COSEWIC
Assessment and Status Report

on the

Streaked Horned Lark
Eremophila alpestris strigata

in Canada

ENDANGERED
2018

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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Previous report(s):

COSEWIC 2003. COSEWIC assessment and update status report on the Horned Lark s*trigata* subspecies *Eremophila alpestris strigata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 23 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

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Streaked Horned Lark — Photo by Randall Moore.

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COSEWIC
Assessment Summary

Assessment Summary – April 2018

Common name
Streaked Horned Lark

Scientific name
Eremophila alpestris strigata

Status
Endangered

Reason for designation
This songbird is restricted to the Pacific coastal plains of western North America and is globally at risk. It is dependent on open natural or anthropogenically-modified, sparsely-vegetated grasslands or other areas with bare ground. It was last confirmed breeding in Canada in 1978, with the most recent indications of potential breeding in 2002; the current Canadian population is likely zero. However, the subspecies breeds in Washington State and small patches of potentially suitable habitat remain on Vancouver Island and in the lower Fraser River Valley in British Columbia, although these continue to decline in both extent and quality. The primary threats to this subspecies in Canada are habitat loss and degradation due to urban development, intensified agricultural practices, invasive plant incursions, coastline management activities and recreational disturbance.

Occurrence
British Columbia

Status history
Designated Endangered in November 2003. Status re-examined and confirmed in April 2018.

COSEWIC
Executive Summary

Streaked Horned Lark
Eremophila alpestris strigata

Wildlife Species Description and Significance

Horned Lark *strigata* subspecies (*Eremophila alpestris strigata*), more commonly known as Streaked Horned Lark, is the rarest subspecies of Horned Lark in Canada. It is a small, brown, yellow, and white bird with a distinctive black facial mask and black headband, which extends in the male into tiny feather tufts or 'horns'. Streaked Horned Lark is smaller than other subspecies, with noticeably yellower underparts and a darker brown back.

Distribution

Streaked Horned Lark occurs only in the Pacific coastal plains of southwestern British Columbia, Washington and Oregon. In British Columbia, its historical distribution is restricted to southeastern Vancouver Island, the Gulf Islands, and the lower Fraser River valley from the mouth of the Fraser River east to Chilliwack.

Habitat

Streaked Horned Lark occurs in open short-grass habitats and areas with bare ground. In British Columbia, suitable sites are from sea level to 10 m elevation, and may include natural areas such as coastal spits, estuaries, sand dunes, and Garry Oak ecosystems, as well as anthropogenically modified areas such as pastures, airports, playing fields, and roadsides.

Biology

Streaked Horned Lark nests on the ground where its clutch of three to five eggs is placed next to a tuft of vegetation or small object. The breeding season in British Columbia is from early April to late August. It feeds primarily on seeds during non-breeding seasons but in spring and summer also consumes invertebrates, which are a food source for nestlings. British Columbia birds typically migrated south to Washington and Oregon for the winter, but a few may have overwintered in British Columbia in some years. Horned Larks are known to tolerate grazing and irregular operation of machines, but tend to nest away from urban landscapes and may suffer nest destruction from mowing or other vehicular traffic.

Population Sizes and Trends

The Canadian breeding population is currently estimated to be zero birds. Streaked Horned Lark was never known to be abundant in British Columbia. It may historically have been most numerous when there were larger areas of grassland on southern Vancouver Island and the lower mainland prior to the cessation of First Nations agricultural burning; more recently, populations may have peaked again in the 1920s and 1930s in response to an increase in farmland habitat, then declined through the 1970s. The last definite breeding record in Canada was in 1978, and since 1981, there has been only one record of a potentially breeding bird, in 2002. The present global population, all in the United States, is estimated at <2000 birds, and declining due to both poor fecundity and low adult survival. Low fecundity is believed to be the result of low egg hatchability and fledging success, high clutch depredation, and long intervals between failed nests and re-nests.

Threats and Limiting Factors

The primary threat to this subspecies is the loss and degradation of suitable breeding habitat. These habitats have become increasingly developed for human activities such as housing, recreation, agriculture and light industry. Continuing development pressures will likely fragment and isolate most remaining habitat. Small areas of natural habitat have had increased recreational pressure (e.g., dog-walking), which is not compatible with successful ground nesting by birds such as Horned Larks. The invasion of agronomic grasses and introduced shrubs on sand spits and beaches has reduced or eliminated habitat.

Improved diking of the Fraser delta has reduced the amount of sparsely vegetated sandy shoreline along the edges of the Fraser River. Invasions of exotic plants have rendered much of the remaining field, Garry Oak and sand dune ecosystems unsuitable to Streaked Horned Lark. Increasing predation pressure from domestic cats and wildlife associated with urban areas, incompatible mowing and harvesting regimes, and increasing recreational use of open spaces likely affect habitat suitability.

Populations in Washington and Oregon have also been declining, though the most recent surveys in Washington (2010-2015) suggest the small population there may presently be stable. However, this population consists of only about 150 pairs. It is unlikely to be a source of dispersing birds to re-establish a breeding population in British Columbia.

Protection, Status and Ranks

Streaked Horned Lark is listed as Endangered on Schedule 1 of the *Species at Risk Act*, and protected from persecution by the *Migratory Bird Convention Act*, 1994, and the *British Columbia Wildlife Act.* It is also listed as Threatened under the US federal *Endangered Species Act*, and as Endangered in Washington State. A few historical Canadian breeding sites are protected within regional and federal parks.

TECHNICAL SUMMARY

Eremophila alpestris strigata

Streaked Horned Lark

Alouette hausse-col de la sous-espèce *strigata*

Range of occurrence in Canada (province/territory/ocean): British Columbia

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)	Assumed to be 2-3 years, as for many passerines.
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	No (because estimated to be zero over last ten years)
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	n/a
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	n/a
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	n/a
[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.	n/a
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	a. No b. Yes c. No
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence	0 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value).	0 km²
Is the population “severely fragmented” i.e., is >50% of its total area of occupancy is 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. n/a (IAO of 0 km²) b. No, within dispersing distance of US population
Number of “locations” (use plausible range to reflect uncertainty if appropriate)	0

Is there an [observed, inferred, or projected] decline in extent of occurrence?	n/a
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	n/a
Is there an [observed, inferred, or projected] decline in number of subpopulations?	n/a
Is there an [observed, inferred, or projected] decline in number of “locations”?	n/a
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat?	Yes, inferred
Are there extreme fluctuations in number of subpopulations?	No
Are there extreme fluctuations in number of “locations”?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each subpopulation)

Subpopulations (give plausible ranges)	**N Mature Individuals**
Total	0

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	Not done, but population already likely at 0 breeding birds in Canada.

Threats (actual or imminent, to populations or habitats, from highest impact to least)

No threats calculator call was completed, because there is currently no known population on which threats could act. However, threats historically and theoretically relevant to the species include:

i. Residential and commercial development (IUCN Category 1), threatening remaining potential habitat

ii. Natural system modifications (IUCN Category 7), specifically control of water flow in the Fraser delta, allowing shorelines to become more vegetated

iii. Agriculture and agriculture (IUCN Category 2), through disturbance or destruction of nests and use of pesticides

iv. Invasive and other problematic species and genes (IUCN Category 8), in particular invasive plants colonizing open habitats, and increasing predation pressure

v. Human intrusions and disturbance (IUCN Category 6), both from recreational activities and maintenance regimes at airports

vi. Transportation and service corridors (IUCN Category 4), primarily through collisions with aircraft

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	Declining. S1B (critically imperilled in Washington) and S2B (imperilled) in Oregon.

