COSEWIC
Assessment and Status Report

on the

Grasshopper Sparrow
Ammodramus savannarum pratensis

pratensis subspecies (*Ammodramus savannarum pratensis*)

in Canada

SPECIAL CONCERN
2013

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:

COSEWIC. 2013. COSEWIC assessment and status report on the Grasshopper Sparrow *pratensis* subspecies *Ammodramus savannarum pratensis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 36 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

Production note:
COSEWIC acknowledges Carl Savignac for writing the status report on the Grasshopper Sparrow *pratensis* subspecies, *Ammodramus savannarum pratensis* in Canada, prepared with the financial support of Environment Canada. This report was overseen and edited by Marty Leonard, Co-chair of the COSEWIC Birds Specialist Subcommittee.

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Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur le Bruant sauterelle de la sous-espèce de l'Est (*Ammodramus savannarum pratensis*) au Canada.

Cover illustration/photo:
Grasshopper Sparrow *pratensis* subspecies — photo by Jacques Bouvier.

Catalogue No. CW69-14/681-2014E-PDF
ISBN 978-1-100-23548-6

Recycled paper

COSEWIC
Assessment Summary

Assessment Summary – November 2013

Common name
Grasshopper Sparrow - *pratensis* subspecies

Scientific name
Ammodramus savannarum pratensis

Status
Special Concern

Reason for designation
In Canada, this grassland bird is restricted to southern Ontario and southwestern Quebec. This subspecies has experienced persistent, long-term declines. It faces several ongoing threats including habitat loss, as pastures and hayfields are converted to row crops, habitat fragmentation, which increases predation rates, and mowing activities that destroy nests.

Occurrence
Ontario, Quebec

Status history
Designated Special Concern in November 2013.

COSEWIC
Executive Summary

Grasshopper Sparrow
Ammodramus savannarum pratensis

pratensis subspecies (*Ammodramus savannarum pratensis*)

Wildlife Species Description and Significance

The Grasshopper Sparrow *pratensis* subspecies (hereafter Eastern Grasshopper Sparrow) is a small dull-coloured song bird of grassland habitats. It has a short tail, flat head and conical beige bill. Adults of both sexes have similar plumage, i.e. a plain buff-coloured throat and breast, buff, unmarked or faintly marked flanks, whitish below and mottled with rust above. Its summer diet is largely composed of grasshoppers and so the Eastern Grasshopper Sparrow is considered beneficial for agriculture.

Distribution

In Canada, the breeding range of the Eastern Grasshopper Sparrow includes extreme southern Québec and southern Ontario, with the vast majority of birds occurring in Ontario. In the United States, it breeds in all states east of the Midwestern states to the East coast and south to Georgia and Texas. The Eastern Grasshopper Sparrow winters in the southeastern United States, but also in the Caribbean and Central America.

Habitat

In Canada, the Eastern Grasshopper Sparrow typically breeds in large human-created grasslands (≥ 5 ha), such as pastures and hayfields, and natural prairies, such as alvars, characterized by well-drained, often poor soil dominated by relatively low, sparse perennial herbaceous vegetation. The habitat used by the Grasshopper Sparrow in its wintering range is generally similar to that used in the breeding range.

Biology

The Eastern Grasshopper Sparrow is monogamous and generally exhibits breeding site fidelity. Males arrive on the breeding grounds in early May, and pair formation occurs immediately after females arrive, which is shortly after the males. Clutch size ranges from 4 to 5 eggs. Two broods can be produced per year. Nestlings are reared and fed in the nest by both adults for approximately 8 to 9 days. Post-fledging care lasts between 4 and 19 days. Age at first breeding is estimated at 1 year.

Population Sizes and Trends

In Canada, the Eastern Grasshopper Sparrow population is estimated at roughly 25,000 breeding pairs, distributed primarily in the Lake Simcoe-Rideau region of Ontario.

Breeding Bird Survey (BBS) trend analyses from Ontario, where the species is detected on enough routes for analyses, show a significant long-term (1970-2011) decline of 1.5% (CI: -2.98, -0.058) per year and a non-significant short-term (2001-2011) decline of 1.39% (-3.87, 1.16) per year, which amounts to population losses of 46% over 41 years and 13% over 10 years, respectively. According to the Ontario Breeding Bird Atlas, the Eastern Grasshopper Sparrow showed a non-significant decline of 17% in the probability of detection over the 20 years between atlases. This amounts to a 9% decline over the last 10 years. In Québec, the SOS-POP database (*Suivi de l'occupation des stations de nidification des populations d'oiseaux en péril du Québec*) suggests a decline of 36% (14/39 of known sites) in the number of sites occupied by the subspecies between 1989-1998 and 1999-2008. In Québec, the average of the maximum number of individuals observed per site has also declined by over half between the periods 1989-1998 and 1999-2008.

Threats and Limiting Factors

The main causes of Eastern Grasshopper Sparrow declines are: 1) habitat loss caused by the conversion of forage crops and pastures to intensive crop production, (2) habitat fragmentation, which can result in high predation rates and 3) more frequent and earlier hay mowing activities during the breeding season causing nest failure.

Protection, Status and Ranks

In Canada, the Eastern Grasshopper Sparrow, its nest and its eggs are protected under the *Migratory Birds Convention Act, 1994.* In Québec, the Grasshopper Sparrow is protected under *Loi sur la conservation et la mise en valeur de la faune* (the *Act Respecting the Conservation and Development of Wildlife*) and the *Loi sur la qualité de l'environnement* (the *Act for the Quality of the Environment*) and it appears on the list of species likely to be designated threatened or vulnerable according to *the Québec Loi sur les espèces menacées ou vulnérables* (the *Act Respecting Vulnerable and Threatened Species*). NatureServe ranks the Eastern Grasshopper Sparrow as apparently secure (S4) in Ontario and imperiled (S2B) in Québec.

TECHNICAL SUMMARY

Ammodramus savannarum pratensis
Grasshopper Sparrow *pratensis* subspecies
Other Common name:
Grasshopper Sparrow (Eastern)

Bruant sauterelle de la sous-espèce *pratensis*
Other French Common name: Bruant sauterelle (de l'Est)

Range of occurrence in Canada: Ontario, Québec

Demographic Information

Generation time (usually average age of parents in the population)	Approximately 1.5 years
Is there an observed continuing decline in number of mature individuals?	Yes
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Unknown
Percent reduction in total number of mature individuals over the last 10 years. Long-term (1970-2011) BBS data show a significant annual rate of decline of 1.5% for a population loss of 46% over the last 41 years. Short-term (2001-2011) BBS data show a non-significant annual rate of decline of 1.39% for a potential population loss of 13% over the last 10 years.	13% based on BBS survey data for Ontario where most birds occur
Projected percent reduction or increase in total number of mature individuals over the next 10 years.	Long-term decline likely to continue
[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.	Long-term decline likely to continue
Are the causes of the decline clearly reversible and understood and ceased?	The causes are well known, but have not ceased. Could be reversible if land managed
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence	270,500 km²
Index of area of occupancy (IAO)	Unknown, but > 2000 km²
Is the total population severely fragmented?	No
Number of locations*	Unknown, but > 10
Is there an observed continuing decline in extent of occurrence?	No, possible increase in Ontario
Is there an observed continuing decline in index of area of occupancy?	Yes
Is there an observed continuing decline in number of populations?	N/A
Is there an observed continuing decline in number of locations*?	Unknown
Is there an observed continuing decline in area, extent and/or quality of habitat?	Yes
Are there extreme fluctuations in number of populations?	N/A
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 population)

Population	N Mature Individuals
Ontario (according to Cadman *et al.* 2007)	50,000
Québec (according to Savignac *et al.* 2011)	200 - 400
Total	50,200 - 50,400

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	Quantitative analyses have not been conducted.

Threats (actual or imminent, to populations or habitats)

- Habitat loss due to conversion of forage lands and pastures to intensive crop production in breeding and possibly in wintering grounds
- Fragmentation of grassland habitat causing high predation rates
- More frequent mowing activities during the breeding season causing nest failure and nestling mortality

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? BBS survey data between 2001 and 2011 show declines in adjacent states ranging from 1.6 to 9.1% per year.	
Is immigration known or possible?	Yes
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Declining
Is rescue from outside populations likely?	Possible, but limited due to declines in the eastern United States

Status History

COSEWIC: Designated Special Concern in November 2013.

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Special Concern	Not applicable

Reasons for designation:

In Canada, this grassland bird is restricted to southern Ontario and southwestern Quebec. This subspecies has experienced persistent, long-term declines. It faces several ongoing threats including habitat loss, as pastures and hayfields are converted to row crops, habitat fragmentation, which increases predation rates, and mowing activities that destroy nests.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Does not meet criterion. Declines over the last 10 years are below the thresholds.
Criterion B (Small Distribution Range and Decline or Fluctuation): Does not meet criterion. EO and IAO are above the thresholds.
Criterion C (Small and Declining Number of Mature Individuals): Does not meet criterion. Population size is above the thresholds.
Criterion D (Very Small or Restricted Total Population): Does not meet criterion. Population size, IAO and the number of locations are above the thresholds.
Criterion E (Quantitative Analysis): There are no quantitative analyses available.

PREFACE

There are two subspecies of Grasshopper Sparrow in Canada; *Ammodramus savannarum perpallius* and *A. s. pratensis.* This assessment is based on a status report prepared for the *pratensis* subspecies.

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
(2013)

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.

