prefer lightly to moderately grazed pasture on the breeding grounds, although this can depend on vegetation type. For example, in tallgrass habitat, Lark Bunting population density increases with grazing intensity, because heavy grazing lowers canopy height. However, heavy grazing has a negative effect on habitat quality in shortgrass, because it eliminates food, shade, and nest-site availability (Finch *et al*. 1987). In North Dakota, Kantrud (1981) found that Lark Bunting densities were highest in moderately grazed areas, and that the species avoided hayland mowed during the previous year. Although Lark Buntings use agricultural habitats for nesting, their breeding success may be lower in cropland than in native grassland due to agricultural activities such as plowing, tilling and mowing. While the direct effects of these activities on Lark Bunting have not been studied, they likely increase the risk of egg and nestling mortality (Finch *et al*. 1987; Neudorf *et al*. 2006).

In the Canadian prairies, Lark Buntings are primarily found in shortgrass and mixed-grass habitat, but also occur in managed agricultural areas, including hayfields, cultivated grasslands and roadside ditches (Environment Canada 2013). Within this region, McMaster and Davis (1998) found that the species was more abundant in perennial grassland cover (grown under the Permanent Cover Program, PCP, a federal government initiative that offered financial incentives for farmers to plant perennial grass cover in areas with high risk of erosion; haying and mowing were permitted in these areas) compared with cropland. Hayed and grazed PCP sites were equally utilized (although Lark Buntings were not found in hayfields in Saskatchewan; Davis *et al.* 2016). Lark Buntings used both native and planted pasture in Saskatchewan, but their reproductive success (nest survival and fledging success) was lower in planted habitat than in native grasslands; the habitat structure of planted pasture (with less grass and shrub cover and more bare ground than native grassland) may make it easier for predators to find Lark Bunting nests (Davis *et al*. 2016). Lark Buntings have been recorded nesting in association with Western Snowberry (*Symphoricarpos occidentalis*) in Saskatchewan (Smith and Smith 1966). In Alberta, Lark Buntings have been observed nesting in relatively tall dense grass or ground cover, often associated with Big Sagebrush (*Artemisia tridentata*; Rand 1948). Throughout their range, Lark Buntings appear to prefer habitat dominated by Wheatgrass (*Agropyron* spp.), Blue Grama (*Bouteloua gracilis*), Needle-and-thread (*Stipa comata*), and Big Sagebrush (Shane 2000).

Lark Buntings use similar habitat on spring and fall migration as they do during the breeding season, including scrub habitat in central Mexico (Shane 2000). On the wintering grounds, Lark Buntings occur in flat semi-arid open habitat, including plains, fields, brushland, cropland, grasslands, small playas and desert flats (Neudorf *et al*. 2006). In Colorado, wintering Lark Buntings use moderately to heavily grazed winter pastures (Giezentanner and Ryder 1969).

Habitat Trends

Lark Bunting evolved in the Great Plains, where it adapted to a heterogeneous landscape shaped by American Bison (*Bison bison*) grazing, Black-tailed Prairie Dog (*Cynomys ludovicianus*) towns, and periodic fires (Neudorf *et al*. 2006). This landscape mosaic has been drastically modified since the arrival of Europeans in the 1800s. Much of the native habitat has been converted to cropland and rangeland, or lost to urbanization. Domestic cattle have altered the grazing regime, resulting in a relatively uniform vegetation structure, and over-grazing in some areas (Giezentanner and Ryder 1969; Fontaine *et al*. 2004). Nonetheless, shortgrass prairie, which is the primary habitat used by Lark Buntings for breeding, is the least disturbed of North America's three prairie types (tallgrass, mixed grass, shortgrass), with approximately 50% of it remaining intact (Roch and Jaeger 2014). However, shortgrass habitat is becoming increasingly attractive for cultivation in the northern Great Plains, as advances in irrigation technology and genetically modified crops open opportunities for monoculture grain farming (Neudorf *et al*. 2006). The trend toward use of shorter wheat varieties may reduce nest cover in such cropland habitats (Neudorf *et al*. 2006).

In the Canadian prairies, over 70% of native grasslands have been converted to farmland, and approximately 20% of original shortgrass habitat remains (North American Bird Conservation Initiative Canada 2012). Since 1985, shortgrass prairie has declined by approximately 10%, while agricultural areas have experienced a shift from tilled to forage lands, due in large part to a strong cattle market (Prairie Habitat Joint Venture 2014). As a result, perennial cover (e.g., haylands and pasture) has expanded across much of the prairies (Prairie Habitat Joint Venture 2014).

Lark Bunting is threatened throughout its range by habitat loss and fragmentation, caused by agriculture, urbanization and oil and gas extraction (Neudorf *et al*. 2006). In North Dakota, the termination of the Conservation Reserve Program, which provided financial support for farmers to revert marginal cropland to perennial grassland cover, is believed to have caused steep declines in habitat availability for Lark Buntings (Johnson and Igl 1995). The World Wildlife Fund has classified most Lark Bunting breeding habitat in the Rocky Mountain region of the US (which includes parts of Colorado, Kansas, Nebraska, South Dakota and Wyoming) as critical or endangered, due to fragmentation caused by cropland conversion, overgrazing, and fire suppression (Neudorf *et al*. 2006).

In Alberta, climate change is projected to increase the extent of the Prairie ecozone in a northwest direction, potentially expanding suitable habitat for Lark Buntings by 23% over the next century (Nixon *et al*. 2015). However, any gains in climate suitability may be negated by ongoing intensification of agriculture and urbanization in the region, which will reduce habitat availability and quality (Nixon *et al*. 2015). Furthermore, because the species is at the northern limit of its range in Alberta, populations may be less robust than in the core range, and thus less capable of expanding into newly available habitat (Nixon *et al*. 2015). Canadian Breeding Bird Survey records show a contraction in Lark Bunting distribution across the prairies in recent decades, suggesting that the species' range has not been expanding in relation to climate change to date (Figure 2).

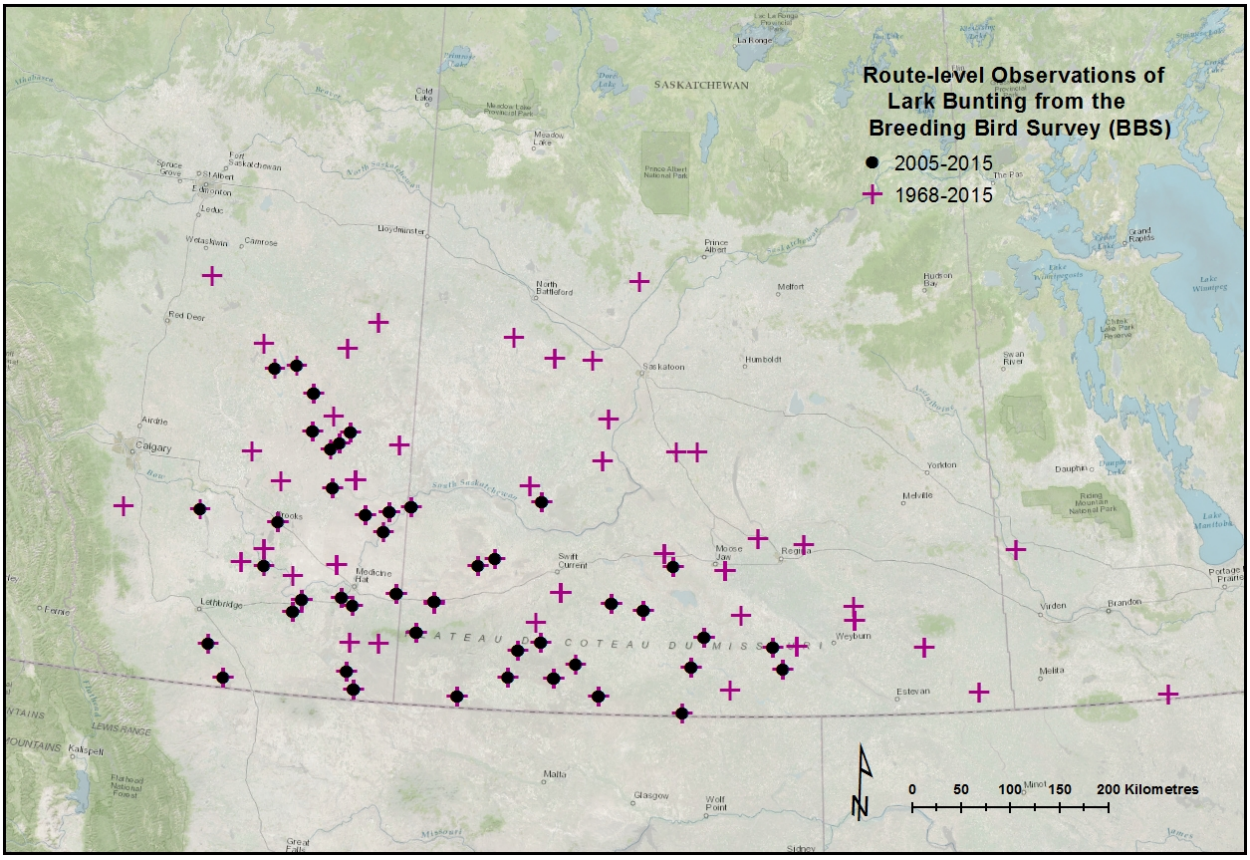

Figure 2. Distribution of Canadian records from the Breeding Bird Survey.