Is immigration known or possible?	Possible, but at present unlikely for a sufficient number of individuals to reestablish a breeding population in Canada. US population is contracting southwards. However, considerable recovery efforts are being undertaken for this subspecies in the US.
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Unknown
Are conditions deteriorating in Canada?	Yes
Are conditions for the source population deteriorating?	Yes
Is the Canadian population considered to be a sink?	Unknown
Is rescue from outside populations likely?	No

Data Sensitive Species

Is this a data sensitive species? No

Status History

COSEWIC: Designated Endangered in November 2003. Status re-examined and confirmed in April 2018.

Status and Reasons for Designation:

Status: Endangered	Alpha-numeric codes: B1ab(iii)+2ab(iii); D1
Reasons for designation: This songbird is restricted to the Pacific coastal plains of western North America and is globally at risk. It is dependent on open natural or anthropogenically-modified, sparsely-vegetated grasslands or other areas with bare ground. It was last confirmed breeding in Canada in 1978, with the most recent indications of potential breeding in 2002; the current Canadian population is likely zero. However, the subspecies breeds in Washington State and small patches of potentially suitable habitat remain on Vancouver Island and in the lower Fraser River Valley in British Columbia, although these continue to decline in both extent and quality. The primary threats to this subspecies in Canada are habitat loss and degradation due to urban development, intensified agricultural practices, invasive plant incursions, coastline management activities and recreational disturbance.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. Total number of mature individuals has remained zero over the past ten years.
Criterion B (Small Distribution Range and Decline or Fluctuation): Meets criteria for Endangered, B1ab(iii) and B2ab(iii), as the EOO and IAO are well below thresholds, there are fewer than 5 locations, and there is a continued inferred decline in extent and quality of habitat.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. Total number of mature individuals has remained zero over the past ten years.

Criterion D (Very Small or Restricted Population): Meets criteria for Endangered, D1, as the population of zero mature individuals is well below the threshold.
Criterion E (Quantitative Analysis): Analysis not conducted.

PREFACE

At the time of the previous status report in 2003, the Canadian population of Streaked Horned Lark was estimated at between one and five birds, in part based on observations of one singing male during grassland surveys on southeast Vancouver Island in 2002. The Canadian population is now estimated to be zero. Targeted surveys for this species have been conducted periodically since 2002, in addition to targeted surveys for Coastal Vesper Sparrow (*Pooecetes gramineus affinis*) that were designed to incidentally record Streaked Horned Lark. Since the 2002 record, no Streaked Horned Larks exhibiting breeding behaviour have been observed within their historical range in Canada.

Considerable work has occurred on Streaked Horned Lark over its US range since 2003, both in terms of its basic biology and on efforts to increase survival and breeding success and restore nesting habitat. This work is described in detail in some of the references cited in this status report (e.g., Camfield *et al*. 2011; Pearson *et al*. 2012, 2016; Wolf and Anderson 2014; Anderson and Pearson 2015; Keren and Pearson 2016; Stinson 2016).

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 (2018)

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
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Canada

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

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TABLE OF CONTENTS

List of Figures

WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Horned Lark (*Eremophila alpestris*) is the only native North American representative of the lark family Alaudidae (though Eurasian Skylark *Alauda arvensis* has a small introduced population on Vancouver Island, and occurs as a vagrant in Alaska, coastal British Columbia, Washington, and California). Twenty-one subspecies of Horned Lark are recognized in North America, including eight in Canada (American Ornithologists' Union 1957, Beason 1995). Four subspecies occur in British Columbia, one as a passage migrant and three as breeders. Among the breeders, Streaked Horned Lark (*E. a. strigata*) has the most restricted distribution (Campbell *et al*. 1997; Cannings 1998), while Pallid Horned Lark (*E. a. articola*) breeds in the alpine areas of most of British Columbia's higher mountain ranges and Dusky Horned Lark (*E. a. merrilli*) occupies open grasslands of the province's interior valleys (Davidson and Mahoney 2015).

Morphological Description

Horned Lark is a slender, long-winged passerine. The beak is relatively short; the square tail largely black with white edges evident in flight. Adults are marked with a dark facial mask and breast band that contrasts with the pale face and throat; these features are especially clear and distinctive in adult males. The 'horns' for which the species is named are tiny, black feather tufts on the sides of the head in adult males. Adult females are similar to males, but duller, smaller, and lack horns.

Streaked Horned Lark has dark brown upperparts with a walnut brown nape. It has a yellow throat and eye stripe and yellowish underparts (Beason 1995). It is smaller than other Horned Lark subspecies occurring in British Columbia (e.g., mean mass of 26.9 g (female) and 28.6 g (male) vs. 30.5 g (f) and 30.0 g (m) for *merrilli* and 37.3 g (f) and 37.0 g (m) for *articola*; Beason 1995; Camfield *et al*. 2010) and has noticeably yellower underparts and a darker brown back than most other Horned Larks; this combination of traits is distinctive within the range of this taxon (Washington Fish and Wildlife Office no date). There is heavy, dark brown streaking on sides of the breast that allow separation of this subspecies in the field, at least in the breeding season (Sibley 2014). In the hand, the longest upper tail covert is distinctly streaked (Pyle 1997). Females cannot be separated to subspecies in the field. Juveniles have a very different plumage, being generally brown above, heavily spotted with white (Sibley 2014).

Population Spatial Structure and Variability

Drovetski *et al*. (2005) evaluated genetic diversity of Streaked Horned Lark using the complete mitochondrial ND2 gene. They sampled 32 individuals and compared them to 68 Horned Larks from Alaska, alpine and eastern Washington, Oregon, California, and Asia. Their Maximum Likelihood analysis of 32 haplotypes identified three geographically localized clades: Pacific Northwest (alpine and eastern Washington; Alaska), Pacific Coast (western Washington; San Joaquin Valley, California), and Great Basin (eastern Oregon).

The first clade corresponds to the other two subspecies breeding in British Columbia (*E. a. articola* and *E. a. merrilli*). The Pacific Coast clade was composed of all *strigata* specimens, 17 of 19 California birds, and one bird from eastern Washington. Each of the three clades was supported by bootstrap values ≥86%. The *strigata* subspecies samples were closely related to those from California, but nonetheless appeared to be unique and isolated. All pairwise F_{st} values with the *strigata* samples were significant (except within this group). Drovetski *et al*. (2005) concluded that Streaked Horned Lark populations were "unique and isolated", with "remarkably low genetic diversity". Mason *et al*. (2014) confirmed that Streaked Horned Lark is well-differentiated from other subspecies.

Designatable Units

Based on its appearance (smaller size, distinctive plumage), isolated breeding grounds, breeding range, and genetics (see above), Streaked Horned Lark is a valid designatable unit.

Special Significance

Streaked Horned Lark subspecies is one of a suite of taxa restricted in Canada to declining savanna and grassland areas on the southern coast of British Columbia; many of these taxa such as Coastal Vesper Sparrow (*Pooecetes gramineus affinis*) are listed under the *Species at Risk Act*.