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

COSEWIC Status Report

on the

Grasshopper Sparrow

Ammodramus savannarum pratensis

pratensis *subspecies* (*Ammodramus savannarum pratensis*)

in Canada

2013

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

The English common name of *Ammodramus savannarum pratensis* (Vieillot, 1817) is Grasshopper Sparrow *pratensis* subspecies (American Ornithologist's Union 1998; hereafter referred to as the Eastern Grasshopper Sparrow). The French common name is Bruant sauterelle de la sous-espèce de l'Est. The taxonomy of the Grasshopper Sparrow is as follows:

Class	Aves
Order	Passeriformes
Family	Emberizidae
Genus	*Ammodramus*
Species	*Ammodramus savannarum*
Subspecies	*Ammodramus savannarum pratensis*

A recent sequence analysis of 1673 base pair fragments of three mitochondrial genes in emberizid sparrows indicated that the Grasshopper Sparrow is only distantly related to the other species of the genus *Ammodramus*, but is more closely related to Cassin's Sparrow (*Aimophila cassinii*) (Carson and Spicer 2003).

Morphological Description

The Eastern Grasshopper Sparrow (Figure 1) is a small (10.5-13 cm; 15.3-23.1 g), dull-coloured passerine, with a short tail, flat head, conical beige-coloured bill and pink lower mandible (Rising and Beadle 1996). Adults of both sexes have similar plumage, i.e. plain buff-coloured throat and breast; buff, unmarked or faintly marked flanks; whitish belly and upperparts, rump and uppertail coverts mottled with rust (Rising and Beadle 1996). Tail feathers are brown, edged in pale greyish brown, and pointed (Rising and Beadle 1996). Juveniles differ from adults by the scaled or barred appearance of the back and rump, whiter supercilium, light brown face and thinly black-streaked breast and belly (Rising and Beadle 1996).

In Canada, the Eastern Grasshopper Sparrow may be confused with several other sparrows, including Nelson's Sparrow (*Ammodramus nelsoni*), Le Conte's Sparrow (*A. leconteii*) and Henslow's Sparrow (*A. henslowii*) (Rising and Beadle 1996). However, Nelson's Sparrow has an orange face and breast and grey nape and crown, while Le Conte's Sparrow has an orange face and breast and streaked flanks. These two species also occupy very different habitats from those of the Grasshopper Sparrow, i.e. wet meadows. They may also be confused with Henslow's Sparrow, but the latter is distinguished from the Grasshopper Sparrow by the absence of well-defined wing bars, presence of chestnut wing feathers, presence of black streaking on breast and flanks, and by the presence of malar and moustachial stripes streaked (Rising and Beadle 1996).

Figure 1. Adult Eastern Grasshopper Sparrow (photo Jacques Bouvier).

Population Spatial Structure and Variability

There are 12 subspecies of Grasshopper Sparrow in the Americas, four of which breed in northern Mexico (Vickery 1996). Two of the four North American subspecies of Grasshopper Sparrow breed in Canada: the Eastern Grasshopper Sparrow (*A. s. pratensis*) and the Western Grasshopper Sparrow (*A. s. perpallidus*), the latter breeding primarily in the prairies west of Manitoba (Vickery 1996). In Canada, these two subspecies are geographically separated by approximately 900 km of forest-dominated landscape between southern and westernmost Ontario (i.e., the Lake-of-the-Woods area; Figure 2) and eastern Manitoba. In the U.S. Midwest, the degree of contact between these two subspecies has not been studied, but contact is possible given the absence of large forested areas separating the eastern grasslands and the Great Plains.

The *floridanus, pratensis* and *ammolegus* subspecies of Grasshopper Sparrow have been compared using mtDNA and microsatellite markers. The results show low but significant differentiation between *floridanus* and the other two subspecies combined in both mtDNA (F_{ST} = 0.069, P < 0.05) and in a single measure of microsatellite differentiation (θ = 0.016, $P < 0.05$). There was no genetic differentiation between *pratensis* and *ammolegus* (Bulgin *et al.* 2003). The authors of this study suggest that Grasshopper Sparrow populations in North America have likely diverged within the past 25,000 years, too short a period to allow for the evolution of substantial genetic differences (Bulgin *et al.* 2003).

There have been no genetic comparisons between the two subspecies of Grasshopper Sparrow in Canada. These subspecies do, however, exhibit a number of morphological differences (Rising and Beadle 1996). For example, the Eastern Grasshopper Sparrow is darker than the Western Grasshopper Sparrow, with less rusty brown and more dark brown or black on the back, and a slightly larger bill (Rising and Beadle 1996).

Designatable Units

This assessment is based on a single designatable unit (DU); *Ammodramus savannarum pratensis,* which is a recognized subspecies of the Grasshopper Sparrow. As a named subspecies, it meets COSEWIC's guidelines for assigning DUs. *A. s. pratensis* also occupies a different ecozone from the other subspecies of Grasshopper Sparrow occurring in Canada, *A. s*. *perpallidus,* with *A. s. pratensis* occurring in the Mixedwood Plains ecozone and *A. s. perpallidus* occurring in the Prairie ecozone.

Special Significance

The Eastern Grasshopper Sparrow may be beneficial to forage crops in Ontario and Québec because agricultural insect pests make up a large part of its diet (Vickery 1996).

There is no Aboriginal Traditional Knowledge available for the Eastern Grasshopper Sparrow in Canada.

DISTRIBUTION

Global Range

The Eastern Grasshopper Sparrow has a large breeding range in North America (Figure 2), and includes southwestern Québec (Savignac *et al.* 2011), south-central Ontario (corresponding to the northern limits of its range; Vickery 1996), Michigan and Wisconsin, southern Maine, New Hampshire, northern Vermont, south to northern Georgia, Alabama, Mississippi, Arkansas, northeastern Texas, Oklahoma, eastern Kansas and Iowa (Vickery 1996).

The Eastern Grasshopper Sparrow probably overwinters in Arkansas, Tennessee, Georgia, eastern North Carolina, South Carolina, the Virginia coast, Maryland, Florida and the Caribbean (including the Bahamas, Cuba and Bermuda) and in Central America to Panama (Vickery 1996; Figure 2).

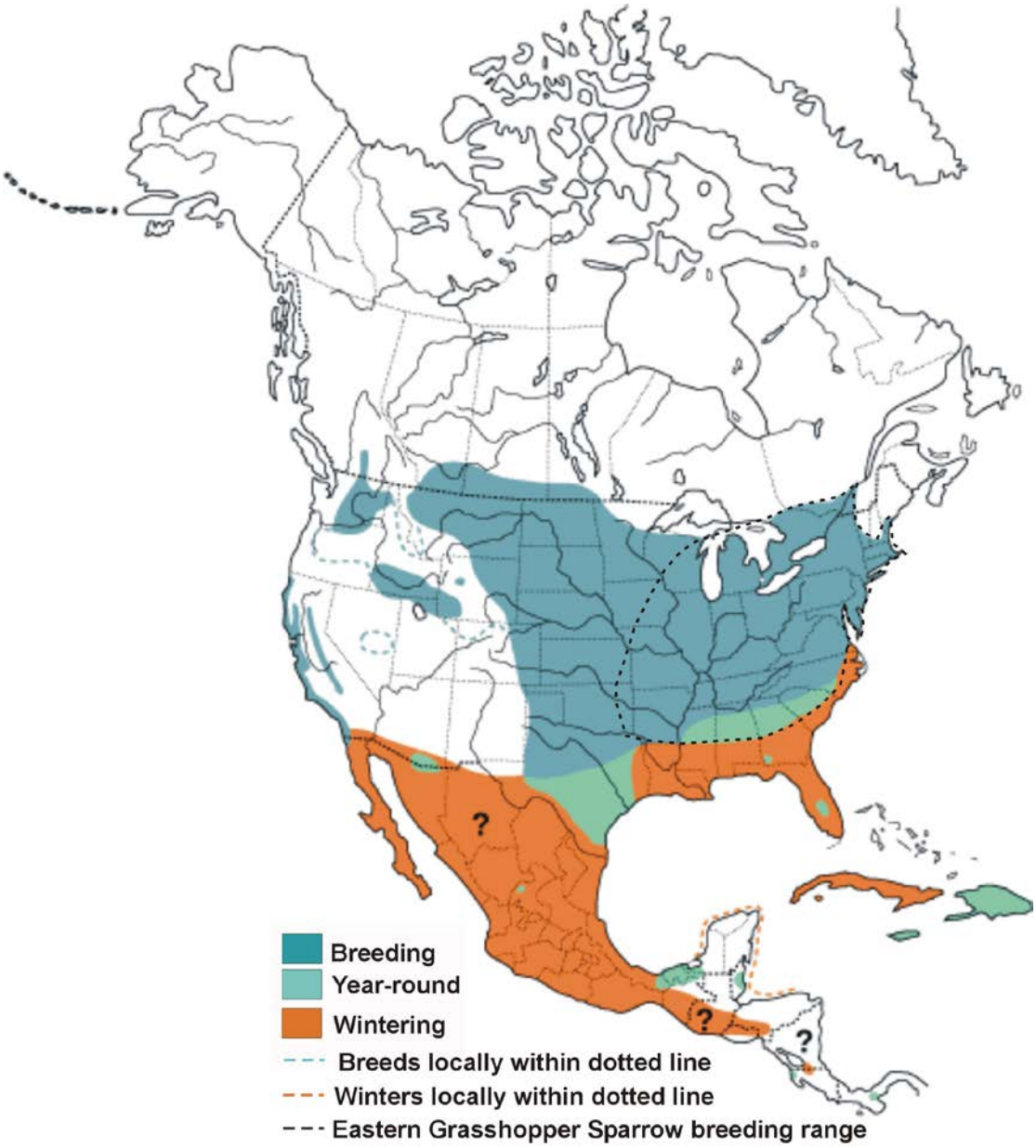

Figure 2. Distribution of the Grasshopper Sparrow in North America (modified from Vickery 1996, reproduced with permission from the Cornell Lab of Ornithology).