Lark Bunting also experiences habitat loss and fragmentation as a result of agriculture and urbanization on the wintering grounds in Mexico and southwestern US. Dry playas are a major feeding habitat for Lark Buntings in winter, but many are disappearing through ecological succession (Neudorf *et al*. 2006). The Chihuahuan Desert of northern Mexico supports many overwintering grassland bird species, including Lark Bunting. Between 2006 and 2011, a 6% annual rate of cropland expansion was recorded in the region, translating to a loss of approximately 69,000 ha of desert shrublands and grassland valleys (Pool *et al*. 2014). This habitat loss is estimated to have displaced 16,000 Lark Buntings (Pool *et al*. 2014).

BIOLOGY

Most of the information on Lark Bunting biology is derived from studies on the US breeding grounds, with little research coming from the Canadian range.

Life Cycle and Reproduction

The Lark Bunting mating system is considered variable and complex (Shane 2000). In areas of high density, birds have been documented practicing resource-defence polygyny, with a positive correlation between vegetation cover and quality of the nesting habitat (Pleszczynska 1978).

Lark Buntings have a mean clutch size of 3.6 to 4.5 eggs (Creighton 1971; With and Webb 1993; Shane 2000; Skagen *et al*. 2005; Neudorf *et al*. 2006; Yackel Adams *et al.* 2007). They are believed to breed only once a year, although they often re-nest following nest failure (Neudorf *et al*. 2006; Yackel Adams *et al*. 2007). The mean number of young fledged per nest ranges from 1.3 to 2.3 in the US (Neudorf *et al*. 2006; Yackel Adams *et al*. 2007). On the Canadian breeding grounds, Davis *et al*. (2016) recorded an average of 3.1 $\pm$ 0.3 young fledged per nest in native grassland, although planted pasture had a lower rate (1.2 $\pm$ 0.0, $p = 0.04$).

Daily nest survival rates were greater in small (<80 ha) grassland patches in Colorado than large patches (small: 0.925 $\pm$ 0.026, 95% CI 0.874-0.975; large: 0.851 $\pm$ 0.038, 95% CI 0.776-0.925, $t_{35} = 6.94$, $p < 0.001$; Skagen *et al*. 2005), potentially due to higher numbers of large mammalian predators in the latter (Skagen *et al*. 2005). In Saskatchewan, daily nest survival was higher in native grassland compared with planted pasture (native: 0.970, 85% CI 0.886-0.949; planted: 0.843, 85% CI 0.777-0.891; Davis *et al*. 2016). Survival for the nesting period in Manitoba was low (0.20) and only 29% of eggs laid fledged young (Davis 1994). Post-fledging survival (from fledgling to independence from parents) increases as the breeding season progresses, perhaps in response to rising food abundance (Yackel Adams *et al*. 2006). Yackel Adams *et al*. (2006) calculated that average post-fledging survival ranged from 0.276 $\pm$ 0.08 to 0.360 $\pm$ 0.08. Using these values and a mean winter survival rate of 0.680, Yackel Adams *et al*. (2006) estimated an annual juvenile survival rate (i.e., survival through the first year) of 0.188 to 0.245. Empirical data are lacking for adult Lark Bunting survival rates. Neudorf *et al*. (2006) used survival data from seven other granivorous passerine species, however, to estimate a value of 0.492 for the species, based on linear regression of mass on survival rate.

The average life span of Lark Buntings is unknown. The longest period between banding and recovery of a Lark Bunting was 3 years (Shane 2000). As with most other passerines, Lark Bunting generation time (i.e., the average age of breeding adults) is probably 2-3 years. Neudorf *et al*. (2006) calculated that Lark Bunting cohort generation time (i.e., the average length of time between when an individual is born and the birth of its offspring) is 2.2 years (SD = 1.6 years).

Physiology and Adaptability

Lark Buntings breed in the North American Great Plains, a region characterized by extreme inter-annual and inter-decadal climatic variability (i.e., cycles of drought and precipitation; Neudorf *et al*. 2006; Skagen and Yackel Adams 2012). Lark Buntings have evolved adaptations in response to this environmental instability, including vagility between

breeding seasons, allowing them to track ideal habitat conditions across the landscape (Skagen and Yackel Adams 2012). Within the breeding season, males form semi-nomadic flocks, presumably to follow swarms of grasshoppers, which are a major component of the diet of adults and young during the summer (Finch *et al*. 1987). Nest initiation is timed to coincide with the peak of grasshopper abundance (Neudorf *et al*. 2006).

Nest-site selection appears to be strongly linked to the avoidance of heat stress for eggs and nestlings, as well as for the dark plumaged incubating male (With and Webb 1993). Lark Buntings nest in close association with tall plants, and nests are oriented to maximize shade during the afternoon, while optimizing morning sun and cool winds (Neudorf *et al*. 2006). Once chicks leave the nest, the male and female parents divide the brood between them and continue parental care separately for several weeks (Yackel Adams *et al*. 2007). This strategy reduces predation and increases foraging efficiency, especially during drought conditions (Yackel Adams *et al.* 2001). Lark Buntings drink less water (by 28-42%) than their ecological counterpart, the Dickcissel (*Spiza americana*), which may allow them to withstand prolonged or severe periods of drought (Shane 2000).

Hill (1976) speculated that Lark Buntings in Kansas may respond to Brown-headed Cowbird (*Molothrus ater*) nest parasitism through egg rejection and nest desertion. However, such avoidance behaviour has not been documented in Saskatchewan, where Lark Buntings experience a high rate (up to 55%; see below) of cowbird parasitism and accept their eggs and nestlings (Sealy 1999). Lark Buntings actively defend their nests against predators through distraction displays (Shane 2000).

Lark Buntings are territorial during the breeding season, but are considered semi-colonial because nests are often grouped together (Shane 2000). Territory size is difficult to estimate because unmated males often display within territories of other males, but likely ranges from 0.2 to 2 ha depending on habitat type and quality (Finch *et al*. 1987; Dechant *et al*. 2002).

Climate change is projected to increase the intensity and frequency of drought in the Great Plains. Although Lark Buntings are adapted to climate fluctuations in the region, they are likely to be adversely affected by further variability. In particular, clutch size, nest survival and productivity are expected to decrease (Skagen and Yackel Adams 2012). These negative effects of climate change may be partially offset, however, if higher air temperatures lead to improved thermoregulation of eggs and nestlings when parents are absent, as well as increased insect prey and foraging success (Skagen and Yackel Adams 2012).

Dispersal and Migration

Lark Buntings breeding in Canada are medium- to long-distance migrants, overwintering in the southern US and north-central Mexico. The species is highly nomadic and does not exhibit fidelity to breeding areas (Finch *et al.* 1987; Neudorf *et al*. 2006); migratory routes also vary annually (Dechant *et al*. 2002), but overall they tend to follow the high plains east of the Rocky Mountains, centered around the 102nd meridian from central Texas to South Dakota (Shane 2000).

Lark Bunting is highly gregarious during migration (Shane 2000). During fall migration, flocks of between 50 and 1000 individuals have been reported in Texas, and more than 10,000 individuals have been reported in Kansas. Hundreds of Lark Buntings were observed flying together during spring migration in Wyoming (Shane 2000).

Populations wintering in Mexico begin spring migration in February. Most birds breeding in Alberta arrive by late May (Shane 2000). Males typically arrive on the breeding grounds a few days to a few weeks before females (Creighton 1971; Chaine and Lyon 2008). Adults depart the breeding grounds by late July or early August in Alberta, while juveniles appear to leave later, perhaps into early September (Shane 2000). No information is available on juvenile dispersal patterns.