DISTRIBUTION

Global Range

Horned Lark is found across much of North America and Eurasia. The historical breeding distribution of Streaked Horned Lark is restricted to the coastal lowlands of southern British Columbia, Washington and Oregon (Beason 1995; Figure 1). The current breeding distribution of this subspecies is now restricted to the Willamette Valley of Oregon, dredged material islands of the Columbia River, and coastal beaches and Puget Sound grasslands of southern Washington (Altman 2011; Wolf and Anderson 2014; Anderson and Pearson 2015). The subspecies is partially migratory to non-migratory, with winter records outside the breeding range in eastern Washington and Oregon and northern California (American Ornithologists' Union 1957; Pearson and Altman 2005; Pearson *et al*. 2005; see **Dispersal and Migration**, below).

Figure 1: Streaked Horned Lark (Randall Moore).

Canadian Range

Streaked Horned Lark in Canada has been historically restricted to southwestern British Columbia (Godfrey 1986; Campbell *et al*. 1997; Figure 2). In the lower Fraser River valley, breeding was concentrated near the mouth of the Fraser River on Sea, Iona, and Lulu islands, with other known breeding localities including the University of British Columbia at Point Grey, and Chilliwack (Campbell *et al*. 1997; Cooper pers. comm. 2017). On Vancouver Island, birds were known to occur locally around Comox and Victoria (Munro and Cowan 1947); additional historical records from Vancouver Island naturalists have recently been found and entered into eBird and document previous breeding near Victoria and on Sidney Island, and the occurrence of a pair during the breeding season at the Victoria airport (Briggs 1959, 1972; Poynter 1959; Fraser pers. comm. 2017). In addition, the species is reported to have bred previously on Salt Spring Island at what is now known as Ruckle Provincial Park (Fraser pers. comm. 2017). It is therefore likely that this subspecies bred more widely on Vancouver Island in the past, when suitable habitat was more widely available. Territorial behaviour (a singing male) was most recently observed at the Nanaimo Airport in 2002 (Beauchesne 2002).

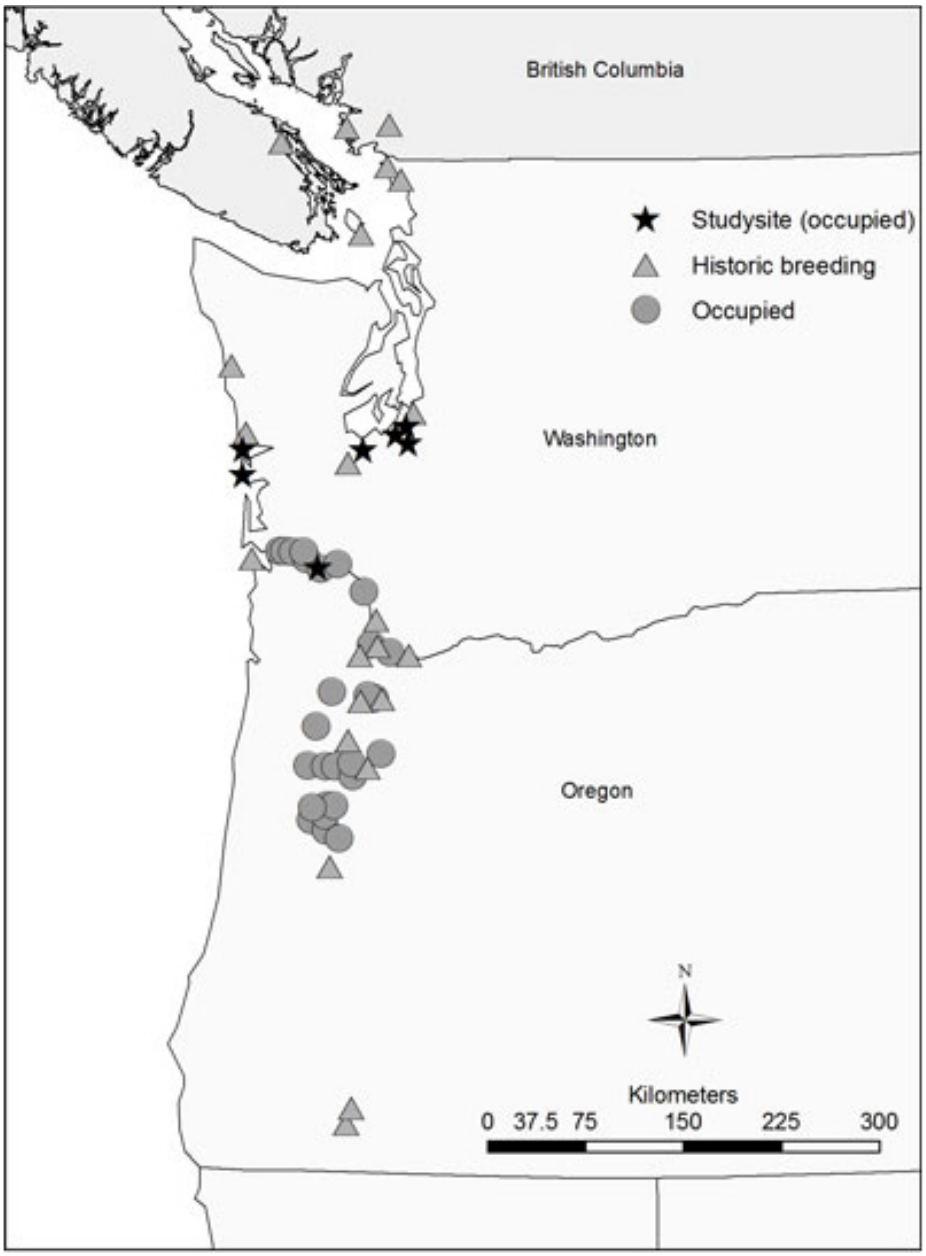

Figure 2: Current and historic breeding distribution of the Horned Lark *strigata* subspecies (from Camfield *et al*. 2011).

Extent of Occurrence and Area of Occupancy

The historical extent of occurrence (EOO) in Canada stretched from Campbell River south to Victoria and east to Chilliwack, an area of about 15,000 km^2. This includes the Strait of Georgia and land in the USA; omitting these, the EOO would have measured approximately 6000 km^2. However, as no breeding birds have been observed over the last 10 years, the present EOO is 0 km^2.

The index of area of occupancy, as with EOO, is presently 0 km^2.

Search Effort

Because of its extreme rarity in Canada, Streaked Horned Lark is not well covered by standard bird monitoring efforts such as the Breeding Bird Survey. However, direct surveys for this subspecies in Canada have periodically been undertaken since 2002, with some efforts targeting both Streaked Horned Lark and Coastal Vesper Sparrow, and others focusing on the latter taxon but also monitoring for larks. As a regional rarity, it is sought by birders and sightings tend to be recorded in eBird and BCVIBird Yahoo Group (which functions as a rare bird alert on Vancouver Island and the Lower Mainland); such local observations are generally credible for this taxon because to be publicly posted in eBird, rare bird sightings must be documented and verified. Streaked Horned Lark is the target of intensive survey, monitoring, and management efforts throughout its US range (e.g., Pearson and Altman 2005; Pearson *et al*. 2005, 2016; Keren and Pearson 2016; see **Population Sizes and Trends – Sampling Efforts and Methods**).