Canadian Range

The Canadian breeding range of the Eastern Grasshopper Sparrow (Figure 3) includes extreme southern Québec (Outaouais, Laurentides and Montérégie regions; Hainault 1995; Savignac *et al.* 2011) and southern Ontario (i.e., all areas south of the Algoma District, eastward; Earley 2007; Figure 3). In Ontario, as in Québec, the breeding range is primarily located south of the Canadian Shield, in the Mixedwood Plains ecozone (Earley 2007; Savignac *et al.* 2011).

Approximately 10% of the global breeding range of the Eastern Grasshopper Sparrow is in Canada and its extent of occurrence (EO) is estimated at 270,500 km^2 based on a minimum convex polygon (G. Falardeau, CWS, unpubl. data 2012). The results of the Ontario Breeding Bird Atlas (OBBA) suggest that the EO in Ontario is increasing (Earley 2007) largely due to new breeding occurrences recently found outside the known breeding range. The EO in Québec is decreasing (mainly in the Montérégie region, Savignac *et al.* 2011). The index of area of occupancy (IAO) based on a 2 km x 2 km grid superimposed on the species' known areas of occupancy cannot be calculated because the location of all nesting sites is not known. It is, however, likely above the threshold of 2000 km^2. This conclusion is supported by the results of the OBBA. That is, the results of the atlas indicate that the species is likely breeding in 285 atlas squares of 100 km^2 each (Cadman *et al.* 2007). Therefore, a pair was present in at least one 2 km x 2 km grid (4 km^2) within each atlas square, which would result in a minimum IAO of 1140 km^2. Given that territories tend to be clustered, it is likely that the density is greater than one pair per grid and could realistically be double. Together, this suggests that the IAO is likely greater than 2000 km^2. Current data suggest that the IAO is probably stable in Ontario but decreasing in Québec (i.e. Montérégie region; Savignac *et al.* 2011).

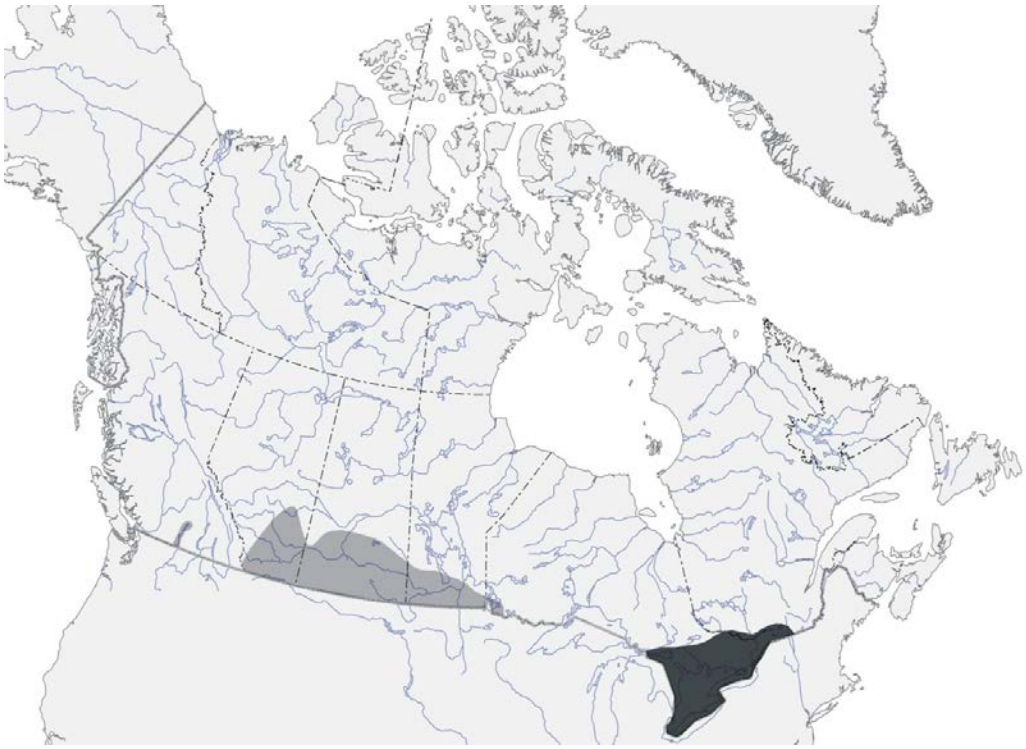

Figure 3. Canadian range of the Grasshopper Sparrow. The darkest area corresponds to the known breeding range of the Eastern Grasshopper Sparrow, and the lighter area corresponds to the breeding range of the Western Grasshopper Sparrow. Estimated range based on Hainault (1995), Campbell *et al.* (2001), Earley (2007), Federation of Alberta Naturalists (2007), Bird Studies Canada (2012a, b, c) and Savignac *et al.* (2011).

Search Effort

The data on the distribution of the Eastern Grasshopper Sparrow in Canada are drawn for the most part from work done on breeding bird atlases that were conducted in Ontario in the 1980s and again in early 2000s (Cadman *et al.* 1987; 2007) and in Québec, conducted in the 1980s and at the end of the 2000s (Gauthier and Aubry 1995; Bird Studies Canada 2012c). Recent distribution data are also provided in the Québec Suivi de l'occupation des stations de nidification des populations d'oiseaux en péril du Québec (SOS-POP) database (SOS-POP 2008).

HABITAT

Habitat Requirements

In Canada, the Eastern Grasshopper Sparrow typically nests in medium to large grasslands (ranging from 6 to 37 ha in Québec; Jobin and Falardeau 2010), on well-drained, often poor, dry soil (with patches of bare ground), with relatively low, sparse perennial herbaceous vegetation cover, with few shrubs (Peck and James 1987; Hainault 1995; Vickery 1996; Ribic and Sample 2001; Balent and Norment 2003; Chapman *et al.* 2004; Thogmartin *et al.* 2006; Jobin and Falardeau 2010). Areas occupied by the Eastern Grasshopper Sparrow in the Lake Simcoe-Rideau region are generally on sand, till moraines, and shallow soils over limestone beds (Earley 2007). The Eastern Grasshopper Sparrow is restricted to these specific habitats and is relatively rare throughout its range (Jobin and Falardeau 2010). The fields frequented by the Grasshopper Sparrow are typically large, uniform fields embedded in landscapes of grasslands and pastures with limited forest cover (Ribic and Sample 2001; Thogmartin *et al.* 2006; Earley 2007; Renfrew and Ribic 2008; Jobin and Falardeau 2010).

In Ontario, the Eastern Grasshopper Sparrow uses a variety of agricultural fields, from planted cereals (e.g. rye) to cattle pastures for breeding and feeding. Dry, close-grazed pastures such as those on till moraines (e.g. Mulmer Hills west of Lake Simcoe, the Dummer Moraine east of Peterborough, and the Oak Ridges Moraine north of Lake Ontario between the Toronto area and Trenton), and limestone plains like the Carden and Napanee plains and Dufferin County, support the highest densities of Grasshopper Sparrow in the province (D.A. Sutherland, pers. comm. 2012). A fairly extensive area around the Napanee Plain, including Prince Edward County and parts of Northumberland also show high densities (M. Cadman, pers. comm. 2013).

The Eastern Grasshopper Sparrow nesting in the Great Lakes Basin and southwestern Québec prefers anthropogenic habitats, such as pastures and hayfields (Corace III *et al.* 2009; Jobin and Falardeau 2010), recently abandoned fields, grassy fields at airports, young conifer plantations and restored mine sites with herbaceous cover, provided the various habitat components are present (Peck and James 1987; Bollinger 1988; Best *et al.* 1995; Cannings 1995; Delisle and Savidge 1997; Galligan *et al.* 2006; Jobin and Falardeau 2010). Jobin *et al.* (2008) describe the habitat of the Eastern Grasshopper Sparrow in southern Québec as fields on poor, dry soils, sometimes recently abandoned, that are not regularly mowed or grazed, having a sparse, heterogeneous structure.

The Eastern Grasshopper Sparrow also uses natural grasslands (Earley 2007; The Couchiching Conservancy 2011) such as alvars dominated by *Schizachyrium scoparium* and *Danthonia spicata* (D. Sutherland pers. comm. 2012). Examples include the Carden Plain and the Rice Lake area in the Lake Simcoe-Rideau region of southern Ontario, which supports one of the highest densities of Eastern Grasshopper Sparrows in the province (Earley 2007).

The Grasshopper Sparrow may also nest in annual row crops such as corn, wheat and barley, although densities are lower than in uncultivated habitats (Basore *et al.* 1986; Dechant *et al.* 1998; McMaster and Davis 1998; Dale *et al.* 2005). Grassland habitats rarely used by the Eastern Grasshopper Sparrow include old fields where the density of small shrubs and other vegetation is too high, and “enriched” cropland, such as dense hayfields or intensively grazed seeded pasture with few perches (Wiens 1969; Slater 2004; Jobin and Falardeau 2010).