Interspecific Interactions

Lark Buntings evolved with American Bison and other large native herbivores on their breeding grounds, and thus depend to some degree on grazing to maintain their breeding habitat (particularly in taller grasslands; see **Habitat Requirements** section; Neudorf *et al*. 2006).

Numerous species prey on Lark Buntings. Predators of adult birds include Burrowing Owl (*Athene cunicularia*), Great Horned Owl (*Bubo virginianus*), Barn Owl (*Tyto alba*), Prairie Falcon (*Falco mexicanus*), Merlin (*F. columbarius*), Ferruginous Hawk (*Buteo regalis*), and Swainson's Hawk (*B. swainsoni*) (Neudorf *et al*. 2006).

Mammals are the main predators of Lark Bunting eggs and nestlings, and include Thirteen-lined Ground Squirrel (*Ictidomys tridecemlineatus*), Coyote (*Canis latrans*), Swift Fox (*Vulpes velox*), Long-tailed Weasel (*Mustela frenata*), American Badger (*Taxidea taxus*) and Striped Skunk (*Mephitis mephitis*; Yackel Adams *et al*. 2001; Skagen *et al*. 2005). Snakes (e.g., Bullsnake, *Pituophis melanoleucus*; Western Plains Garter Snake, *Thamnophis radix*; Blue Racer, *Coluber constrictor*, and Western Hognose Snake, *Heterodon nasicus*) may also prey opportunistically on Lark Bunting nests (Skagen et al. 2005). Long-billed Curlew (*Numenius americanus*), Upland Sandpiper (*Bartramia longicauda*) and Western Meadowlark (*Sturnella neglecta*) have been documented taking eggs or nestlings (Neudorf *et al*. 2006). Once chicks leave the nest, raptors become the predominant predators on them during the fledgling period (Yackel Adams *et al*. 2001).

In Colorado, 52% of nests were depredated, while 39% of fledglings died within two weeks of leaving the nest, primarily because of raptor predation (Yackel Adams *et al*. 2001). Yackel Adams *et al*. (2006) found that 92.3% of failed nests were due to predation and 1.2% due to cattle. In Manitoba, 71% of Lark Bunting nests experienced predation (Davis and Sealy 2000).

Lark Buntings are a frequent host of Brown-headed Cowbirds, but brood parasitism is not well studied in the species. Hill (1976) recorded that 15.5% of nests in Kansas were parasitized, but only observed one successful fledging of a cowbird chick. In Saskatchewan, Sealy (1999) found that 54.5% of Lark Bunting nests were parasitized, while in Manitoba 100% of nests were parasitized but no cowbirds fledged (Davis and Sealy 2000). Although the range of Lark Buntings overlaps with the historical distribution of Brown-headed Cowbirds, it does not appear that Lark Buntings have evolved any avoidance strategies against the brood parasite (Sealy 1999). Hill (1976) hypothesized that the stark contrast in egg appearance between the two species (Brown-headed Cowbird has brown speckled eggs while Lark Bunting has bright blue eggs) might facilitate recognition and subsequent ejection of the cowbird eggs from Lark Bunting nests. Yet this hypothesis is not supported in Manitoba and Saskatchewan, where Lark Buntings are frequently parasitized and accept cowbird eggs (Sealy 1999; Davis and Sealy 2000). Rates of brood parasitism by Brown-headed Cowbirds are higher in areas grazed by cattle for several grassland species, although this phenomenon has not been studied in Lark Buntings (Goguen and Mathews 2000; Patten *et al*. 2006).

Lark Buntings potentially compete with several other grassland bird species for resources during the breeding season, such as Western Meadowlark, Horned Lark (*Eremophila alpestris*), McCown's Longspur, and Chestnut-collared Longspur. Competition is likely reduced through temporal segregation of nesting, and through differences in diet and foraging behaviour, and may only become a problem under drought conditions (Neudorf *et al*. 2006).

Little information exists on parasites that infect Lark Buntings. Nasal mites (*Ptilonyssus morofskyi*) have been found in birds, as well as various hematozoa (e.g., *Haemoproteus*, *Trypanosoma* and microfilariae). However, the impacts of these parasitic infections are unknown (Neudorf *et al*. 2006).

Grasshoppers are a major part of the Lark Bunting diet during the breeding season. Lark Bunting young are fed exclusively on invertebrates, with grasshoppers comprising about 85% of their diet by the end of the summer (Finch *et al*. 1987). Approximately 80% of the adult diet is made up of invertebrates during the summer months. The number of nests established in an area is positively correlated with grasshopper density (Finch *et al*. 1987). Lark Buntings feed primarily on small seeds, grain, and insects during the non-breeding season, and may occasionally consume cactus fruit as well (Shane 2000).

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

Information on Lark Bunting abundance and trends is primarily generated from data collected through the North American Breeding Bird Survey (BBS). The BBS is a large-scale survey of bird species breeding across the continental US and Canada. The survey was launched in 1966, with coverage of the Great Plains states and Prairie provinces beginning in 1967 (Environment Canada 2014b).

The BBS is conducted by skilled volunteer observers along randomly selected roadside routes. Each BBS route is 39.2 km long, with 50 stops located at 0.8 km intervals. Observers conduct a 3-minute point count at each stop, recording all birds seen or heard (number and species) within a 0.4 km circle radius of its centre. Routes are surveyed once per year during the height of the breeding bird season; in Canada, surveys are conducted between 28 May and 7 July, with most occurring during the first 3 weeks of June (Environment Canada 2014a).

Abundance estimates from the BBS represent an index of relative abundance, not an absolute count of breeding populations (Sauer *et al*. 2014). In Canada, data are categorized into geographic strata, based on the distribution of Bird Conservation Regions (BCRs) within provinces and territories. For a given species, only strata that have observations from at least three routes, with at least one route surveyed for 5+ years, are included in the analysis (previously, strata were included if they had data on at least three routes and an average of two survey-years per route). The breeding distribution of Lark Bunting in Canada falls within the Prairie Pothole Region (BCR 11). This region represents the northernmost extent of the Great Plains and stretches from the foothills of the Rockies in Alberta to the Red River Valley in Manitoba, north to the boreal forest and south across the US border (Environment Canada 2013).

The global estimate of Lark Bunting population size (Partners In Flight (PIF) Science Committee 2013) was derived from BBS data spanning 2005-2014 (Rosenberg *et al*. 2016). A single estimate was calculated from counts averaged across all years. Indices of abundance were calculated by multiplying average counts per route by the area of the geo-political polygon (i.e., Canada, the US, or both combined) and dividing by the theoretical area covered by each route (25.1 km^2, assuming a radius of 0.4 km around each of the 50 count circles; Blancher *et al*. 2013). Three correction factors were then applied to the indices to yield the population estimates. For pair correction, indices were multiplied by 2 based on the assumption that one member of a breeding pair is generally detected during surveys. For detection area correction, all observations were categorized into distance categories from the centre of the point count (i.e., 80 m, 125 m, 200 m, 400 m and 800 m) and the square of the ratio between the 0.4 km point count radius and the distance class was calculated (to account for area of detection increasing as the square of detection distance). Time of day correction was applied to adjust counts to the maximum time of detection by deriving the ratio of counts at the peak of detection relative to the average count over entire routes (Rich *et al*. 2004). Finally, a Monte Carlo simulation was used to generate a distribution of population size estimates and the mean of the distribution was taken as the point estimate for current population size (Rosenberg *et al*. 2016).

Environment and Climate Change Canada generates BBS trends using a Bayesian hierarchical model, which generally yields more precise estimates than previous approaches (Smith *et al*. 2014). This accounts for sampling error due to variation among observers, routes, and geographic strata, as well as first-year observer effects and annual variation around a long-term trend (Environment Canada 2014a). It also enables missing data to be interpolated based on information from the entire model (Wilson 2014).

Information on abundance and distribution may be less robust from surveys on the periphery of a species' range, where numbers may be low and highly variable. This could be a factor for Lark Bunting BBS data, because the species is at the northern limit of its range in Canada. Another caveat of BBS data is that surveys are conducted along roadsides and may not be representative of population abundance and distribution in habitat located away from roads (Sauer *et al*. 2014).