HABITAT

Habitat Requirements

Across its range, Horned Lark favours open areas with short, sparse vegetation cover. Landscape types selected by Streaked Horned Lark vary range-wide, but share these common features. In British Columbia, habitats used include agricultural fields, airports, beaches, sand dunes, short-grass playing fields, road sides, and other areas with bare ground. Documented breeding habitat occurred between sea level and 10 m elevation, and was restricted to short-grass fields in agricultural areas, airports, and estuaries; and to dredge spoils and sparsely vegetated, sandy beaches along the lower Fraser River and Sidney Island. Nests on islands in the lower Fraser River were under scattered dune plants growing between the water's edge and the thicker plant growth higher above the waterline (Poynter 1959; Butler and Campbell 1987; Campbell *et al*. 1997; Cooper pers. comm. 2017).

In Washington, the centre of the Streaked Horned Lark breeding distribution is in the glacial outwash prairies of south Puget Sound. These prairies are remnant grasslands left over from the last ice age. The soils of these prairies are thin, have low nutrient levels, and drain rapidly – characteristics that help maintain a prairie grassland condition. Even historically, Streaked Horned Lark may have had rather restrictive habitat requirements in some areas: in Tacoma at the beginning of the 1900s, they were documented as breeders in the area as a "common summer resident of the dryest [sic] prairies" (Bowles 1906, p. 145), and "extremely local in their distribution, large areas of prairie being altogether untenanted, while an exactly similar piece of land will be swarming with them" (Bowles 1900, p. 30). Alternatively, this may reflect social tendencies of a loosely colonial species. Other breeding sites in Washington and Oregon include dredge spoil deposits on riverine islands and on river banks, bare-soiled industrial sites, sandy coastal beaches and deflation plains, agricultural fields, airports, and disturbed areas on military training bases (Rogers 2000; Anderson and Pearson 2015).

The last confirmed breeding record for British Columbia was in 1978, although breeding was suspected at the Vancouver International Airport in 1981 (Butler and Campbell 1987). Since then, the only record of potential breeding was at the Nanaimo Airport on Vancouver Island in 2002 (Beauchesne 2002). In the Puget Sound area of Washington, four of five known breeding sites are at active airports.

Habitat Trends

The amount of suitable habitat for Streaked Horned Lark in British Columbia is now very limited, and has undoubtedly declined over the last few decades as agricultural intensification, urbanization, and other development have occurred within its breeding range. Although historical habitat availability data for British Columbia are incomplete, some inferences can be made. Before European colonization, parts of southern Vancouver Island had large areas of grassland, in part forming a matrix with open Garry Oak (*Quercus garryana*) woodlands. These areas of open meadow would have declined following banning of annual agricultural burning by First Nations in the region (see below), so that some areas transitioned to Garry Oak woodlands or closed forest dominated by Douglas-fir (*Pseudotsuga menziesii*), and habitat for Streaked Horned Lark likely became restricted to sparsely vegetated sites such as spits, sand bars, beaches, and, possibly, microhabitats within Garry Oak ecosystems. These natural habitat options have gradually been lost or drastically altered by development and structural changes with introduced grasses and shrubs. An inventory of sensitive ecosystems on eastern Vancouver Island and the Gulf Islands showed that naturally occurring, sparsely vegetated ecosystems (i.e., sand dunes, gravel and sand spits, and inland cliffs and bluffs) are at present the rarest terrestrial ecosystem in that region, comprising only 37.9 hectares in total in the 1990s (Ward *et al*. 1998), with undoubtedly less in existence today. Therefore, very little suitable natural habitat currently exists, and tends to exist only as tiny remnants. At the same time, agricultural land in the historical range continues to be converted to housing, golf courses, commercial developments, or industrial greenhouses that preclude use by Streaked Horned Lark (Dawe *et al*. 2001). In the Fraser Valley, patches of suitable habitat in agricultural land may now be too small to support Streaked Horned Lark, so the potential breeding range is likely limited to sparsely vegetated coastal dune and meadow habitats elsewhere in the Lower Mainland and southeastern Vancouver Island areas (Environment and Climate Change Canada 2016).

Breeding of Streaked Horned Lark was documented in the lower Fraser River valley in 1926 (Brooks and Swarth 1925; Behle 1942). In 1925, Sumas Lake was drained, exposing 3,600 ha of lake bottom, which was subsequently farmed. It may not be a coincidence that Streaked Horned Lark was first noticed breeding in this area at this time, though Brooks (1917) refers to Horned Larks as “stragglers” in the area in the early 1900s, and Rogers (2000) suggested they may have been breeding then at an unknown site nearby. Nonetheless, the drained lake would have created large amounts of sparsely vegetated habitat (i.e., the type of habitat used by nesting Horned Larks) a year or two after being drained. This pattern has been noted elsewhere; in Oregon, Streaked Horned Larks were inferred to move into land cleared for pasture (Gabrielson and Jewett 1940). It is therefore

possible that the draining of Sumas Lake provided additional suitable habitat for Streaked Horned Lark in the lower Fraser River valley. Farmland in the Chilliwack and Sumas areas probably continued to provide some suitable habitat over the next two or three decades. By the 1960s more intensive farming practices were introduced, which have reduced the amount of suitable agricultural habitat to the point that almost none remains (Environment and Climate Change Canada 2016).

The quantity of suitable breeding habitat that historically existed on Vancouver Island and the Gulf Islands is unknown, but is assumed to be much greater than that available currently. The loss of native terrestrial habitats in the region over the past 150 years, due to modifications following European settlement, has been estimated at between 80% (Ward *et al*. 1998) and 95% or more (Fuchs 2001; MacDougall *et al*. 2004). James Douglas, Governor of the Colony of Vancouver Island (1851-1864) talks about "walking across open prairie for 6 miles behind Fort Victoria", an indication that there were large areas of open grassland in the region. Maps of historical open plant communities in the Victoria region show that grassland and Garry oak savannahs were extensive (Brierly *et al.* 2002), even though much of the information was compiled from surveys conducted 30 years or more after Governor Douglas banned grassland burning by First Nations in the mid-1800s (which had helped to maintain these coastal prairie systems; Fuchs 2001), so considerable in-growth by trees (e.g., Garry Oak, Douglas-fir) and native and non-native shrubs (particularly Snowberry *Symphoricarpos albus* and Scotch Broom *Cytisus scoparius*) would have already begun (Lutz 1995; Turner 1999). Remnants of the large expanse of open prairie can be found at sites such as Cowichan Bay, Beacon Hill Park in Victoria, and Trial Island Ecological Reserve. Although some parts of these areas appear to be suitable for Streaked Horned Lark, they are currently very small and often subject to human disturbance.