At the microhabitat scale, various structural components of the habitat are important such as moderate vegetation height (25-50 cm on average; Patterson and Best 1996; Jobin and Falardeau 2010), relatively low bare soil cover (mean of 17%), relatively large areas of dead (46%) and live (36%) herbaceous vegetation (Patterson and Best 1996; Jobin and Falardeau 2010), and a moderately thick litter layer (4 cm; Wiens 1969; Jobin and Falardeau 2010). Breeding sites selected by the Eastern Grasshopper Sparrow are often dominated by plant species that are adapted to poor, dry soils, such as *Poa* spp., *Elytrigia repens*, *Potentilla* spp. (*argentea* and *reptans*), *Danthonia spicata*, *Fragaria virginiana* and *Phleum pratense* (Jobin and Falardeau 2010). Perches, such as mullein stalks (*Verbascum thapsus*) and short scattered shrubs are often present (Jobin and Falardeau 2010).

The Grasshopper Sparrow’s wintering habitat is similar to its breeding habitat, i.e. arid grasslands with reduced vegetation cover (Vickery 1996; Gordon 2000).

Habitat Trends

Before European settlement (pre-1700), the Eastern Grasshopper Sparrow may have been present south of the Canadian Shield in small numbers, primarily in alvars, natural prairies, savannahs and in agricultural land cleared by First Nation communities (Cadman *et al.* 2007). Extensive clearing of forests by Europeans in the late 1800s in the Mixedwood Plains ecozone and the subsequent increase in forage lands favoured the expansion of Eastern Grasshopper Sparrow habitat in southern Ontario (Cadman *et al.* 2007) and southern Québec (Gauthier and Aubry 1995). However, since the 1980s, its habitat has declined significantly, particularly in extreme southern Ontario (Carolinian Region; Earley 2007) and in southern Québec (Jobin *et al.* 2007; Savignac *et al.* 2011). Agricultural intensification through the conversion of livestock pasture to annual crops (such as corn and soy beans), and intensively cultivated field crops (e.g. cereals) is believed to be the primary cause of the decline in Grasshopper Sparrow habitat (Earley 2007; Savignac *et al.* 2011).

In Ontario, the 2011 census of agriculture shows a strong trend toward the creation of row crops at the expense of hay and pasture, especially over the last 10 years (Ontario Ministry of Agriculture and Food 2013).

In Québec, habitat for the Eastern Grasshopper Sparrow has also declined in recent decades. In the St. Lawrence lowlands, between 1971 and 1988, the number of dairy farms, which have suitable habitat for the Eastern Grasshopper Sparrow, decreased by 50% because of industrialization and urbanization (Jobin *et al.* 1996). The area planted to corn, soybean and wheat crops increased by 23% between 1960 and the mid-1990s due, among other things, to new policies favouring cereal production for livestock feed (Jobin *et al.* 1996, 2007; Bélanger and Grenier 2002; Latendresse *et al.* 2008). In the Outaouais region, 4/7 sites (57%) between 1988 and 1989 (Hainault and St-Hilaire 1989), and 11/32 sites (34%) between 1989 and 1990 (St-Hilaire 1990) were lost due to conversion to cropland and pasture. Habitat losses were also high in the 2000s, with 9/36 (25%) suitable sites in the Pontiac region converted to other uses between 2004 and 2005 (Jobin and Falardeau, unpubl. data 2011).

Overall, 36% of the 72 known historical sites in Québec in 2008 (all considered high quality) were reportedly converted to cropland, with a habitat suitability index of low to nil. Fifteen percent of the sites were considered to have a moderate suitability index (e.g., recent conversion to pine plantations—which are still of low density or hayfields cut in June and July), and 49% of the sites were still considered to have a high habitat suitability index for the Grasshopper Sparrow (Jobin and Falardeau, unpubl. data 2011).

In part of the species wintering range, namely southern Florida (Vickery 1996), the habitat of the Eastern Grasshopper Sparrow is declining, particularly in the dry prairie, due to fire suppression activities (Butler *et al.* 2009).

BIOLOGY

Reproduction

The Eastern Grasshopper Sparrow is monogamous (Ammer 2003), but occasional polygyny is possible (Vickery 1996). The sparrow arrives on its breeding grounds in early May (varies from mid-April to late May; Smith 1968; Weir 1989; Vickery 1996) with males arriving 5 to 10 days before females (Vickery 1996). Pair formation occurs as soon as the females arrive and nest construction generally begins immediately after pair formation (Vickery 1996). The nest is built in two to three days by the female alone and consists of a simple cup nest on the ground domed with grass or dead vegetation (Vickery 1996; Slater 2004). The Eastern Grasshopper Sparrow typically produces two broods per year (Wiens 1969; Peck and James 1987; Vickery *et al.* 1992). The Grasshopper Sparrow may initiate an additional brood following nest loss and may even attempt up to four broods in the same breeding season (Vickery 1996).

The average clutch size in Ontario is 4 to 5 eggs (Peck and James 1987). Clutch size typically decreases with increasing nest initiation date (Sutter and Ritchison 2005; Giocomo *et al.* 2008).

Nestlings are fed by both adults, sometimes assisted by non-breeding adults and unrelated juveniles (Kaspari and O'Leary 1988). The nest rearing period is relatively short and lasts about 8 or 9 days (Vickery 1996). In Ontario, Eastern Grasshopper Sparrow chicks were reported to fledge between 20 June and 7 July (Weir 1989). The young are unable to fly when they leave the nest and both parents participate in post-fledging care for a period ranging from 4 to 19 days (Vickery 1996).

Breeding success is highly variable and depends on predation pressure (Vickery 1996). It ranges from 7 to 83% throughout the breeding range of the Eastern Grasshopper Sparrow (Gill *et al.* 2006; Giocomo *et al.* 2008). Hovick *et al.* (2011) estimated post-fledging survival at sites in Iowa at only 21%. The mortality was attributed to high rates of predation.

Age at first breeding is the first spring after hatching (Vickery 1996). Generation time (average age of adults in the population) is estimated at approximately 1.5 years.

Survival

No detailed information is available on survival or longevity of the Eastern Grasshopper Sparrow in Canada. Its life span is generally less than 3 years, although a maximum longevity of 6.6 years has been reported for a bird captured in Florida (Delany *et al.* 1993).

The apparent survival rate of the Grasshopper Sparrow is expressed as the return rate of banded adult birds. The apparent return rate for Eastern Grasshopper Sparrow ranges from 15% in Kentucky (Sutter and Ritchison 2005); 33% in New York (Balent and Norment 2003) and 57% in Maryland (Gill *et al.* 2006). In New York, the apparent return rates of males (29%) and females (27%; Balent and Norment 2003) are similar, but differ in Maryland (57% for adult males and 41% for females, Gill *et al.* 2006). Year-old birds tend to have lower return rates than older adults, ranging from 0% to 12% (Balent and Norment 2003; Gill *et al.* 2006; Jones *et al.* 2007).

Dispersal and Migration

The Eastern Grasshopper Sparrow is a short-distance migrant, arriving on its breeding grounds in about mid-April and leaving beginning in late August (Weir 1989; Vickery 1996; Savignac *et al.* 2011).

Little is known about the migration routes of the Eastern Grasshopper Sparrow due to its secretive behaviour, but it is likely that individuals coming from Canada migrate along the east coast of the United States to the Caribbean, passing through Florida (Vickery 1996).

Diet and Foraging Behaviour

During the breeding season, the Eastern Grasshopper Sparrow feeds almost exclusively on the ground in low vegetation or patches of bare ground (Vickery 1996). Its diet consists primarily of insects and seeds (Vickery 1996). In the southeastern United States, prey items consist primarily of grasshoppers (ca. 80%), followed by Lepidopteran larvae (Kaspari and Joern 1993; Alder and Ritchison 2011).

In winter, the Grasshopper Sparrow's diet changes to consist primarily of seeds (Martin *et al.* 1951).

Interspecific Interactions

There are no detailed studies on the predators of the Eastern Grasshopper Sparrow. However, species associated with agricultural areas, such as the Raccoon (*Procyon lotor*), Striped Skunk (*Mephitis mephitis*), Red Fox (*Vulpes vulpes*) and American Crow (*Corvus brachyrhynchos*), are likely frequent nest predators (Jobin and Picman 2002). In Wisconsin, Raccoons and ground squirrels (*Citellus* spp.) are believed to be the main predators (Renfrew and Ribic 2003; Renfrew *et al.* 2005). Other predators documented throughout its range include weasels (*Mustela* spp.), domestic cats (*Felis catus*), and several species of snakes (Vickery 1996; Herkert *et al.* 2003; Renfrew and Ribic 2003; Renfrew *et al.* 2005; Galligan *et al.* 2006).

During the breeding season, the Grasshopper Sparrow may compete with other species of sparrows for insects and seeds. The Savannah Sparrow (*Passerculus sandwichensis*) uses the same type of habitat as the Grasshopper Sparrow and countersinging between the two species has been observed (Wiens 1969). The Savannah Sparrow is dominant over the Eastern Grasshopper Sparrow in Wisconsin, but in Maine and Pennsylvania, the two species breed in sympatry (Vickery 1996). The Eastern Meadowlark (*Sturnella magna*) and Bobolink (*Dolichonyx oryzivorus*) are known to displace Grasshopper Sparrows from singing posts (Vickery 1996).

Home Range and Territory

The Eastern Grasshopper Sparrow exhibits nest site fidelity (Dornak 2010). Territory sizes are not known for Québec or Ontario, but range from an average of 0.3 ha to 1.4 ha across various U.S. states (Smith 1968; Wiens 1969; Wray II 1979; Crossman 1989).

Research on the conspecific Florida Grasshopper Sparrow suggests that adults are not territorial in winter, with males and females sharing common home ranges varying in size from 1.0 to 173.6 ha (n = 44) (Dean 2001).