Lark Bunting behaviour may also affect the reliability of trend estimates based on BBS data. The highly nomadic nature of the species from year to year may lead to alternatively inflated or diminished estimates of population numbers and trends at local or regional scales (Neudorf *et al*. 2006). Focusing on regional or range-wide abundance patterns is one way to minimize this problem (Wilson 2014). Another approach is to examine rolling averages of population trends over time, rather than static comparisons (Smith pers. comm. 2016).

Trends for the US wintering grounds are provided by Christmas Bird Count (CBC) data. The CBC is conducted across continental North America from December 14 to January 5 every year, with parties of volunteers recording birds seen within 24 km diameter non-overlapping circles over a 24-hour period (National Audubon Society 2010).Another source of data for Lark Bunting distribution and abundance is provincial breeding bird atlases. In Alberta, surveys were conducted from 1987 to 1991 and again from 2001 to 2005; while effort between the two periods was not directly comparable, the analysis nonetheless addressed changes over time (Federation of Alberta Naturalists 2007). In Saskatchewan, no formal atlas has been published and a systematic survey effort similar to that in most other provinces is only launching in 2017 (Bird Studies Canada 2017). In Manitoba, there has been only one iteration of a breeding bird atlas, with data collection from 2010 to 2014 (Bird Studies Canada undated)

Abundance

The global estimate of the total breeding population of Lark Bunting is 10 million individuals, but predicted to drop by half over the next 16 years (Rosenberg *et al*. 2016). A previous estimate of 9.1 million individuals identified 160,000 of them (1.8%) as breeding in Canada (PIF Science Committee 2013), derived from BBS data for 1998-2007 (Blancher *et al*. 2013); the Status of Birds in Canada broadly classifies abundance as being within the range of 50,000-500,000 individuals (Government of Canada 2015).

The population estimates assume that habitat is sampled in a representative manner, in approximate proportion to its occurrence in the regional landscape. In addition, the estimates assume that correction factors account for birds that are present but not detected. The pair correction factor may lead to an overestimate if many counts include both members of a pair, or involve unmated birds (Rich *et al*. 2004). Importantly, the estimates above were generated as the population was rapidly declining, so the current population may be substantially smaller.

Fluctuations and Trends

The inter-annual variability in Lark Bunting distribution and abundance present a challenge for calculating population trends for the species. A preliminary analysis of Canadian BBS data suggests that abundance patterns on the Canadian breeding grounds are strongly tied to moisture conditions in the southern part of the species' range. Specifically, in years when the southern part of the breeding range experiences a wet spring, abundance in Canada is as much as 80% lower, irrespective of local weather conditions (Smith pers. comm. 2016).

Lark Bunting numbers have declined across its breeding range (Table 1). From 1970-2015 the species is estimated to have declined by 3.2% per year (95% credible interval: -4.3, -2.3, n = 558 routes) throughout North America, amounting to a cumulative loss of 77% of the population (95% credible interval: 65, 86; Table 1). Even in the central part of its breeding range, Lark Bunting experienced a 5.3% per year decline (95% credible interval: -8.1, -3.5, n = 53 routes) in South Dakota and a 6.5% per year decline (95% credible interval: -9.1, -3.0, n = 30 routes) in Kansas since 1970, translating to cumulative losses of 92% and 95% in these states (Table 1). Within Canada, data for the same period show a decline of 8.6% per year (95% credible interval: -12.2, -5.1, n = 84 routes), for a cumulative loss of 98% (95% credible interval: 91, 100; Table 1; Figure 3). Breeding Bird Survey results from 2005 to 2015 show a considerable contraction in extent of occurrence, compared to longer term data for 1968-2015 (Figure 2).

Table 1. Long- and short-term annual population trends for Lark Bunting based on BBS surveys for its Canadian range and portions of the US range, with 95% lower (LCI) and upper (UCI) credible intervals. Results in bold are statistically significant declines (i.e., the 95% credible interval is below 0 and there is a 99% probability that the population is declining by more than 50% over the specified time period). Selected US trends are presented for jurisdictions adjacent to Canada (Montana and North Dakota) and in the central part of the breeding range (i.e., Wyoming, South Dakota, Nebraska, Kansas and Oklahoma) (Smith pers. comm. 2016).

Region	1970-2015				2005-2015			
	Annual Rate of Change	LCL	UCL	N routes	Annual Rate of Change	LCL	UCL	N routes
Continental	**-3.2**	-4.3	-2.3	558	**-6.1**	-8.6	-3.3	485
All BCR-11 (Canada and US)	**-7.2**	-9.4	-5.2	151	-6.2	-15.4	3.8	133
Canada	**-8.6**	-12.2	-5.1	84	**-14.0**	-24.6	-1.8	70
Alberta	**-9.7**	-15.6	-3.7	41	**-31.1**	-44.9	-17.4	36
Saskatchewan	**-8.5**	-12.3	-4.7	43	-11.5	-23.6	2.7	31
US	**-4.3**	-.5.7	-3.4	454	**-5.4**	-7.9	-2.5	413
Montana	-1.1	-3.3	1.0	50	-4.7	-11.7	2.1	49
North Dakota	**-9.7**	-12.1	-7.6	41	**-15.2**	-24.5	-5.0	38
Wyoming	**-2.7**	-4.3	-0.7	112	2.0	-3.1	9.8	89
South Dakota	**-5.3**	-8.1	-3.5	53	-3.3	-9.1	3.3	50
Nebraska	**-3.6**	-5.9	-1.4	42	-2.3	-8.9	3.2	37
Kansas	**-6.5**	-9.1	-3.0	30	1.6	-7.5	14.5	30
Oklahoma	3.8	-1.2	8.8	10	31.0	9.0	53.4	10

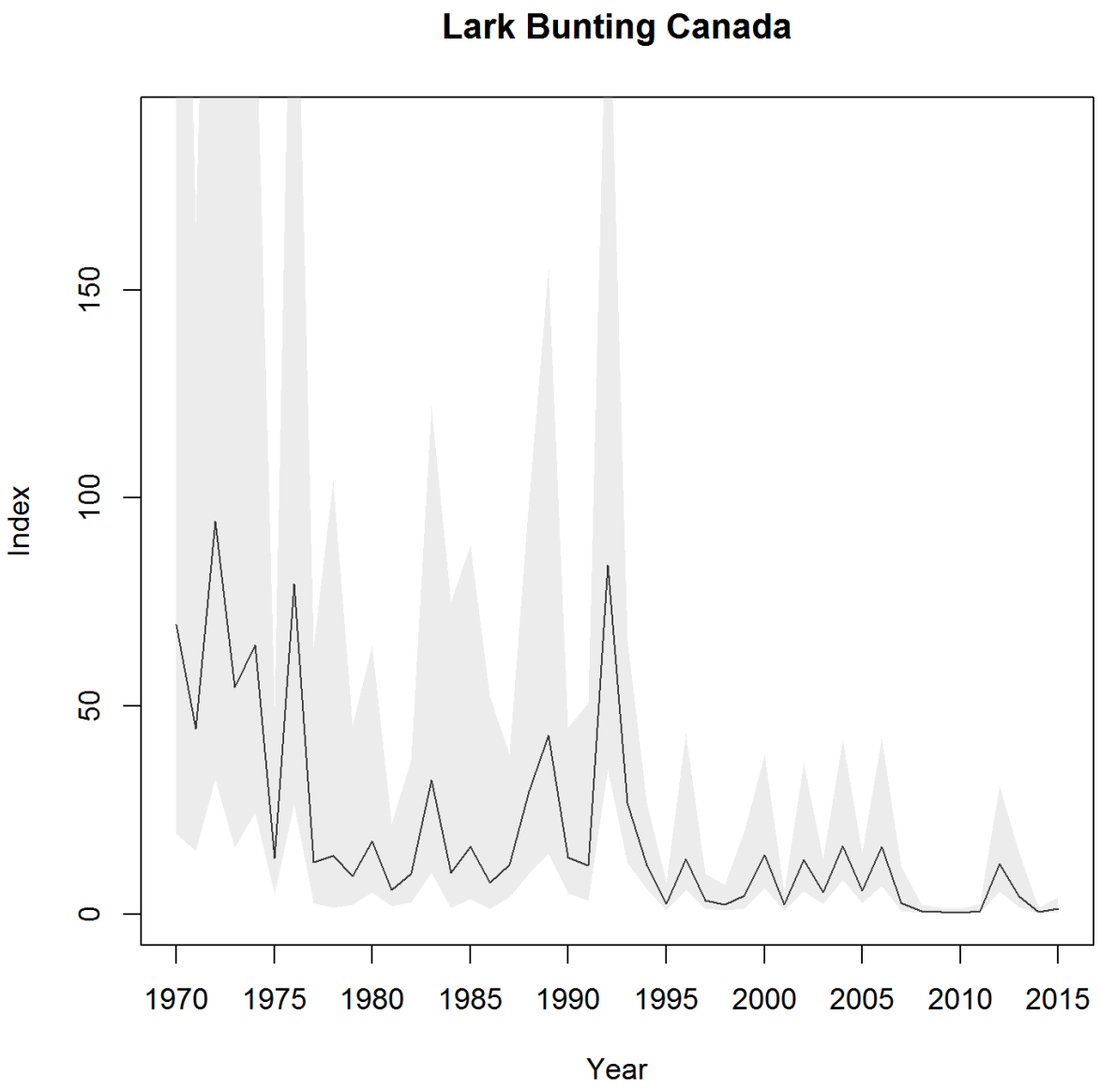

Figure 3. Breeding Bird Survey annual index of abundance for Canada from 1970 to 2015, showing fluctuations overlying the overall long-term decline. Gray shading reflects 95% credible interval around the estimate (ECCC 2017). The indices of abundance represent the expected average number of birds observed during a BBS route, conducted by an average BBS observer within the species' Canadian range.