On Vancouver Island and the Lower Mainland, sandy beach and dune habitats have been drastically altered since the arrival of Europeans and large-scale timber extraction, leading to changes in the amount and type of woody material deposited on beaches. Formerly a large amount of woody material that ended up on beaches was from large trees undercut by rivers and streams. These relatively structurally complex pieces (e.g., trunks with root wads attached) did not roll and helped maintain sand beach and dune systems. Following the advent of widespread logging and booming of wood, much of the material deposited on beaches is of a considerably less complex nature. Trunks are limbed, and root wads are cut off**.** Informal surveys indicate that between 70 and 87% of the woody material on British Columbia beaches has saw-cut ends. This results in logs that act like 'rolling pins', compacting sand and restricting its movement rather than acting as dune stabilizing structures that also allow for inshore sand movement; this considerably alters the dynamics of sandy beach and dune communities (Maser and Sedell 1994; Fairbarns *et al*. 2007). To illustrate the changes to beach habitat, COSEWIC (2003a) analyzed air photos of sand dune habitats on southern Vancouver Island and found that, over a 40-year period ending mid-1990s, sites lost between 21 and 50% of their open dune areas, grass and bryophyte areas declined by 6-52% and forest and shrub cover increased by 46-220%, changes that would impact a species that prefers open grass to forest. Notably, Scotch Broom and Gorse (*Ulex europaeus*) have become abundant on sandy spits and beaches above the inundation zone, rendering areas unsuitable for Streaked Horned Lark. To further

exacerbate the situation, many sparsely vegetated spits and foreshore sites in the region have been used as building sites for residential or light industrial purposes and as such are no longer suitable for Streaked Horned Lark, or other grassland bird species (Dawe *et al*. 2001). For example, in the 1960s this subspecies nested on Sea Island in habitat near the current boat launch, whose construction destroyed this habitat (Cooper pers. comm. 2017).

Elsewhere, prairie habitat in western Washington has declined 98% since the arrival of European settlers, with prairies being converted to urban or unsuitable agricultural areas, returning to forest because of fire suppression, or being invaded by exotic plants (Smith *et al*. 1997; Rogers 2000; Stinson 2005).

BIOLOGY

Very little is known about the ecology of Streaked Horned Lark in British Columbia, therefore most of the following is inferred from studies done on this subspecies in the US parts of its range, or other subspecies elsewhere in the species' range.

Life Cycle and Reproduction

For Streaked Horned Lark, Anderson and Pearson (2015) describe mid-February to mid-April as the "pre-breeding stage", when wintering lark flocks disperse, individuals arrive on the nesting grounds, and males begin territorial defence. Between-season pair bond maintenance is unknown (Beason 1995), but Horned Lark is probably monogamous during the breeding season (Beason and Franks 1974). The male typically arrives on the breeding ground first and establishes a breeding territory. The female probably selects a territorial male upon her arrival, and then finds a nest site within his territory. The female alone constructs the nest by scraping a small hollow on the ground, or finding an existing depression (e.g., a hoof print; Campbell *et al*. 1997). The nest is then lined with fine grasses and other plant fibres (Cannings 1981; Campbell *et al*. 1997). Nests are usually situated with a protective object (e.g., a lump of dirt, tuft of grass or other vegetation) to one side, possibly to help maintain the temperature within the nest by shading and shelter from winds (With and Webb 1993; Nelson and Martin 1995). Pebbles or other paving materials may be placed around the nest, or to one side (Baicich and Harrison 1997).

A clutch of four eggs is typical, although two to seven eggs are possible (Baicich and Harrison 1997). Streaked Horned Lark tends to have smaller clutch sizes than other subspecies; Bowles (1900) reported that the mean clutch size in the Puget Sound area was 2.5 eggs, whereas data from Wolf and Anderson (2014) show a mean of 2.95 (n = 43 nests) and Camfield *et al*. (2011) found a mean clutch size of 3.05 (Western Washington; n = 135 clutches; 95% CIs 2.93, 3.17). Three Streaked Horned Lark nests have been found with eggs in British Columbia: two with three eggs and one with four eggs (Campbell *et al*. 1997). Eggs are incubated by the female for 11 or 12 days (Campbell *et al*. 1997). The female also broods the hatchlings but both parents typically feed the nestlings (Beason 1995). Nestlings fledge after approximately 10 days (Cannings 1981; Baicich and Harrison 1997). As with many other grassland bird species, the nestling period is short and young

fledge when they can walk but before they can fly (Beason 1995). Wolf and Anderson (2014) report mean fledging rates over three years in southern Puget Sound ranging from 0.7 to 1.7 fledglings per nest, whereas Camfield *et al*. (2011) report a mean of 0.23 ± 0.04 fledglings per egg laid (n = 123 nests; 95% CIs 0.15, 0.31). The overall fecundity estimated by Camfield *et al*. (2011) is 0.91 ± 0.17 female fledglings/female/year (n = 4 years; 95% CIs 0.63, 1.19). This low fecundity was the result of low egg hatchability and fledging success, high clutch depredation, and long intervals between failed nests and re-nests. Adult survival is also low, at 0.55 ± 0.08 (n = 32; 95% CIs 0.39, 0.70) for males and 0.47 ± 0.08 (n = 26; 95% CIs 0.32, 0.63) for females. Apparent juvenile survival is considered high at 0.17 ± 0.05 (n = 88; 95% CIs 0.09, 0.30; Camfield *et al*. 2011).

In the Georgia Depression, the Horned Lark breeding season was reported to extend from April 5 to August 25 (Campbell *et al*. 1997). Camfield *et al*. (2011) documented mean breeding season length in Washington across six sites and 4 years: breeding season length (days) was 94.0 ± 10.5. At one site in southern Puget Sound, clutches were initiated in the first week of May (Wolf and Anderson 2014); other field studies for this taxon have shown the earliest dates of clutch initiation to be in the period of 6-10 April (Pearson *et al*. 2016). Nesting continues through the summer with latest nests fledging in the third week of August (Wolf and Anderson 2014). Horned Larks are known to breed two or three times per season at low elevations and low latitudes (Beason 1995).

Horned Larks are only rarely parasitized by Brown-headed Cowbirds (*Molothrus ater*; Beason 1995). This may be because they typically begin nesting before cowbirds, their nests are exposed and they have a short nestling period, such that cowbird nestlings may be left behind when the larks fledge (Friedmann 1963). There are no records of cowbird parasitism (n=115 nests) of any Horned Lark subspecies in British Columbia (Campbell *et al*. 1997).

Nest failure may result from abandonment, predation, bad weather or accidental destruction. Agricultural practices including tilling or mowing during the breeding season may result in the accidental destruction of nests or trampling of adult birds (Kershner and Bollinger 1996). There are also documented cases of Horned Larks having been trampled by livestock (Beason 1995). Cannings (1981) reports a nest with nestlings being abandoned during a hailstorm. Nestlings may also starve if cold wet weather prevents adults from foraging effectively.

Physiology and Adaptability

Studies in the Great Plains suggest that Horned Larks occur mainly in grazed areas (Jones and Bock 2002) and will tolerate even heavily grazed areas (Kantrud 1981; Bock *et al*. 1993). Horned Larks will also occupy physically disturbed sites. For example, Rogers (2000) found that Streaked Horned Lark preferentially foraged in wheel ruts in a grassland area. However, Horned Larks tend to avoid hayland (Kantrud 1981) and choose habitats relatively remote from urban landscapes (Jones and Bock 2002).

Dispersal and Migration

Migration behaviour in Horned Lark varies among subspecies: arctic and alpine populations are completely migratory, whereas some southern populations are resident year-round on their breeding grounds (Beason 1995). Streaked Horned Lark is thought to be partially migratory to non-migratory (Pearson and Altman 2005). Populations from coastal British Columbia probably moved south in autumn to join permanent residents in southern Washington and Oregon or may have moved as far as California (American Ornithologists' Union 1957), but a few birds evidently overwintered based on winter (January) specimen records from the Fraser delta (Munro and Cowan 1947). At present, birds from the southern Puget Sound population are almost entirely migratory, whereas numbers of Streamed Horned Lark are present throughout the winter in the Columbia and Willamette Valleys of Oregon, often mixed in with large flocks of other subspecies (Pearson *et al*. 2005).