Behaviour and Adaptability

Eastern Grasshopper Sparrow abundance increases in response to prescribed burns (Coppedge *et al.* 2008; With *et al.* 2008; Butler *et al.* 2009). Frequent burns (e.g., annual) in habitat dominated by tall grasses favours optimal vegetation cover for breeding (Powell 2008). In contrast, the Eastern Grasshopper Sparrow shows less tolerance for prescribed burns in the arid grasslands of Ontario. Here prescribed burns often stimulate mass germination of the invasive *Melilotus albus* (Kline 1986), which renders the habitat unsuitable for the species (D.A. Sutherland, pers. comm. 2013).

The Eastern Grasshopper Sparrow generally responds positively to low to moderate grazing intensity in pasture settings. Low grazing pressure can create or maintain habitats with a more horizontally and vertically diversified plant structure, which is favourable to the Grasshopper Sparrow (Patterson and Best 1996; Delisle and Savidge 1997; Powell 2008). It does not, however, tolerate intensive grazing (Bock *et al.* 1993; Saab *et al.* 1995; With *et al.* 2008).

In the Outaouais region of Quebec, the Eastern Grasshopper Sparrow re-occupied sites two or three years following abandonment of corn and strawberry crops (Jobin and Falardeau 2010), suggesting that habitat management and restoration activities may benefit the sparrow within a short period of time.

The Grasshopper Sparrow may respond favourably to mowing before or after the breeding period due to the similarity of the vegetation structure to that of its preferred habitat (Delisle and Savidge 1997; Ingold 2002).

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

North American Breeding Bird Survey (BBS)

The BBS is a program that surveys North American breeding bird populations (Sauer *et al.* 2011). Breeding bird abundance data are collected by volunteers at 50 stops spaced at 0.8 km intervals along permanent 39.2 km routes (Environment Canada 2009). Every bird seen or heard within a 400-m radius is recorded. In Canada, the surveys take place in June, during the breeding season of most species. They begin one half hour before sunrise and are completed within approximately 5 hours.

The use of BBS data to monitor the Eastern Grasshopper Sparrow has several drawbacks including: (1) the birds sing infrequently and early in the morning, reducing detections (Hochachka *et al.* 2009; B. Jobin pers. comm. 2012); (2) there are relatively few routes covering the breeding habitat of the species in Québec and the density of nesting birds per route is also low, so trends cannot be determined for Quebec and (3) the surveys are limited to secondary roads and underestimate detections of birds within more isolated habitats (Dale *et al.* 2005).

Ontario Breeding Bird Atlas (OBBA)

The Ontario Breeding Bird Atlases (1981-1985 and 2001-2005) provide another source of information on population abundance and trends for the Eastern Grasshopper Sparrow in Canada because most are breeding in Ontario (Cadman *et al.* 2007). Surveys are volunteer-based, with observers recording evidence of breeding in 10 km X 10 km squares. Observers aim for a minimum of 20 hours of effort per square (Cadman *et al.* 2007). For Ontario, the percent change in the probability of observation of the Eastern Grasshopper Sparrow over a 20-year period was calculated by comparing the percentages obtained in the first atlas period to the second atlas period for the 10-km squares where breeding indices were recorded, adjusting for observation effort (e.g., squares having a minimum of 20 hours of coverage; Cadman *et al.* 2007). The probability of observation is the likelihood that a species was reported in the first 20 hours of fieldwork in an average atlas square.

Atlas data are valuable for comparing temporal changes in the distribution of breeding birds. Comparing the probability of observation in the two periods is considered adequate for estimating Grasshopper Sparrow population trends given the large number of samples collected during the two periods and the standardized methodology used (Cadman *et al.* 2007). In addition, this program generally covers the entire breeding range of the Eastern Grasshopper Sparrow in Ontario (Cadman *et al.* 2007).

Monitoring of nest site use by populations of bird species at risk in Quebec (SOS-POP)

In Québec, volunteer birders have been monitoring nest sites occupied by species at risk since 1994 under the SOS-POP program. The SOS-POP database also contains survey data from the Regroupement QuébecOiseaux, the Canadian Wildlife Service (CWS), and the Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs du Québec (MDDEFP), that manage the database. The data are used to protect the nesting sites of these species. To optimize monitoring, survey instructions and priorities are established annually by a steering committee (Regroupement QuébecOiseaux 2012).

Abundance

BBS data indicate that between 1987 and 2006, the abundance of Eastern Grasshopper Sparrows in eastern North America was low, with fewer than seven birds per route. In Ontario and Québec, abundance is below three birds per route (Environment Canada 2009; Figure 4).

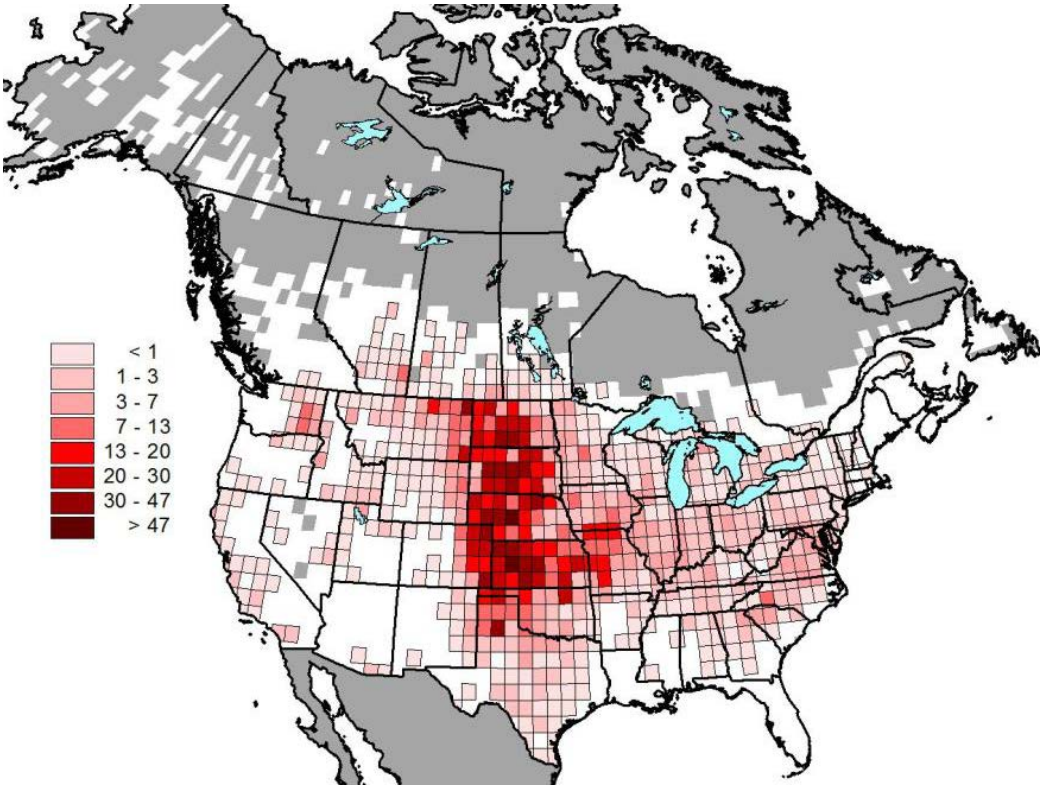

Figure 4. Relative abundance of the Grasshopper Sparrow (all subspecies) calculated for each degree block of latitude and longitude between 1987 and 2006 during the breeding season according to the North American Breeding Bird Survey (BBS). Grey areas = not sampled by the BBS; white areas = areas sampled but no Grasshopper Sparrows found (Environment Canada 2009).

Table 1. Estimated population size and relative abundance of the Eastern Grasshopper Sparrow in Canada based on BBS data.

Province	Population size (adults)	% of global population	Relative abundance from BBS (birds/route)	Standard deviation of relative abundance	Number of BBS routes	Number of routes detecting Grasshopper Sparrows
ON	30,000	0.2	0.07	0.01	131	38
QUE	80	0.0	0.00	0.00	99	1
Total	**30,080**	**0.2**				

Based on BBS data, the North American Grasshopper Sparrow population totals 8.6 million breeding birds, or 4.3 million breeding pairs (Rich *et al.* 2004). According to the same data, the breeding population of the Eastern Grasshopper Sparrow in Canada accounts for only 0.2% of the North American population, or approximately 30,000 birds (15,000 breeding pairs), almost all of which occur in Ontario (Table 1).

Due to its greater sampling effort, the Ontario Breeding Bird Atlas provides a more reliable abundance estimate of the Eastern Grasshopper Sparrow (Blancher and Couturier 2007). In Ontario, the breeding population was estimated at 50,000 adults, or 25,000 breeding pairs (Blancher and Couturier 2007). According to these authors, 86% of the Ontario population occurs in the Lake Simcoe-Rideau region. For Québec, the total number of mature individuals, estimated from Canadian Wildlife Service surveys conducted in 2004 and 2005, was between 200 and 400 or 100 and 200 breeding pairs (Savignac *et al.* 2011). The total number of mature individuals of the Eastern Grasshopper Sparrow in Canada is roughly between 50,200 and 50,400.

Fluctuations and Trends

Historically, the Eastern Grasshopper Sparrow probably nested in small numbers in natural arid grasslands (e.g., alvars) and grasslands maintained by Aboriginal peoples in southern Ontario and Québec (Cadman *et al.* 2007). It benefited significantly from the increase in pastureland and other forage land resulting from forest clearing by the early European settlers (Vickery 1996; Brennan and Kuvlesky 2005; Earley 2007). For example, the Grasshopper Sparrow was reportedly rare in Ontario in the 1800s, but expanded its range northward by 330 km after 1900 following intensive forest clearing for agriculture (Weir 1989). More recently, the conversion of pastures and other forage lands to intensive crops, such as corn and soybean, habitat fragmentation and habitat loss due to urban development since the 1950s have reversed the trend and the Eastern Grasshopper Sparrow is now in decline in several parts of its range (Earley 2007; Savignac *et al.* 2011).