Population decline has accelerated over the past decade (2005-2015). The North American population has declined at a rate of 6.1% per year (95% credible interval: -8.6, -3.3, n = 485 routes), equating to a cumulative loss of 47% (95% credible interval: 29, 59; Table 1). The rate of change is similar (-6.2% per year) for Bird Conservation Region 11, which includes all of the Canadian range and parts of northern US states (95% credible interval: -15.4, 3.8, n = 133 routes). In the Canadian portion of the range, the rate of decline has been faster, at 14.0% per year (95% credible interval: -24.6, -1.8, n = 70 routes; Table 1), for a cumulative loss of 78% (95% credible interval 16, 94). The reliability of continental trends is considered high for the long-term and moderate for the past ten-years, while for Canadian trends it is low for both time periods, given the smaller sample size and high inter-annual fluctuations in numbers (Smith pers. comm. 2016). Nonetheless, the Canadian declines are sufficiently steep that there is a 100% probability that they are greater than 50% (Smith pers. comm. 2016). Given the short-term fluctuations, the overall change in population size over the past decade is best interpolated from the long-term decline of -8.6% per year, which equates to a ten-year decline of 59%.

While short- and long-term BBS trends are traditionally reported as the percent/year geometric mean rate of change between the start and end years (e.g., 1970 and 2015), population trends derived from a snapshot of two points in time can be misleading, because numbers often vary greatly from year to year due to the irruptive nature of the species. An alternate approach is to examine rolling 10-year trends, in which a data point is plotted for each year, representing the average annual percent change over the previous decade (see Figure 4; Smith pers. comm. 2016). This highlights both the substantial fluctuations that occur, and the overall pattern over time. For example, from 1982 to 1992 the trend was an annual increase of over 20%, yet for 1983 to 1993 the trend was negative. Over the entire 35-year period, most years (69%) have shown a negative 10-year trend, and most of these have been sufficiently large to equate to a cumulative decline of more than 50% over 10 years (71% of years with negative trends). During the last 10 years (2005-2015), there were two data points (representing trends from 2000-2010 and 2004-2014) with the lowest trend overall for the entire 35-year period (approximately -30% per year). While 95% credible intervals for each annual trend estimate are broad, the range of plausible values is primarily strongly negative over most years in the past decade.

CBC data for Lark Bunting wintering in the southern states show a similar declining trend over the 1970-2015 period (Figure 5), providing further evidence of a long-term population reduction for the species.

The second Alberta Breeding Bird Atlas observed a decrease in relative abundance of Lark Buntings compared to the first atlas, and extent of occurrence was somewhat reduced, although these changes were not quantified (Federation of Alberta Naturalists 2007). The Manitoba Breeding Bird Atlas reported possible breeding evidence for Lark Bunting in only three 10 x 10 km squares between 2010 and 2014 (Bird Studies Canada undated). As this is the first atlas for the province, there is no basis for comparison, but historical BBS records indicate that southwestern Manitoba has long been at the fringe of the species' range in Canada (Figure 2).

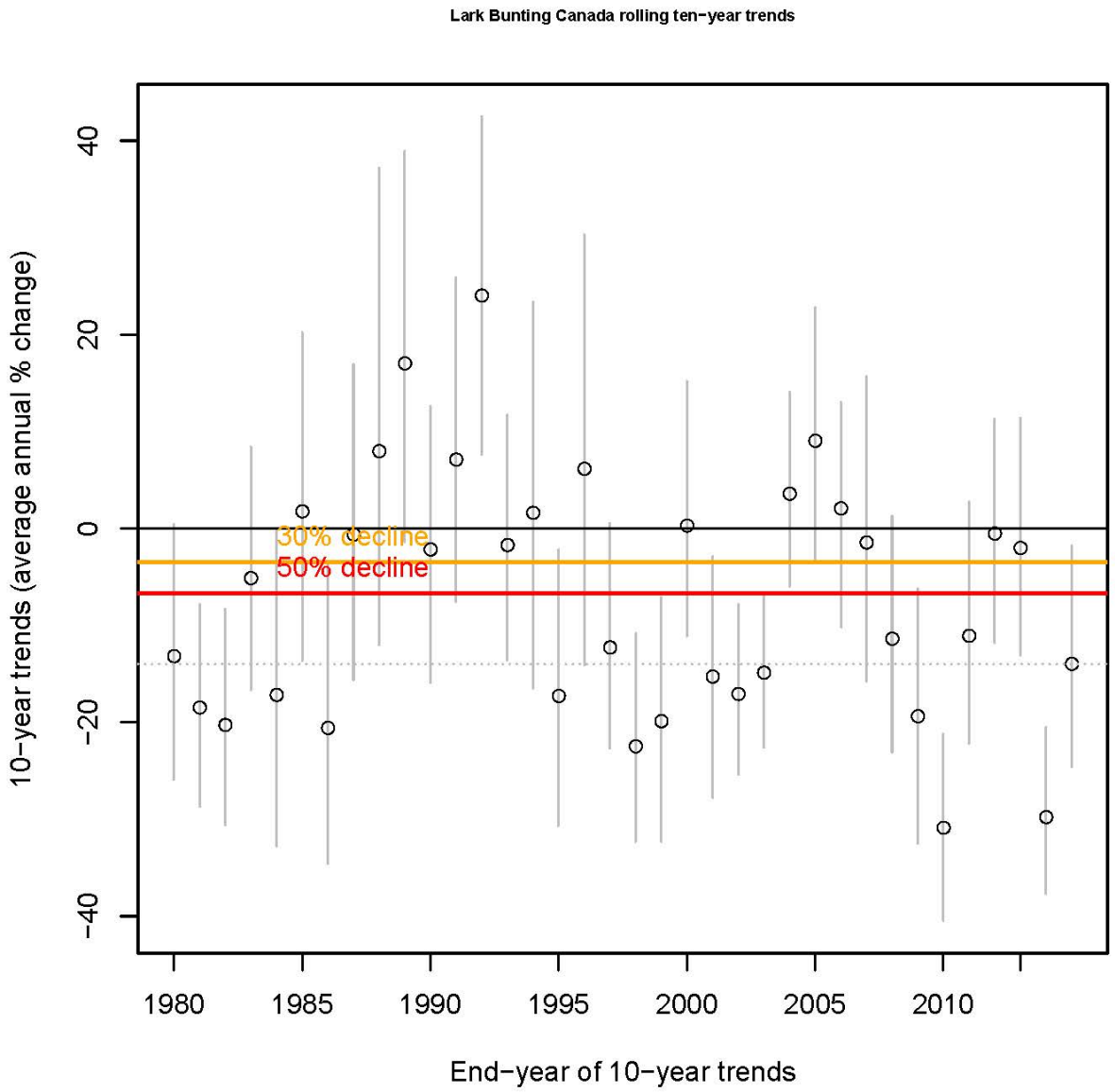

Figure 4. Rolling 10-year trends of Lark Bunting population change in Canada based on BBS data from 1980-2015. Each point represents the average annual rate of change over the previous decade, with bars indicating 95% credible intervals. The orange and red lines indicate annual rates of decline equivalent to 10-year declines of 30% and 50% respectively, while the dotted line represents the annual rate of change estimated for Canada from 2005-2015 BBS data (A. Smith pers. comm. 2016).