Horned Lark migration is diurnal. Hatch-year birds gather in the late summer and are joined by adults later in the season. Horned Larks will also form mixed flocks with other species such as longspurs and buntings (Beason 1995).

Interspecific Interactions

Birds are the primary predators of Streaked Horned Lark in the USA (Pearson and Hopey 2008; Pearson *et al*. 2012). Predation by Northern Harrier (*Circus hudsonius*), Red-tailed Hawk (*Buteo jamaicensis*), Great Horned Owl (*Bubo virginianus*), American Kestrel (*Falco sparverius*), American Crow (*Corvus brachyrhynchos*), Western Meadowlark (*Sturnella neglecta*), Striped Skunk (*Mephitis mephitis*), and garter snakes (*Thamnophis* spp.) has been recorded at nests of Streaked Horned Lark (Pearson and Hopey 2008, Pearson *et al*. 2012, Stinson 2016).

Based on what is known about this taxon in the USA and other grassland bird species in British Columbia, potential predators of eggs, nestlings and adults in the Georgia Depression include birds of prey (e.g., Cooper's Hawk, *Accipiter cooperii,* and Merlin, *Falco columbarius*); corvids (e.g., Northwestern Crow, *Corvus caurinus* and Common Raven, *Corvus corax*); small and medium-sized mammals (e.g., Coyote, *Canis latrans*; Red Fox, *Vulpes vulpes*; Raccoon, *Procyon lotor*; skunks; domestic dog, *Canis familiaris*); and snakes (e.g., Common Garter Snake, *T. sirtalis,* and Western Terrestrial Garter Snake, *T. elegans*). Domestic cats (*Felis catus*), however, probably represent the greatest predation threat in this region. Cats are known to be effective predators of small to medium-sized birds (George 1974; Coleman and Temple 1993; Cooper 1993). On southeastern Vancouver Island domestic or feral cats were frequently seen during bird surveys at grassland sites, including the single site where a displaying Streaked Horned Lark was observed during the 2002-2003 surveys (Beauchesne 2002, 2003).

POPULATION SIZES AND TRENDS

The Canadian population of Streaked Horned Lark has declined to the point where it is likely extirpated, or functionally so. Historically, the population was probably small; Campbell *et al*. (1997) believed it was a local resident on southern Vancouver Island in the late 1800s.

Sampling Effort and Methods

Cannings (2014) conducted 57 5-min point counts over 4 days throughout much of the subspecies' historical Canadian range (24 on Vancouver Island, 18 at Vancouver airport, 8 at Abbotsford airport, 1 at the Chilliwack airport and 6 at the Hope airport). In addition, area searches were conducted at 6 sites on Vancouver Island (between 30 and 160 minutes at each site). Additional *ad hoc* searches were made by birders employed by the Vancouver Airport, who watched for larks and other species of interest while carrying out daily wildlife control operations at the airport throughout 2014 (Gotz pers. comm. 2014; Levesque pers. comm. 2014).

Beauchesne (2002, 2003) searched for Horned Larks and Vesper Sparrows in likely habitat throughout southern Vancouver Island for 30 days (approximately 240 hours) in each of 2002 and 2003. Beauchesne *et al*. (2010a) surveyed 246 sites on southeastern Vancouver Island and the Gulf Islands in 2009; while these particular surveys targeted Coastal Vesper Sparrow, they took place in habitats suitable for Streaked Horned Lark. These surveys were repeated in 2014 (Beauchesne 2014). Similarly, Beauchesne (2010b, 2012, 2013) surveyed the Nanaimo airport area for Coastal Vesper Sparrow for 16, 11 and 22 days over three consecutive breeding seasons.

The eBird (2017) database was also consulted for any recent records of Streaked Horned Lark in its historical breeding range.

Abundance

Campbell *et al*. (1997) considered Streaked Horned Lark to be extremely scarce in the lower Fraser River valley, and Fraser *et al*. (1999) considered it extirpated on southeastern Vancouver Island. In 2002 a single male was observed giving flight songs at the Nanaimo airport (Beauchesne 2002); however, a mate was not located, nor was a nest found in approximately 16 hours of search time at the site (COSEWIC 2003b). Extensive surveys conducted periodically between 2002 and 2014 (see **Sampling Effort and Methods**, above) revealed no Streaked Horned Larks on Vancouver Island (Beauchesne 2013, 2014; Cannings 2014) or in the Fraser Valley (Cannings 2014). There are about 30 observations of 1-2 Horned Larks in the early breeding season (i.e., April - May, with about 10 of these in May; presumed multiple sightings of the same birds counted only once) from the 1990s to the present (eBird 2017). Only one of these provides any evidence of breeding behaviour, and the observed individual, a singing male recorded on 29 April 2015, was identified as probably being a late-migrating *articola* ssp. (Fenneman 2015, pers. comm. 2017). None of the other recent breeding season records identify birds to subspecies. Other subspecies of

Horned Lark migrate through this region, though lark migration is usually over by the end of April (Campbell *et al*. 1997). According to several long-term birders and bird biologists, no other recent records of this subspecies in British Columbia are known (Allinson pers. comm. 2014; Dawe pers. comm. 2014; McNichol pers. comm. 2014; Monty pers. comm. 2014). The current Canadian population of Streaked Horned Lark is thus likely to be 0. The present US population is estimated to be 1,170–1,610 birds, including fewer than 150 pairs in Washington (Stinson 2016).

Fluctuations and Trends

Historically, small numbers of Streaked Horned Lark bred in the lower Fraser valley from Abbotsford to the Fraser River delta (Campbell *et al*. 1997), but Fannin (1891) described it as nowhere common in British Columbia. Streaked Horned Lark was first documented on southern Vancouver Island in the late 1880s. At least nine Streaked Horned Lark specimens were collected on Vancouver Island between 1890 and 1953. Unfortunately, the amount of collection or nest finding effort was not documented, but it is speculated that effort was not extensive and this cryptic bird could have been easily overlooked (Campbell *et al*. 1997). In the lower Fraser River valley, birds were first collected in the late 1890s, near Sumas Lake. The population was described as “small” and is said to have “persisted in farmland and prairie areas of the Fraser River delta” from the late 1920s through the next 30 years, although precise population estimates are not available (Campbell *et al*. 1997). Poynter (1959) reported nesting on Sidney Island, and Briggs (1972) noted “at least a pair” of Horned Larks at the Victoria Airport in June 1972. By the mid-1960s, breeding populations were confined to the mowed fields at the Vancouver International Airport, possibly near Abbotsford (Campbell *et al*. 1997), in sand dune habitat on Sea and Iona islands (Cooper pers. comm. 2017), and perhaps on farm fields at Westham Island (Knapton 1972). As many as seven birds were noted on Sea Island between 1963 and 1966. The last confirmed breeding record on Sea Island was in 1978, although breeding was suspected in 1981 (Butler and Campbell 1987). To date, eBird breeding season (April - July) records of Horned Lark from the historical range of this taxon in Canada only include observations of nesting or presumed-nesting birds from the 1950s, ‘60s and ‘70s (Victoria area and the lower Fraser River). Retrospective comments attached to these records note that “species bred here regularly in 1970s” (Iona Island; Weber 1968a) and “not unusual, breeding on the island in 1970s” (Sea Island; Weber 1968b). Weber *et al*. (1990) list Streaked Horned Lark as a rare resident at Sea Island in their 1990 checklist. One of the last known summer occurrences was 10 birds seen on 1 May 1987 (Campbell *et al*. 1997; Weber pers. comm. 2014). These birds were not identified to subspecies, so they may not have been Streaked Horned Lark, although as noted above, Horned Lark migration is usually completed by late April. Occasional subsequent sightings of birds not identified to subspecies have also been identified in eBird for April and May (see **Abundance**, above).