North American Breeding Bird Survey (BBS)

Long-term BBS data for Ontario, where the majority of birds occur, showed a significant annual rate of decline of 1.5% (CI: -2.98, -0.058, n = 61 routes, A. Smith, unpubl. data 2013; Figure 5) between 1970 and 2011 for a population loss of 46% over the last 41 years. Short-term BBS data showed a non-significant annual rate of decline of 1.39% (CI: -3.87, 1.16, n = 57 routes, A. Smith, unpubl. data 2013; Figure 5) for a population loss of 13% over the last 10 years.

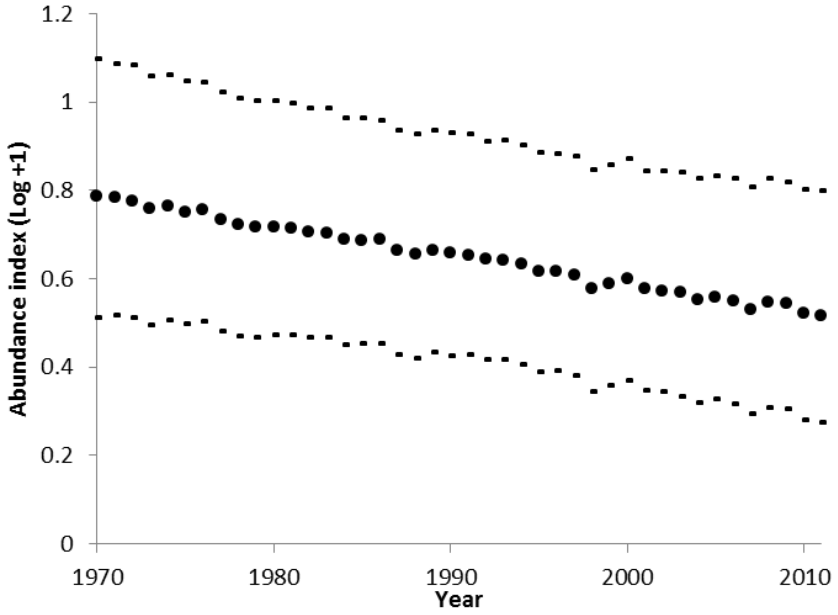

Figure 5. Annual abundance index for Ontario between 1970 and 2011 (with 95% confidence intervals) according to a hierarchical Bayesian model of BBS data (A. Smith, unpubl. data 2013).

Ontario Breeding Bird Atlas

A comparison of the distribution of Eastern Grasshopper Sparrow between the first and second atlas periods (1981-1985 and 2001-2005) shows a non-significant decline of 17% in the probability of observation for the entire province (Cadman *et al.* 2007) over the 20-year period. This amounts to a decline of approximately 9% over the last 10 years. However, the Grasshopper Sparrow has undergone a significant decline of 48% in the Carolinian region because its habitat is being converted into intensive row-crop agriculture at a high rate (Cadman *et al.* 2007). In the Lake Simcoe-Rideau region, where most of the Eastern Grasshopper Sparrows in Ontario occur, the population has undergone a non-significant decline of 5% since the 1980s (Cadman *et al.* 2007). There are too few occupied atlas squares to estimate population trends for the other regions of the province (Cadman *et al.* 2007; Figure 6).

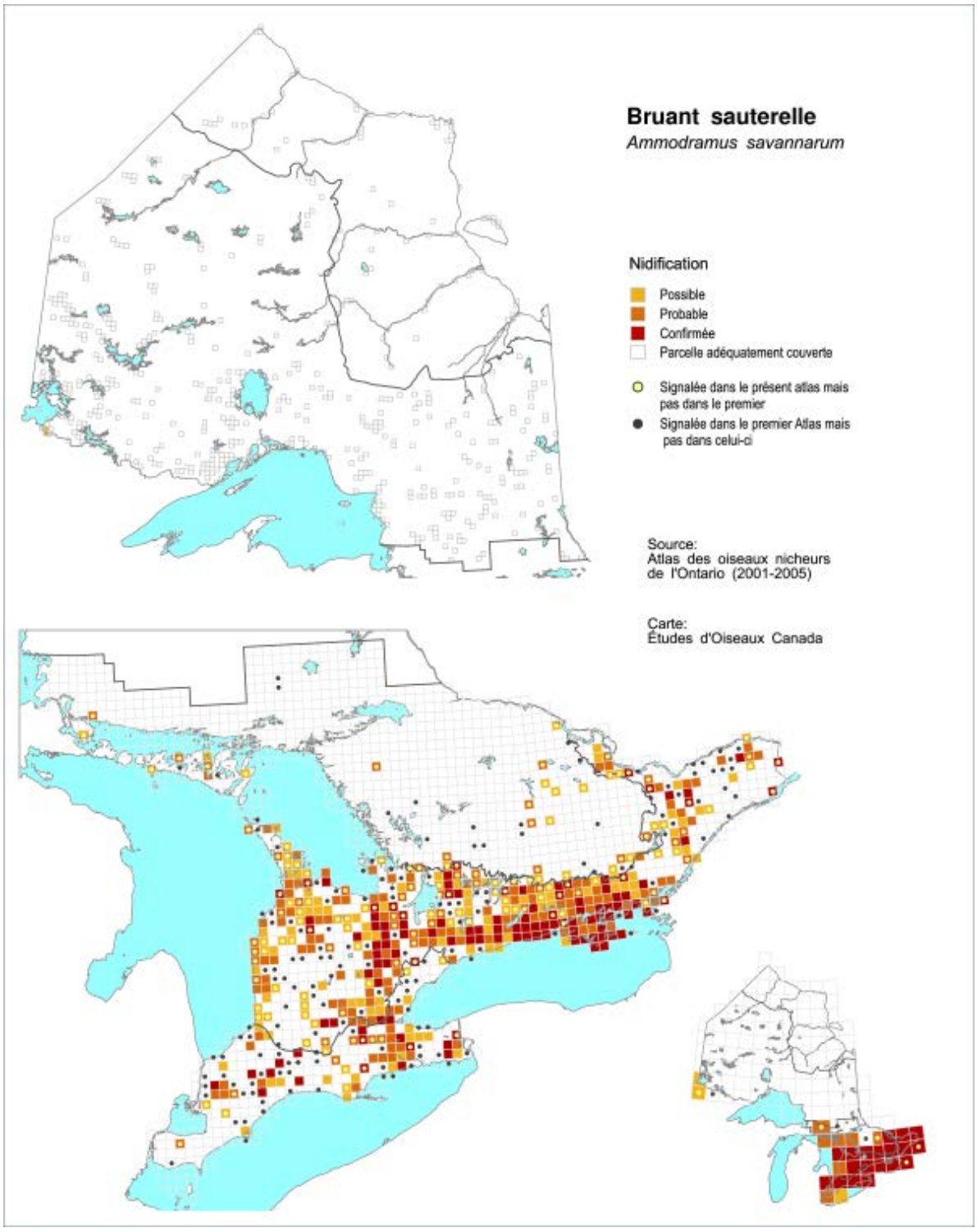

Figure 6. Distribution of the Eastern Grasshopper Sparrow in Ontario in 2001-2005 (reproduced with the permission of Cadman *et al.* 2007). The squares with black dots correspond to squares where the Eastern Grasshopper Sparrow was present in the first atlas period (1980-1985), but not in the second (2001-2005) and the yellow dots, the opposite.

SOS-POP

An analysis was conducted to compare the occupation of sites by the Eastern Grasshopper Sparrow in southern Québec during the periods 1989-1998 and 1999-2008 (SOS-POP 2008). Only the 39 sites occupied during the first period and visited at least once in the second period were considered. A majority of sites visited once during the period 1999-2008 were no longer suitable for the species, while almost all sites that were still suitable were visited several times. The data show a decline of 36% (14/39) in the number of sites occupied during the period 1999-2008, mainly in the Montérégie region (Savignac *et al.* 2011). During the period 2004-2008, the Eastern Grasshopper Sparrow was detected at only 46% (32/69 sites) of the historically occupied sites (i.e., sites occupied since 1961; Figure 7).

In addition, the mean maximum number of birds observed per site declined significantly between 1989-1998 (2.67 ± 2.08, n = 39) and 1999-2008 (1.49 ± 2.62; Mann-Whitney U = 370.5; P < 0.001, n = 39; Savignac *et al.* 2011). The maximum number of birds per site was also higher during the first period for 85% of the known sites (Savignac *et al.* 2011). Search effort was higher in the 1999-2008 period (surveys along transects and song playback) than in the 1989-1998 period (passive point counts along roads), providing further evidence for the decline observed in southern Québec (Savignac *et al.* 2011).