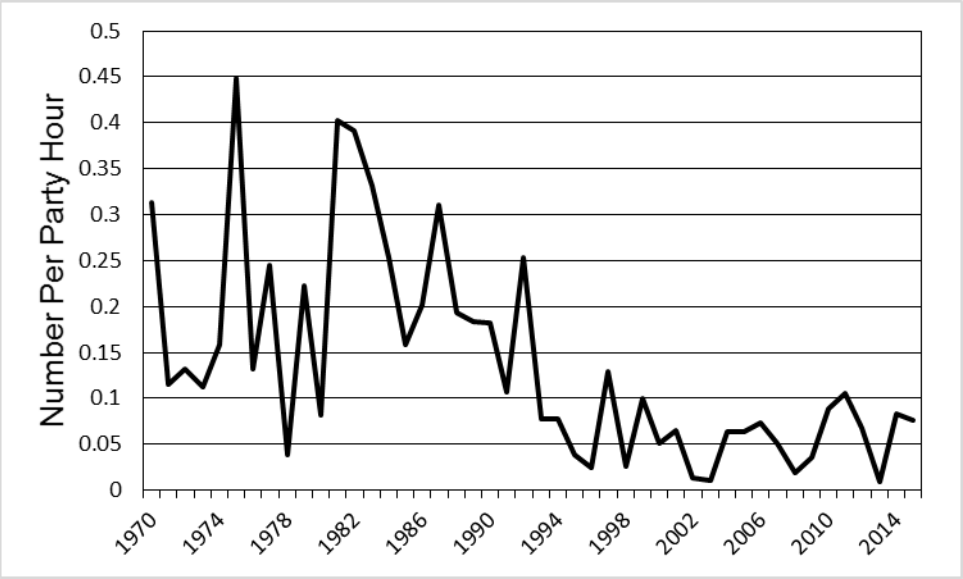

Figure 5. Trends in Lark Bunting observations during the Christmas Bird Count in the southern US from 1970-2015. Counts represent the average of individual counts per party hour for each count circle where the species was recorded (National Audubon Society 2010).

Rescue Effect

Lark Bunting is highly nomadic from year to year, and the Canadian population is continuous with that in the northern US, such that individuals may breed on different sides of the border in consecutive years, depending on conditions. For example, the distribution of Lark Buntings is influenced to a large degree by precipitation patterns, and the position and magnitude of the North Atlantic Oscillation (Skagen and Yackel Adams 2012). As such, individuals from the US are almost certainly emigrating to Canada in some years. However, Lark Bunting populations in US states bordering Canada have also experienced short- and long-term declines, although these are only statistically significant for North Dakota for the 1970-2014 period (Table 1) Therefore, while the US population is likely to provide a source of immigrants, it is ultimately unlikely to rescue the Canadian population, given that it is also declining.

THREATS AND LIMITING FACTORS

Threats

Threats are described below and summarized in Appendix 1 based on a modified version of the IUCN-CMP (World Conservation Union-Conservation Measures Partnership) unified threats classification system (COSEWIC 2014), which resulted in an overall score for Lark Bunting of high to medium. The rate of population decline observed is more consistent with very high to high threats, suggesting that some threats may be inadequately understood or underestimated.

Little is known about threats specific to the Canadian population of Lark Bunting, but they are suspected to be similar to those in the US. Over much of the Great Plains, habitat loss, degradation, and fragmentation due to agriculture, urbanization and oil and gas development are considered the main threats to the species, along with direct and indirect effects of pesticide application (Neudorf *et al*. 2006).

Category 2: Agriculture and aquaculture (high to low threat)

Grassland habitat is one of the most endangered ecosystems in North America. Overall, prairies have declined by approximately 79% across the continent since the early 1800s, with more than 97% of tallgrass, 71% of mixed-grass and 48% of shortgrass habitat lost (Roch and Jaeger 2014). In Canada, it is estimated that more than 70% of the prairie landscape has been degraded or converted since European settlement (North American Bird Conservation Initiative Canada 2012), with much of this occurring prior to the 1930s. Of the remaining native shortgrass and mixed-grass habitat, much is highly fragmented (Roch and Jaeger 2014; Alberta Prairie Conservation Forum 2015; Prairie Conservation Action Plan 2015), and small patches of native prairie face ongoing threats of clearing and alteration for cropland and grazing. Some Lark Buntings nest in agricultural landscapes, but their breeding success may be lower in these habitats. Agricultural practices such as surface tillage, plowing, mowing and pesticide application are known to be detrimental to the species during the nesting period (Neudorf *et al*. 2006). Depending on annual movements, the proportion of individuals exposed to agriculture may range from large to restricted, and the severity of the effects can vary from serious to moderate.

Cattle grazing in shortgrass habitat poses a further threat because it decreases vegetative cover necessary for nest shading, food availability and protection from predators (Finch *et al*. 1987; Skagen and Yackel Adams 2010). In mixed and tallgrass habitat, however, cattle grazing likely has a positive influence on Lark Bunting populations because it maintains the shorter plant height structure preferred by the species (Fontaine *et al*. 2004). Lark Buntings have been noted to drown in stock tanks used to provide water to livestock, although this risk has been little studied (Chilgren 1979). Most Lark Buntings are expected to be exposed to livestock farming and ranching at one or more points in their life cycle, but the severity of effects is considered to be slight overall.

Category 9.5: Air-borne pollutants (medium to low threat)

Agricultural pesticides have been linked to grassland bird declines in the UK and North America (Mineau and Whiteside 2013; Gibbons *et al*. 2015). Mineau and Whiteside (2013) analyzed population trends of 26 grassland bird species (including Lark Bunting) across 45 states in relation to several agricultural variables (e.g., agricultural intensification, loss of cropped pasture, proportion of land treated with herbicides). They found that lethal risk from insecticide use was the best predictor of species decline and cautioned that insecticide toxicity should be considered a major threat to grassland species (Mineau and Whiteside 2013). A review by Gibbons *et al*. (2015) concluded that neonicotinoids may have both direct and indirect effects on a variety of birds. Experimental application of the

insecticide diazinon to control grasshoppers in the US resulted in Lark Bunting mortality (McEwen *et al*. 1972). The chemical is currently permitted for use in the US, but was recently banned in Canada (Health Canada 2013). Widespread spraying of grasshoppers in the Great Plains (type of pesticide unspecified) during late summer represents a potential hazard for Lark Buntings, which rely heavily on this food source during the breeding season (Neudorf *et al*. 2006). While only a restricted portion of the population may regularly be exposed to high pesticide levels, they may experience serious to moderate effects.

Category 1.1: Housing and urban areas (low threat)

Some of the loss of grassland habitat described under Category 2 was for urban development rather than agriculture, and similar considerations apply. Given the limited urban expansion anticipated within the Lark Bunting's Canadian range, this is likely to be a threat mostly in parts of the wintering range, affecting only a small part of the population, but severity is expected to be serious.

Category 3: Energy production and mining (low threat)

In recent decades, oil and gas development on the prairies has expanded significantly. The Grassland Natural Region in Alberta contains over 75,000 well sites, 45,000 km of access roads, and 3000 km of pipelines (Patey LeDrew undated). Specific effects of oil and gas development on Lark Buntings have not been documented, but likely include reduced habitat suitability through both direct changes to vegetation and sensory disturbance. For example, grassland bird species avoided areas within 150 to 267 m of roads and well pads associated with unconventional oil extraction (hydraulic fracturing and horizontal drilling techniques) in North Dakota (Thompson *et al*. 2015). Oil and gas development may also facilitate the spread of invasive weeds, which can alter suitable breeding habitat for grassland birds (Scheiman *et al*. 2003). While the footprint of oil and gas development may not expand much over the next decade, wind and solar farms are increasing in both the breeding and wintering ranges, with potential for causing displacement and mortality of Lark Buntings. Overall though, energy production threats likely affect only a small portion of the population, and are of moderate severity.

Category 4.2: Utility and service lines (low threat)

Power lines provide perches for avian predators and cowbirds, increasing the risk of predation and brood parasitism, especially in treeless areas previously lacking such vantage points (Neudorf *et al*. 2006; Patten *et al*. 2006; Lammers and Collopy 2007). Only a small portion of the population is believed to face this threat, and its severity is considered moderate.