In the Puget Sound region of Washington, Streaked Horned Lark was considered an abundant breeder in the mid- to late 1800s and early 1900s (Suckley and Cooper 1860; Bowles 1900, 1906). In the San Juan Islands of Washington (approximately 18 km across the Strait of Juan de Fuca, east of southeastern Vancouver Island), Horned Larks were first noted as breeding in 1946, after which they were recorded as breeding "commonly at times"; breeding there has not been recorded since 1962 (Rogers 2000). In several parts of western Oregon from the 1870s to early 1900s, Streaked Horned Lark was described by various authors as being a "not uncommon" to "abundant" breeder, and was still common in the 1930s; the subspecies was "particularly abundant" in Polk and Yamhill counties where, in the fall, groups of dozens or hundreds were noted (Gabrielson and Jewett 1940; Altman 2011). Rogers (2000) suggested that the subspecific identification of some of the historical Oregon records may have been inaccurate, but the subspecies is clearly still more common in Oregon than elsewhere in its range (Stinson 2005, 2016; Altman 2011).

The overall breeding range of Streaked Horned Lark has contracted significantly from the north and south; it no longer breeds in southern British Columbia, the northern Puget Sound area of Washington, along the Washington coast north of Grays Harbor, or in the Rogue River Valley of Oregon (Pearson and Altman 2005; Altman 2011; Keren and Pearson 2016). Whatever the original population was in the United States, the subspecies has declined greatly in recent decades to its current numbers (**Abundance**, above).

Camfield *et al*. (2011) calculated estimates of the population growth rate using vital rate data from Streaked Horned Lark breeding on the Puget lowlands, lower Columbia River and the Washington coast. Their results ($\lambda = 0.62 \pm 0.10$, 95% CIs 0.47, 0.79) indicate that this population is declining rapidly, with the decline apparently the result of both low fecundity and low adult survival (0.51 ± 0.06, $n = 58$; Camfield *et al.* 2011). More recent survey results (2010-2015; Keren and Pearson 2016) suggest the small population in Washington is presently stable, albeit at low numbers (see **Abundance**); however, these authors also found that male and female trends are diverging, leading to a male-biased sex ratio (reduced N_e) at some sites. These researchers further suggest it may be premature to assume this apparent stability is "a true trend" (Keren and Pearson 2016).

Rescue Effect

Because historical populations of this taxon have significantly declined in adjacent Washington (or been extirpated, as in the case of the northern Puget Sound population; Pearson and Altman 2005; Keren and Pearson 2016), and declines in the Canadian population are linked to habitat loss, rescue from USA populations is unlikely. Populations of Streaked Horned Lark are subject to intensive management in Washington and Oregon, where efforts are being made to increase breeding success, e.g., in Washington through translocation of eggs from Oregon nests (with some success; Stinson 2016) and use of nest exclosures (with little success; Pearson *et al*. 2012; Wolf and Anderson 2014).

THREATS AND LIMITING FACTORS

The primary threats identified for Streaked Horned Lark in Canada are loss and degradation of habitat due to urban and industrial development and modern agricultural practices, increased disturbance at remaining suitable or restorable sites, infilling of most remaining open spaces by exotic vegetation, and improved diking techniques affecting sand dune habitat in the Fraser River (Environment and Climate Change Canada 2016). Although Streaked Horned Lark habitat was never large in extent, suitable habitat has been in decline over the last few decades. Indeed, the Recovery Strategy for this taxon states that Critical Habitat cannot be identified for it at this time, as it is not known whether any suitable habitat remains in Canada (Environment and Climate Change Canada 2016).

A formal threats assessment was not done, given the lack of evidence for a current population in Canada, but the threats below have been recognized for the population in Washington and Oregon, and would likely also apply to any future reestablished population in Canada. They follow the IUCN-CMP (International Union for the Conservation of Nature – Conservation Measures Partnership) unified threats classification system (based on Salafsky *et al*. 2008), and are listed in order of severity (greatest to least).

Category 1: Residential and commercial development

The range of this subspecies overlaps with areas and habitats that have become increasingly developed for human activities, such as housing, recreation, and light industry. This development has fragmented or destroyed most suitable habitat (Campbell *et al*. 1997). Continuing development pressures will, in the future, likely eliminate most of the remaining potentially suitable habitat.

Category 7: Natural system modifications

Improved diking of the Fraser delta has reduced the amount of sparsely vegetated sandy shoreline along the edges of the Fraser River; this less-disturbed habitat may represent some of the only remaining potential habitat for Streaked Horned Lark in British Columbia (Environment and Climate Change Canada 2016).

Category 2: Agriculture and aquaculture

Intensification of agriculture has reduced the suitability of some farmlands that were previously used for nesting by Streaked Horned Lark. Agricultural practices that involve mechanical procedures (e.g., tilling, mowing) during the nesting season can disturb or destroy nests of ground-nesting birds, having a direct effect on reproductive success. Modern crop ‘improvements’ of more rapid growth with earlier and more frequent harvest exacerbates the risk (Rodenhouse *et al*. 1993). In addition, industrial agricultural practices increasingly rely on chemicals, which have unknown consequences for most species of birds (Gard *et al*. 1993). Combined samples from four dead Streaked Horned Larks found at Corvallis Airport, Oregon in 2014, tested positive for zinc phosphide, a rodent control applied to grain (Stinson 2016).

Category 8: Invasive and other problematic species and genes

Invasions of exotic plants such as Scotch Broom, Gorse, Himalayan Blackberry (*Rubus discolor*), and tall non-native grasses have overtaken most of the remaining field, Garry Oak and sand dune habitats in the former breeding range of Streaked Horned Lark (Fraser *et al*. 1999). Invasive plant species are known to be affecting its habitat in the US; for example, in the Puget Lowlands, all current nesting sites experience a disturbance regime that is controlling vegetation ingrowth (Stinson 2016), and use of dredge spoils habitats in the Columbia River is limited by the density of introduced beach grasses (Fort 2007).

Predation is one of the main causes of nest failure of Streaked Horned Lark (Pearson and Hopey 2005; Anderson 2006; Camfield *et al*. 2010, 2011). The effects of predators in increasingly urbanized landscapes, including increased predation pressure from domestic cats and urban native species such as Northwestern Crows, may threaten birds attempting to nest in Canada.