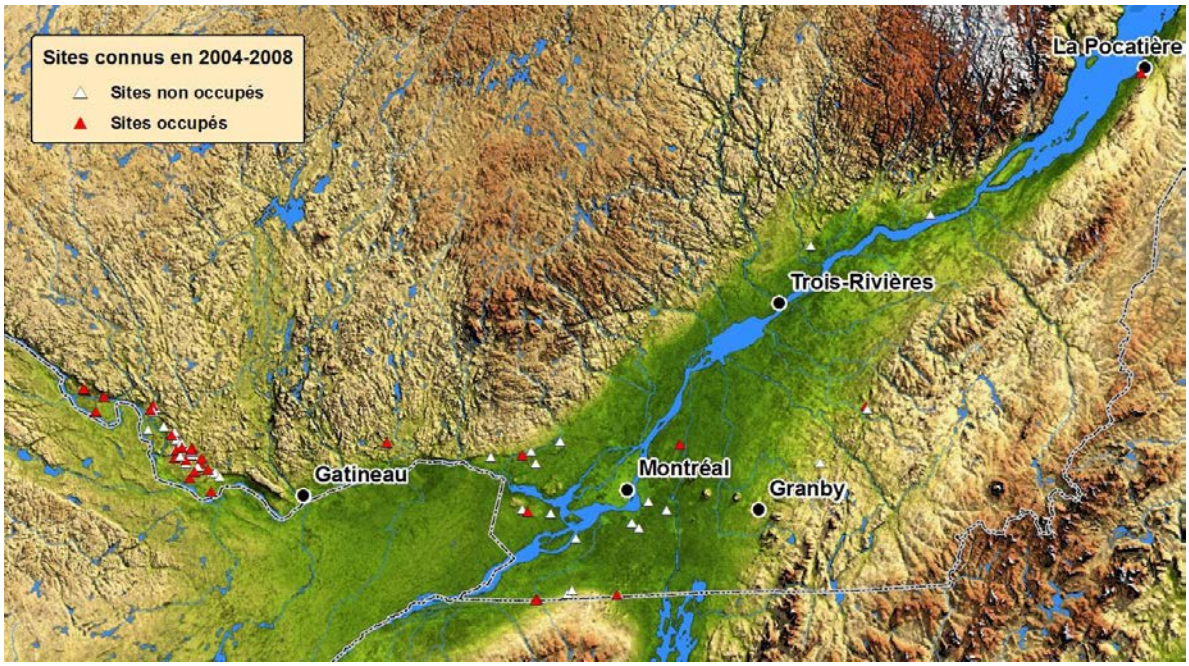

Figure 7. Changes in SOS-POP occurrence of Grasshopper Sparrow at 69 known sites in Québec since 1961 (SOS-POP 2008). The sites were visited during the period 2004-2008 (from Savignac *et al.* 2011). The white triangles represent 37 sites formerly occupied by the Eastern Grasshopper Sparrow and not occupied in 2004-2008 and the red triangles represent the 32 sites still occupied by the Eastern Grasshopper Sparrow. Legend: Known sites between 2004-2008; white triangle = unoccupied sites, red triangle = occupied sites.

Summary of Population Trends

In summary, BBS data indicate a significant long-term decline and a non-significant short-term decline in Eastern Grasshopper Sparrow populations in Ontario. The evidence of this decline in some parts of Ontario is supported by the results of the Ontario Breeding Bird Atlas, which indicate that the decline is associated primarily with the southernmost part of the province. In Québec, the SOS-POP database also suggests a decline in the Eastern Grasshopper Sparrow in most of its range.

RESCUE EFFECT

In the event of the future extirpation of the Canadian population of the Eastern Grasshopper Sparrow, immigration of individuals from U.S. states is possible. However, BBS survey data between 2001 and 2011 show declines in all adjacent states, ranging from 1.6 to 9.1% per year, with significant declines in both New York and Pennsylvania. (Sauer *et al.* 2011; Figure 8). These declines reduce the likelihood of rescue from the U.S. population.

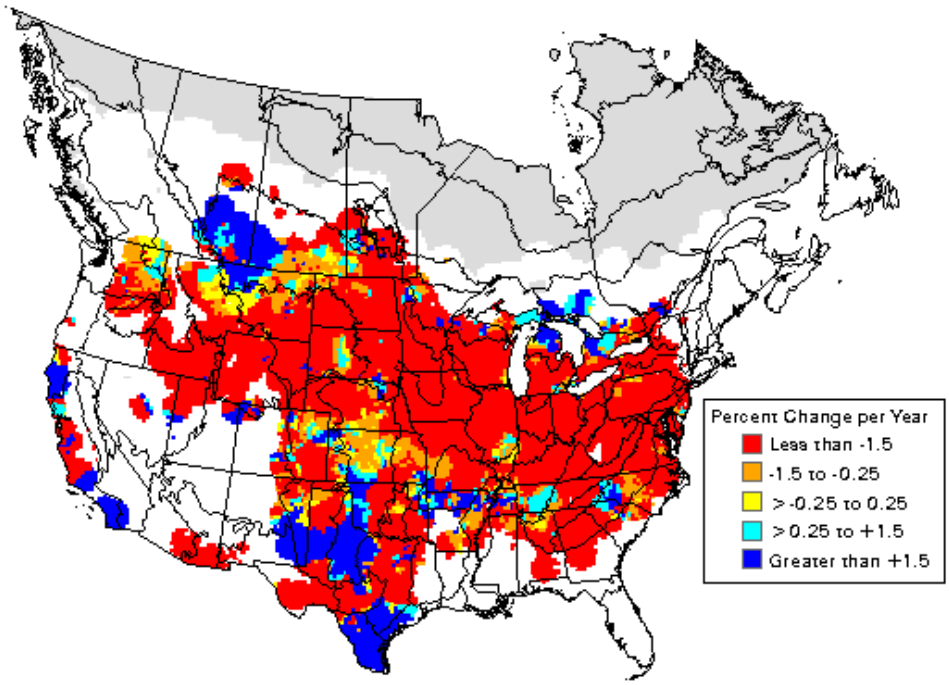

Figure 8. Map of BBS trends for the Grasshopper Sparrow in the United States and Canada for the period 1966-2011 (Sauer *et al.* 2011).

THREATS AND LIMITING FACTORS

Habitat Loss

Habitat loss is the main factor responsible for the decline of Eastern Grasshopper Sparrow numbers in Canada (Earley 2007; Savignac *et al.* 2011). In the Carolinian Region of Ontario, the Eastern Grasshopper Sparrow suffered a significant 48% decline in the probability of detection between atlases (i.e. from the 1980s to 2000s), primarily due to the intensification of crop production, resulting in the conversion of grassland habitats, such as pastures, to row crops (Earley 2007). The loss of Grasshopper Sparrow habitat in Ontario is also due in part to reversion to forest following the abandonment of agricultural fields (Earley 2007).

In Québec, habitat loss appears to be directly related to the intensification of agriculture characterized by the development of synthetic chemicals, surface drainage techniques, more high-performance machinery and new varieties of faster-growing plants, which have accelerated the conversion of perennial forage crops to annual crops (Jobin *et al.* 2007). The intensification of agriculture in southern Québec is particularly significant in the Montérégie region, where the Eastern Grasshopper Sparrow was historically relatively common. In this region, the area sown to intensive crops (corn, soybeans and grains) increased in 80% of the regional county municipalities between 1993 and 2001 (Jobin *et al.* 2007). This increase has been to the detriment of perennial crops (pastures, hayfields), which have declined significantly. A number of agriculturally unproductive fields used by the species have also been abandoned and left to succeed to forest or converted to conifer plantations (see Habitat Trends).

The loss of nesting habitat is also one of the most important limiting factors in the U.S. Upper Great Lakes region, where Eastern Grasshopper Sparrow densities are among the highest (Corace III *et al.* 2009). In this region, hayfield cover, the main habitat of the Eastern Grasshopper Sparrow, has declined significantly in 83% of 242 counties between 1966 and 2000 (Corace III *et al.* 2009).

Habitat Fragmentation and Predation

The Eastern Grasshopper Sparrow is reported to be sensitive to habitat size, and like many grassland birds responds negatively to smaller habitat patches (Johnson and Igl 2001; Balent and Norment 2003; Herkert *et al.* 2003; Davis 2004; Thogmartin *et al.* 2006). Habitat fragmentation also causes patch isolation, which increases the probability of local extinction and reduces the likelihood of recolonization by birds from other populations (Balent and Norment 2003; Slater 2004).

The Eastern Grasshopper Sparrow generally occurs on habitat patches of at least 6 ha (Vickery *et al.* 1994; Helzer 1996; Helzer and Jelinski 1999; Jobin and Falardeau 2010), although the minimum size of patches in some regions exceeds 30 ha (Askins 1993; Herkert 1994), and even 100 ha (Vickery *et al.* 1994; Davis 2004). In New York State, breeding success is clearly higher in fields greater than 8 ha (59%) than in smaller fields (< 8 ha; 25%; Balent and Norment 2003). The Eastern Grasshopper Sparrow also appears to be negatively associated with the presence of forest edges near its habitat (Johnson and Temple 1990; Vickery 1996; Jobin and Falardeau 2010). Nest density and breeding success of the Eastern Grasshopper Sparrow generally increases as a function of the distance from forest edges and appears to be higher in the centre of grassland patches (Wiens 1969; Bock *et al.* 1999; Helzer and Jelinski 1999; Balent and Norment 2003), due to higher predation rates near forest edges (Bock *et al.* 1999; Renfrew and Ribic 2003; Renfrew *et al.* 2005).

In fragmented habitats, the predation rate is generally high, ranging from 13 to 89% depending on the study (Patterson and Best 1996; Renfrew *et al.* 2005; Pranty and Tucker 2006; Giocomo *et al.* 2008; Hovick 2010). Nest and fledgling predation increases with the degree of habitat fragmentation (Patterson and Best 1996; Renfrew and Ribic 2003; Slater 2004; Renfrew *et al.* 2005; Galligan *et al.* 2006; Pranty and Tucker 2006; Giocomo *et al.* 2008; Hovick *et al.* 2011). According to Herkert *et al.* (2003), in five Great Plains states, predation is higher in patches of less than 100 ha than in large grassland patches (over 1,000 ha).