Category 8.2: Problematic native species (low threat)

Nest failure is primarily due to predation (92% of nest failures; Yackel Adams *et al*. 2007). The extended period of parental care and rarity of double brooding in the species are likely adaptations to this strong predation pressure and the low probability of

successfully raising a second brood (Yackel Adams *et al*. 2007). Lark Buntings are also common hosts of Brown-headed Cowbirds, although few cowbirds appear to fledge from their nests (Sealy 1999; Davis and Sealy 2000). While a large percentage of the population faces threats from predation and parasitism, severity is considered slight, given that the species may largely have evolved with these pressures.

Lark Buntings are also preyed upon by domestic and feral cats (Neudorf *et al*. 2006), which are recognized as an important cause of bird mortality worldwide, particularly for bird species that nest or forage on or near the ground (Blancher 2013; Loss *et al*. 2013) However, specific impacts of cat predation on Lark Buntings have not been reported, and are considered at this point to be negligible.

Category 11: Climate change and severe weather (low threat)

Climate change is likely to be primarily a future threat to Lark Bunting, although some effects of droughts, temperatures extremes, and storms and flooding are already occurring. The Great Plains are projected to experience warming temperatures, increased precipitation, and more frequent extreme weather events over the next century. Shortgrass prairie in the US is forecast to warm by up to 6.7°C, with a decrease of as much as 8% in average annual precipitation in the next 100 years (Landscope America 2015). The Canadian prairies are expected to experience average temperature increases of 2-3°C, with decreased precipitation and more intense storms predicted for summer months (Sauchyn *et al*. 2009; Agriculture and Agri-Food Canada 2015).

Lark Buntings are vulnerable to heavy precipitation events on the breeding grounds (Pleszczynska 1978; Skagen and Yackel Adams 2012). Large precipitation events (>10 mm) depress nest survival, and could decrease foraging success of adults and the thermoregulatory ability of eggs and nestlings. Flooding from storms could also wash away nests and result in direct mortality of adults and chicks (Skagen and Yackel Adams 2012). On the wintering grounds, the availability of seeds (which are a major component of Lark Bunting diet during the non-breeding season) is highly dependent on rainfall (Neudorf *et al.* 2006).

Conversely, Lark Buntings typically have decreased clutch size, nest survival, and post-fledging survival during years with severe drought. Lark Buntings are highly vulnerable to drought conditions, when some grasshopper species decline (Fowler *et al*. 1991; George *et al*. 1992; Hawkins *et al*. 1998; Yackel Adams *et al*. 2006), although others increase (Lenhart *et al*. 2015; Johnson pers. comm.). Lark Buntings experience reduced recruitment during droughts, and competition with other grassland bird species may intensify during these times (Neudorf *et al*. 2006; Yackel Adams *et al*. 2006). Elevated temperatures also lead to reduced clutch size (Skagen and Yackel Adams 2012). More frequent and intense droughts could reduce chick survival by causing increased starvation, exposure, and predation (Yackel Adams *et al*. 2006).

In Alberta, climate change is predicted to increase suitable habitat for Lark Bunting by 23%. However, concurrent intensification of agricultural practices and changes in land use would likely negate any gains in habitat (Nixon *et al*. 2015). In the short term, a large proportion of the Canadian Lark Bunting population is likely to be affected by droughts and temperature extremes, and a small percentage by storms and flooding, but the severity is considered to be slight for all of these threats at this time.

Limiting Factors

Avoidance of thermal stress appears to strongly influence nest-site selection in Lark Buntings (With and Webb 1993). Vegetative cover is an important determinant of nest survival in Lark Buntings, with higher shading leading to higher reproductive success. Males with territories in areas with more cover attract more females (Pleszczynska 1978). The amount of shading declines over the course of the breeding season, and early nests tend to be more successful than those laid later in the season (Pleszynska and Hansell 1980). Vegetation structure may also inhibit predators, such as Thirteen-lined Ground Squirrels, which are less abundant in tallgrass (>25 cm) habitat in Colorado (Skagen and Yackel Adams 2010). Food availability is also a key factor limiting breeding success and survival, with nest initiation typically associated with a peak in grasshopper abundance (Neudorf *et al*. 2006).

Number of Locations

Most of the threats to Lark Bunting are widespread across its range. The broad distribution of Lark Bunting, combined with its excellent dispersal abilities and its highly nomadic behaviour, makes it difficult to determine the number of discrete locations in Canada, but it is very likely greater than ten.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

Lark Buntings are protected under the federal *Migratory Birds Convention Act (1994)* in Canada, under the federal *Migratory Bird Treaty Act* in the US and under the Convention for the Protection of Migratory Birds and Game Mammals in Mexico. Lark Buntings also receive provincial protection, under the *Alberta Wildlife Act*, the *Saskatchewan Wildlife Act*, and the *Manitoba Wildlife Act*. However, none of the preceding legislation has specific provisions for habitat protection.

Non-Legal Status and Ranks

The Lark Bunting's global status under the IUCN Red List is Least Concern. The species has a global (G) rank of G5 (secure) because it is widespread and apparently secure on the Great Plains, although some regional declines have been recorded (NatureServe 2015). In the US it is ranked as N5B (secure on the breeding grounds

because it is common, widespread, and abundant) and N5N (secure on the non-breeding grounds because it is common and widespread). In Canada it is ranked as N4N5B (apparently secure to secure on the breeding grounds), reflecting some uncertainty about its status. Apparently secure means that it is uncommon but not rare, and that there is cause for long-term concern because of declines or other factors. Lark Bunting is ranked as S4 in Alberta (apparently secure), S4S5B in Saskatchewan (apparently secure to secure) and S1B in Manitoba (critically imperilled because of extreme rarity or because factors make it extremely vulnerable to extirpation, such as steep declines). Lark Bunting is unranked (SNRB) in North Dakota and ranked as secure (S4B) in Montana, the two US states adjacent to its Canadian range (NatureServe 2015).

Lark Bunting is considered a species of continental importance under the Partners in Flight North American Landbird Conservation Plan (Rosenberg *et al.* 2016). Lark Bunting has previously been identified as a stewardship species because a high proportion of its global population (~95 % of the breeding population and 31% of the winter population) is found in a single biome (the Prairie Avifaunal Biome) and because it is a common bird in steep decline (Partners in Flight Science Committee 2013). In North Dakota, Lark Bunting is designated as a Level I species of conservation priority, indicating that it is in decline either in the state or across its range or that it has a high rate of occurrence in the state but is at risk range-wide (Dyke *et al*. 2015).

Habitat Protection and Ownership

Lark Buntings are known to breed in Grasslands National Park, Saskatchewan (Nantel, pers. comm. 2016). They have also been recorded breeding on Canadian Forces Base Suffield, Alberta (McDonald, pers. comm. 2016), a 2700 km^2 area representing one of the largest native grasslands remaining on the Canadian prairies. The Suffield National Wildlife Area (NWA) is a 458 km^2 refuge within the Suffield Base that is protected from military training activities and public access for the purpose of conserving prairie habitat and wildlife. However, approximately 79% of Canadian prairie habitat is privately owned (Riley *et al.* 2007).

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BIOGRAPHICAL SUMMARY OF REPORT WRITER(S)

Dr. Andrea Smith is a senior scientist with Hutchinson Environmental Sciences Ltd., based in Bracebridge Ontario. She obtained her M. Sc. in conservation biology and her Ph.D. in evolutionary ecology, both at Queen's University. Andrea's graduate work focused on habitat use of migratory birds in agricultural landscapes of Mexico (M. Sc.) and phylogeography and speciation of seabirds (Ph. D.). Andrea has worked on a variety of research projects relating to species at risk, invasive species, and environmental impact assessment. She has prepared four previous COSEWIC status reports (two on marine fish species, one on a freshwater fish and one on an arctic shorebird), and has also developed a prioritized list of crustacean species potentially at risk in Canada for COSEWIC. Andrea's research interests include documenting the interactive effects of multiple stressors on biodiversity, and applying conservation science to develop policy.

COLLECTIONS EXAMINED

No collections were examined for this report.