Category 6: Human intrusions and disturbance

Activities such as horse-back riding, dog walking, bird watching, and trail bike riding are often incompatible with ground-nesting birds (Rogers 2000). Increased human disturbance, which logically goes along with increasing human populations, can affect ground-nesting birds. At Iona Island in the lower Fraser River delta, suitable habitat remains but the increase in human activity, including dog-walking, means there is too much disturbance for nesting by Streaked Horned Lark (Cooper pers. comm. 2017). While airports are known to provide some of the last habitat refuge for grassland species, including Horned Larks, mowing and other activities at airports during breeding disturbs larks and can cause nest destruction or abandonment, even with modified mowing regimes (Wolf and Anderson 2014).

Category 4: Transportation and service corridors

Horned Lark is the most commonly reported bird species involved in US military aircraft strikes (total 3,283 strikes, 1995-2016; BASH 2017), and as of 2013, the sixth-highest reported species for US civilian aircraft (summarized in Stinson 2016). Aircraft strike mortality for Streaked Horned Lark is not reported, but could be expected as these birds nest at five airports in Washington and one in Oregon, and Horned Larks (unidentified subspecies) are still occasionally reported in the vicinity of the Vancouver International Airport. As rate of adult survival was found to have the greatest influence on lambda for these birds in Washington, this could be an important source of mortality for Streaked Horned Lark *a*cross its range (Camfield *et al*. 2011; Center for Natural Lands Management 2011).

Limiting Factors

Factors associated with small population size are likely affecting Streaked Horned Lark in Washington and Oregon. Low hatchability may be the result of inbreeding depression, reflecting low genetic diversity found by Drovetski *et al*. (2005), whereas low fecundity may be driven primarily by high rates of nest predation (Camfield *et al*. 2010; Pearson *et al*. 2012). A recent Washington study found a male bias in adult sex ratios, which, if real, would explain observations of unpaired adult males in at least one subpopulation, and result in reduced effective population size (N_e) at some sites (Karen and Pearson 2016). See Camfield *et al*. (2011) for main causes of nest failure (low survival and low fecundity; Pearson *et al*. 2008). Low fecundity was the result of low egg hatchability and fledging success, high clutch depredation, and long intervals between failed nests and re-nests.

Number of Locations

There are no known locations for Streaked Horned Lark in Canada at present; a nest has not been found in Canada since 1978. The last confirmed breeding location was the Vancouver airport (Butler and Campbell 1987); most recently, a single male sang on territory at the Nanaimo airport in 2002 (Beauchesne 2002).

PROTECTION, STATUS AND RANKS

Legal Protection and Status

Streaked Horned Lark is protected by the federal *Migratory Birds Convention Act* of 1994, which makes it illegal to possess migratory birds or their nests. It is also protected under the British Columbia *Wildlife Act*, which prohibits shooting, trapping, poisoning or any other measure of killing of wildlife, or the disturbance or destruction of eggs or active nests.

It was listed as Endangered under the federal *Species at Risk Act* in 2005 (Environment and Climate Change Canada 2016) and Threatened under the US federal *Endangered Species Act* (2016). It is also listed as Endangered in Washington State (2006).

Non-Legal Status and Ranks

Streaked Horned Lark is ranked as G5T2 globally (i.e., the species as a whole is secure, but the subspecies is imperilled) and as an extirpated breeder (SXB) in British Columbia; it is considered a critically imperilled breeder (S1B) in Washington and an imperilled breeder (S2B) in Oregon (NatureServe 2015). It is also currently on the Red List as a candidate for designation as a threatened or endangered species in British Columbia (BC Conservation Data Centre 2014). In Oregon, it is designated as a State Sensitive Species with “critical status” (Rogers 2000).

Habitat Protection and Ownership

A few former breeding sites are located within regional parks on Sea Island and Iona Island in Greater Vancouver. Iona Beach Regional Park includes a few hectares of sand dune and spit habitat (as do Island View Beach Regional Park and Sidney Spit in the Gulf Islands National Park Reserve), but some of that habitat is affected by an active log salvage operation, and there is heavy use by humans and their dogs. The Sea Island Conservation Area, adjacent to Vancouver International Airport and within the area formerly used by nesting Streaked Horned Lark, contains 140 ha of woodlands, wetlands, and old field habitat, and is administered by Environment and Climate Change Canada (2016). This area could contain suitable habitat, but only if fields are mowed short prior to the nesting season (i.e., when mowing will not disturb birds). An unknown amount of old-field habitat occurs in Richmond's 13.8 ha Terra Nova Natural Area reserve, but its suitability as habitat for Horned Larks is unclear.

A small amount of potential habitat still remains on privately owned agricultural land. Other potential breeding habitat occurs at Vancouver International Airport, Boundary Bay Airport, Victoria International Airport, Nanaimo Airport, Abbotsford Airport, and Chilliwack Airport. None of these sites are managed to conserve habitat for Horned Larks. Dredge spoil islands and deposits in and along the Fraser River provide potential habitat, but are presently not managed for Streaked Horned Lark.

In Washington and Oregon, there are no records of Streaked Horned Lark occurring on National Wildlife Refuges (USFWS 2002). Most of the remaining breeding habitat is on military reserves (Rogers 2000).

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BIOGRAPHICAL SUMMARY OF REPORT WRITERS

Richard Cannings was born and raised in the Okanagan Valley in a family keenly interested in natural history. This early involvement in birds, bugs and plants led him to a university education in zoology, including a BSc degree from the University of British Columbia and a MSc from Memorial University of Newfoundland. He worked for 15 years as the Curator of the Cowan Vertebrate Museum in the Department of Zoology at the University of British Columbia. He left UBC in 1995 to return to his Okanagan roots, working half-time for Bird Studies Canada, coordinating Canadian Christmas Bird Counts, the eBird program, the Great Backyard Bird Count and the British Columbia-Yukon Owl Survey. He also undertook consulting work is primarily centred on endangered species, particular those in southern British Columbia. He was co-chair of the Birds Specialist Subcommittee (SSC) on the Committee on the Status of Endangered Wildlife in Canada for eight years and has served on both the BC Environmental Appeal Board and the BC Forest Appeals Commission. He has written a number of books, including *Birds of the BC Interior and Rockies*, *Birds of Southwestern British Columbia, The Rockies: a Natural History*, and *An Enchantment of Birds*; *The Birds of the Okanagan Valley* and *British Columbia* with brothers Sydney and Robert Cannings; *British Columbia: A Natural History* and *The New BC Roadside Naturalist* with Sydney Cannings; and *Birdfinding in British Columbia* with Russell Cannings. Since 2015, he has been the elected member of Parliament for Okanagan-Similkameen.

Louise Blight is a conservation biologist who has been working on seabirds, marine and island ecosystems, and species at risk for over 20 years. Her MSc, PhD, and consulting work have included primary research on British Columbia seabirds, at-sea surveys in the Pacific Ocean, and field studies of penguins, larids, and procellariiforms in the Antarctic and Southern Ocean. She has also worked extensively on at-risk taxa in British Columbia's Garry oak ecosystems, including working for several years on conservation strategies for birds in these coastal savannah systems. Her travels have also led to extended forays into coastal and marine habitats in Latin America and Australia. One of her research interests is the use of historical data and information sources in conservation science and planning, which led to her co-editing the multi-author book *Marine Historical Ecology in Conservation: Using the Past to Manage for the Future* (UC Press). She is currently a member of the COSEWIC Birds SSC, and a daily contributor to eBird.

COLLECTIONS EXAMINED

No collections were examined for the preparation of this report.