Mowing Activities

Although the Eastern Grasshopper Sparrow is tolerant of hay mowing activities before and after the breeding season, it does not adapt well to mowing during the breeding season (Vickery 1996). The modernization of agricultural techniques as well as a generally warmer climate promote earlier and more frequent hay cutting during the breeding season (up to two weeks earlier in some areas of northeastern North America; Martin and Gavin 1995; Jobin *et al.* 1996; Nocera *et al.* 2005). In the case of the Bobolink, Bollinger *et al.* (1990) found that egg and nestling mortality can be as high as 51% in hayfields cut during the breeding season in New York State. Additional mortality due to nest abandonment, nest predation and subsequent hay-cropping operations (weeding and baling) increased mortality in Bobolink to 94% (Bollinger *et al.* 1990).

Other Threats and Limiting Factors

Impact of Livestock Grazing

The Eastern Grasshopper Sparrow responds negatively to intensive livestock grazing in already arid, relatively unproductive grasslands (Bock *et al.* 1993; Saab *et al.* 1995; With *et al.* 2008). Intensive grazing not only reduces the abundance and height of the plants used as nesting cover, but also alters the composition and structure of grassland vegetation (Kantrud and Kologiski 1982; Holechek *et al.* 1982). Intensive grazing modifies the diversity and availability of insects on which grassland bird species feed (Quinn and Walgenbach 1990) and reduces reproductive success (Sutter and Ritchison 2005; With *et al.* 2008). In the United States, trampling by livestock results in significant nest destruction, ranging from 7 to 12% depending on the breeding stage (Jensen *et al.* 1990; Renfrew and Ribic 2003; Renfrew *et al.* 2005).

Climate Change

Several studies conducted in the U.S. Midwest show a negative effect of climate change on the productivity of the Eastern Grasshopper Sparrow. Habitat selection by this subspecies in the spring is closely associated with spring precipitation in a given region (Ahlering *et al.* 2009). Spring precipitation acts as an indicator of site productivity. More frequent periods of drought in the spring could therefore affect Eastern Grasshopper Sparrow nest site selection, insect density (With *et al.* 2008), proportion of plant cover, and the distribution of predators and competitors (Thogmartin *et al.* 2006).

Agricultural Chemicals

The density of Eastern Grasshopper Sparrow territories in Maine declined in the two- to five-year period following application of the herbicide hexazione (4 kg/ha) on low-bush blueberry (*Vaccinium angustifolia*) (Vickery 1993). Also there is a direct link between the decline in several species of farmland birds, including the Grasshopper Sparrow (Western and Eastern subspecies together), and large-scale application of granular pesticides to agricultural land (Potts 1986; Mineau 2005; Mineau and Whiteside 2006, 2013). Field tests also showed that highly toxic insecticides could kill Grasshopper Sparrows (Mineau and Whiteside 2013). Moreover, the various types of pesticides used in agriculture in North America are designed to eliminate insect pests, including several species of Orthoptera (Vickery 1996), which make up a large part of the Grasshopper Sparrow's diet.

Suppression of Grassland Fires

There are no data on the effect of fire suppression on the Eastern Grasshopper Sparrow for eastern Canada during the breeding season. However, the likelihood of occurrence of the Eastern Grasshopper Sparrow on its wintering grounds in the dry prairie of southern Florida is known to be twice as high when prescribed burns are conducted annually (Butler *et al.* 2009). Wintering habitat of the Florida subspecies has declined significantly due to fire suppression (Butler *et al.* 2009).

PROTECTION, STATUS AND RANKS

Legal Protection and Status

The Eastern Grasshopper Sparrow is protected in Canada under the *Migratory Birds Convention Act, 1994* (Environment Canada 2010a). This Act prohibits the possession or sale of migratory birds and their nests, as well as any activity that is harmful to migratory birds, their eggs and their nests, except in cases authorized by the *Migratory Birds Regulations*. This species is also protected in the United States and Mexico under similar legislation.

In Québec, the Eastern Grasshopper Sparrow is protected under the *Loi sur la conservation et la mise en valeur de la faune* (RLRQ, c. C- 61.1) (LCMVF) (Act respecting the conservation and development of wildlife) (CQLR, c. C-61.1) (Gouvernement du Québec 2013a), which prohibits the hunting, taking and keeping in captivity and sale of Grasshopper Sparrows, as well as the destruction or harm of its nests and eggs. Moreover, according to the *Loi sur la qualité de l'environnement* (RLRQ, c. Q-2) (Environment Quality Act) (CQLR, c. Q-2), managers of commercial and industrial projects that wish to modify the quality of the environment have to consider the Eastern Grasshopper Sparrow during impact assessment studies and to put in place protection measures (Gouvernement du Québec. 2013b). The Eastern Grasshopper Sparrow is on the *Liste des espèces susceptibles d'être désignées menacées ou vulnérables* (list of species likely to be designated threatened or vulnerable) according to the *Loi sur les espèces menacées ou vulnérables* (RLRQ, c E-12.01) (LEMV) (Act respecting threatened or vulnerable species) (CQLR, c E-12.01), which means that it is not yet afforded any protection under the *Act Respecting Threatened or Vulnerable Species* (R.S.Q., c. E-12.01).

Non-Legal Status and Ranks

Globally, the Grasshopper Sparrow as a whole has a rank of G5 (secure, last assessed 1996) (NatureServe 2013). According to the IUCN Red List, the species is considered Least Concern (NatureServe 2013) and has been added to the stewardship list of the North American Landbird Conservation Plan (Rich *et al.* 2004). The U.S. Fish and Wildlife Service considers it to be a species of conservation concern in the following U.S. Bird Conservation Regions: Prairie Potholes (BCR 11), Badlands and Prairies (BCR 17), and Eastern Tallgrass Prairie (BCR 22) (U.S. Fish and Wildlife Service 2002). In the United States, the Grasshopper Sparrow has a rank of N5 (secure) (NatureServe 2013), even though it is considered critically imperiled in three states, imperiled in three states and vulnerable in 10 states (NatureServe 2013).

In Canada, the Grasshopper Sparrow is assessed as apparently secure (N4B; NatureServe 2013) or secure according to the 2005 Canada General Status Rank, but the Eastern Grasshopper Sparrow has no conservation status rank. The species is considered apparently secure (S4B) in Ontario and imperiled (S2B) in Québec (NatureServe 2013). In Canada, the species is also recognized as a Priority species in BCR 13 (Lower Great Lakes/St. Lawrence Plain BCR) (Ontario Partners in Flight 2008). In Canada, neither the species nor the Eastern Grasshopper Sparrow is currently monitored or tracked by the Ontario or Québec biodiversity data centres. The General status rank indicates that the Eastern Grasshopper Sparrow is secure in Ontario and May be at risk in Québec.

Habitat Protection and Ownership

In Canada, suitable Eastern Grasshopper Sparrow habitat is primarily located on private agricultural lands (Natural Resources Canada, 2005; Savignac *et al.* 2011). Habitat protection is achieved mainly through voluntary conservation programs. For example, in Ontario, in the eastern Lake Simcoe sector and more specifically the Carden Plain, the Eastern Grasshopper Sparrow is locally common in large areas of native grassland (e.g., alvar) and pastureland protected by the Nature Conservancy of Canada, The Couchiching Conservancy and Ontario Parks (e.g., Cameron Ranch, Windmill Ranch, Prairie Smoke Preserve and North Bear Alvar, and several sectors in the Rice Lakes Plains) (D. Sutherland pers. comm. 2012).

Little information is currently available on the quantity of available habitat and level of habitat protection on public lands in Canada. According to Parks Canada's Biotics database, the Eastern Grasshopper Sparrow is not present in any protected areas managed by Parks Canada Agency in eastern Canada (Parks Canada 2011). In Ontario, the Grasshopper Sparrow is present in small numbers in several provincial parks including Bronte Creek, Carden Alvar (candidate Provincial Park), Peter's Woods Nature Reserve, Sandbanks Provincial Park, Burnt Lands Nature Reserve, and Presqu'ile Provincial Park (D. Sutherland pers. comm. 2012). Overall, protected areas on public lands represent a very small area.

The recovery program for the Loggerhead Shrike (*Lanius ludovicianus*), *migrans* subspecies, which could also benefit the Eastern Grasshopper Sparrow in Ontario, provides critical habitat identification (including short- to mid-grass pasture) on 6,800 ha of public and private lands in the sectors of Carden (3,581 ha) and Napanee (3,030 ha) Ontario (Environment Canada 2010b).

ACKNOWLEDGEMENTS AND AUTHORITIES CONTACTED

The author thanks Gilles Falardeau, Dave Fraser, Ken DeSmet, Brenda Dale, Chris Risley and Don Sutherland for sharing their knowledge of the ecology of the Eastern Grasshopper Sparrow; the Regroupement QuébecOiseaux and the Canadian Wildlife Service for sharing SOS-POP data; the official sponsors of the Ontario Breeding Bird Atlas (Bird Studies Canada, Canadian Wildlife Service, Ontario Nature, Ontario Field Ornithologists and the Ontario Ministry of Natural Resources) for providing data from the atlas; and the thousands of volunteer participants who collected data, with special thanks to all the volunteers who participated in the collection of BBS and SOS-POP data. Funding for this report was provided by the Canadian Wildlife Service of Environment Canada.

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