Appendix 1. Threats Assessment Worksheet for Lark Bunting

Species or Ecosystem Scientific Name	Lark Bunting, Calamospiza melanocorys
Element ID	**Elcode**
Date (Ctrl + ";" for today's date):	09/06/2016
Assessor(s):	Andrea Smith, Marcel Gahbauer, Jon McCracken, Joanna James, Kristiina Ovaska, Gord Court, Jeff Keith, Bill Watkins, Ken De Smet, Louise Blight, Scott Wilson, Susan Skagen, Kim Borg
References:	COSEWIC draft report

Overall Threat Impact Calculation Help:		**Level 1 Threat Impact Counts**	
Threat Impact		**high range**	**low range**
A	Very High	0	0
B	High	1	0
C	Medium	1	0
D	Low	5	7
Calculated Overall Threat Impact:		High	Medium

Assigned Overall Threat Impact:	**BC = High - Medium**
Impact Adjustment Reasons:	
Overall Threat Comments	

Threat		**Impact (calculated)**		**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
1	Residential & commercial development	D	Low	Small (1-10%)	Serious (31-70%)	High (Continuing)	
1.1	Housing & urban areas	D	Low	Small (1-10%)	Serious (31-70%)	High (Continuing)	Most likely a threat in wintering areas (primarily northern Mexico and southern Texas), where some habitat loss and fragmentation due to urbanization may affect wintering birds, presumably including some Canadian birds. Scope is small, because habitat conversion in wintering range has more to do with agricultural expansion. General consensus that severity is serious, although specific data are not available.
1.2	Commercial & industrial areas		Negligible	Negligible (<1%)	Serious (31-70%)	High (Continuing)	Footprint is negligible, but severity would be comparable to residential/urban expansion.
1.3	Tourism & recreation areas						
2	Agriculture & aquaculture	BD	High - Low	Large - Restricted (11-70%)	Serious - Moderate (11-70%)	High (Continuing)	*NOTE: Scope does not take into account threat 2.3 but it would add very little to the scores because severity is slight.*

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
2.1	Annual & perennial non-timber crops	BD	High - Low	Large - Restricted (11-70%)	Serious - Moderate (11-70%)	High (Continuing)	Agricultural conversion has historically been extensive, but no longer occurring much in Canada, where much of the land is still in ranching and will most likely stay that way over the next decade. On wintering grounds in northern Mexico, 6%/year is being cleared for groundwater-irrigated agriculture, but there is some uncertainty as to the exact location of wintering areas, and the species uses more than just grassland habitats. Impacts are from habitat loss, fragmentation and degradation due to conversion to cropland; the scope and severity both span wide ranges because of the uncertainty associated with Lark Buntings being nomadic and perhaps able to compensate for change to some extent. There is potential for cumulative affects of agricultural conversion and climate change.
2.2	Wood & pulp plantations						
2.3	Livestock farming & ranching	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	Risk of trampling of nests and young, drowning of adults in stock tanks, and especially loss of habitat due to overgrazing. Some level of grazing occurs throughout the range, and habitats with grazing are used for some parts of life cycle, therefore most individuals are likely exposed to these threats. Severity depends on how land is managed; moderate grazing is beneficial, but overall balance is negative.
2.4	Marine & freshwater aquaculture						
3	Energy production & mining	D	Low	Small (1-10%)	Moderate (11-30%)	High (Continuing)	
3.1	Oil & gas drilling	D	Low	Small (1-10%)	Moderate (11-30%)	High (Continuing)	Drilling is widespread in southern Alberta and Saskatchewan, as well as parts of the wintering range, and results in some habitat loss and fragmentation. Lark Buntings may avoid some of these areas, but where they do occur near them, nest and adult survival may be reduced if infrastructure provides novel perches for predators such as raptors and ravens. Severity takes into consideration the high well density in some areas and negative effects of associated roads.
3.2	Mining & quarrying						
3.3	Renewable energy	D	Low	Small (1-10%)	Moderate (11-30%)	High (Continuing)	Wind farms and solar farms are increasing in both the breeding and wintering ranges. There is potential for more direct mortality from wind farms than solar farms, although evidence to date is limited. The footprint of habitat loss is probably similar to 3.1.
4	Transportation & service corridors	D	Low	Small (1-10%)	Moderate (11-30%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
4.1	Roads & railroads		Negligible	Pervasive (71-100%)	Negligible (<1%)	High (Continuing)	Most individuals are likely to be exposed to roads at some point in their life cycle, and this species often perches along rural roads. However, road mortality not documented to be a particular issue for this species, and fences and grit associated with roads may be beneficial, therefore severity overall is considered negligible.
4.2	Utility & service lines	D	Low	Small (1-10%)	Moderate (11-30%)	High (Continuing)	A relatively small portion of the population is near utility and service lines, but those individuals may be exposed to increased risk of predation and parasitism from raptors and cowbirds using the lines as perches.
4.3	Shipping lanes						
4.4	Flight paths						
5	Biological resource use						
5.1	Hunting & collecting terrestrial animals						
5.2	Gathering terrestrial plants						
5.3	Logging & wood harvesting						
5.4	Fishing & harvesting aquatic resources						
6	Human intrusions & disturbance		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	
6.1	Recreational activities		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	Some off-road vehicle use occurs within the range, but this is not a big issue for this species. Recreational shooting occurs in the US, but is of very small scope/severity.
6.2	War, civil unrest & military exercises		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	CFB Suffield in Alberta is within the Canadian breeding range, but includes a national wildlife area, which is largely protected from disturbance.
6.3	Work & other activities						
7	Natural system modifications						
7.1	Fire & fire suppression						
7.2	Dams & water management/use						
7.3	Other ecosystem modifications						
8	Invasive & other problematic species & genes	D	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
8.1	Invasive non-native/alien species		Negligible	Restricted (11-30%)	Negligible (<1%)	High (Continuing)	Lark Buntings appear to focus more on habitat structure than plant species, therefore the relatively widespread presence of non-native grasses is likely a minor concern overall. Only monocultures (e.g., cheat grass) may deter use for nesting. Feral cats are predators in some areas; while specific data on Lark Bunting predation are not available, the terrestrial nature of the species and overall knowledge of cat predation pressure suggest a potential effect on the population, though severity is likely negligible.
8.2	Problematic native species	D	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	Lark Buntings are frequent hosts to Brown-headed Cowbirds; cowbird numbers have remained relatively stable within Lark Bunting range over the past decade, and likely have an ongoing effect on the population, especially in fragmented habitats. Taller grasses around oil platforms may support more snake predators, but the scope and severity of their impact are likely both negligible.
8.3	Introduced genetic material						
9	Pollution	CD	Medium - Low	Restricted (11-30%)	Serious - Moderate (11-70%)	High (Continuing)	
9.1	Household sewage & urban waste water						
9.2	Industrial & military effluents						
9.3	Agricultural & forestry effluents						
9.4	Garbage & solid waste						
9.5	Air-borne pollutants	CD	Medium - Low	Restricted (11-30%)	Serious - Moderate (11-70%)	High (Continuing)	Birds may be exposed when adjacent to crop lands during both breeding and wintering. Diazinon for grasshopper control leads to decline in abundance and mortality in Lark Bunting, but its use is restricted in Canada and banned by the end of 2016. Research is needed to ascertain what effects pesticides used in Mexico could have on Lark Buntings.
9.6	Excess energy						
10	Geological events						
10.1	Volcanoes						
10.2	Earthquakes/tsunamis						
10.3	Avalanches/landslides						
11	Climate change & severe weather	D	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
11.1	Habitat shifting & alteration						Climate change could result in a 23% increase in potential range in Alberta over the long term, but much less within the next 10 years; habitat fragmentation (due to increased agricultural production) may decrease potential for exploitation of the increase by the birds.
11.2	Droughts	D	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	Alberta and Saskatchewan are already experiencing increased droughts, and more are predicted, although likelihood of prolonged annual droughts over the next 10 years is low. Drought can reduce fledgling survival by increasing starvation, exposure and predation, and also leads to decreased clutch size; however, drier conditions may be preferable to too wet, and dry-wet cycles are normal in this habitat. Multi-year, prolonged droughts would be a problem. While Lark Buntings are nomadic and may select breeding grounds based on current conditions, drought conditions that arise after a breeding site has been selected can have an impact, as per above. Effects on wintering grounds on food production unknown. Drought has potential to have a large effecton Lark Buntings over the long term (over more than 10 year period).
11.3	Temperature extremes	D	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	Considerations similar to 11.2, and temperature increases and droughts go hand-in-hand. Higher temperatures can lead to reduced clutch size.
11.4	Storms & flooding	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	Large precipitation events can reduce nest survival by reducing foraging success of adults, by compromising thermoregulation of eggs and nestlings and by washing out nests. They can also cause direct mortaility of adults or chicks via hail. Storms may increase with climate change, but are likely of small scope over the next 10 years.

Classification of Threats adopted from IUCN-CMP, Salafsky et al. (2008).