

Management Plan for the Short-eared Owl (*Asio flammeus*) in Canada

Short-eared Owl



2018



Government
of Canada

Gouvernement
du Canada

Canada

Recommended citation:

Environment and Climate Change Canada. 2018. Management Plan for the Short-eared Owl (*Asio flammeus*) in Canada. *Species at Risk Act Management Plan Series*. Environment and Climate Change Canada, Ottawa. v + 37 pp.

For copies of the management plan, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the [Species at Risk \(SAR\) Public Registry](http://sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1)¹.

Cover illustration: © Steve Garvie (Wikimedia Commons)

Également disponible en français sous le titre
«Plan de gestion du Hibou des marais (*Asio flammeus*) au Canada »

© Her Majesty the Queen in Right of Canada, represented by the Minister of Environment and Climate Change, 2018. All rights reserved.
ISBN 978-0-660-25764-8
Catalogue no. En3-5/94-2018E-PDF

Content (excluding the illustrations) may be used without permission, with appropriate credit to the source.

¹ <http://sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1>

Preface

The federal, provincial and territorial government signatories under the [Accord for the Protection of Species at Risk \(1996\)](#)² agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c. 29) (SARA), the federal competent ministers are responsible for the preparation of management plans for listed species of special concern and are required to report on progress within five years after the publication of the final document on the SAR Public Registry.

The Minister of Environment and Climate Change and Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Short-eared Owl and has prepared this management plan as per section 65 of SARA. To the extent possible, it has been prepared in cooperation with the following as per section 66(1) of SARA.

- Parks Canada Agency
- Department of National Defence
- Governments of the Northwest Territories, Alberta, Manitoba, Quebec, New Brunswick, Newfoundland and Labrador, and Nunavut
- Tłı̨ch̨o Government
- Gwich'in Renewable Resources Board
- Nunavut Wildlife Management Board
- Sahtú Renewable Resources Board
- Wek'èezhii Renewable Resources Board
- Wildlife Management Advisory Council (Northwest Territories)

Success in the conservation of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this plan and will not be achieved by Environment and Climate Change Canada and/or the Parks Canada Agency or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this plan for the benefit of the Short-eared Owl and Canadian society as a whole.

Implementation of this management plan is subject to appropriations, priorities and budgetary constraints of the participating jurisdictions and organizations.

² <http://registrelep-sararegistry.gc.ca/default.asp?lang=En&n=6B319869-1%20>

Acknowledgements

The Management Plan for the Short-eared Owl was prepared by Vincent Carignan and François Shaffer (Environment and Climate Change Canada, Canadian Wildlife Service [ECCC-CWS] – Quebec Region), in collaboration with Pierre-André Bernier (consulting biologist), Véronique Connolly (consulting biologist) and:

ECCC-CWS – Pacific and Yukon Region – Sofi Hindmarch, Andrea Norris and Pam Sinclair.

ECCC-CWS – Prairie and Northern Region – Donna Bigelow, Ryan Fisher, Samuel Haché, Lisa Pirie and Troy Wellicome.

ECCC-CWS – Ontario Region – Mike Cadman.

ECCC-CWS – Atlantic Region – Jen Rock and Peter Thomas.

Parks Canada Agency (PCA) – Diane L. Amirault-Langlais, Eric Tremblay, Joanne Tuckwell and Leah de Forest.

Government of the Northwest Territories – Department of Environment and Natural Resources: Joanna Wilson.

Government of British Columbia – Michael J. Chutter, Retzer Miller, Tori Stevens and Dave Trotter.

Government of Alberta – Ministry of Environment and Sustainable Resource Development: Mike Russell and Emily Herdman.

Government of Manitoba – Department of Conservation and Water Stewardship: James Duncan and Ken De Smet.

Government of Quebec – Ministère des Forêts, de la Faune et des Parcs: Isabelle Gauthier, Charles Maisonneuve and Antoine St-Louis.

Government of New Brunswick – Department of Natural Resources: Maureen Toner.

Government of Newfoundland and Labrador – Department of Environment and Conservation: Jessica Humber.

Additional contributors include: Geneviève Langlois and Charles Clavet (ECCC-CWS – Quebec Region); Nataika Melnycky and Kaytlin Cooper (Gwich'in Renewable Resources Board), Deborah Simmons and Catarina Owen (Sahtú Renewable Resources Board); and Karla Letto (Nunavut Wildlife Management Board).

Finally, we thank all other parties, including landowners, citizens and stakeholders who provided comments on this document or information used to produce the management plan, as well as the thousands of volunteers who participated in bird surveys through citizen science projects.

Executive Summary

The Short-eared Owl is a bird found in natural and anthropogenic open habitats throughout Canada. The species was designated as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 1994 and 2008 and has been listed as such in Schedule 1 of the *Species at Risk Act* (SARA) since 2012.

Around 300,000 individuals and 63% of the Short-eared Owl's North American breeding range are in Canada. The species breeds in all provinces and territories, but is most common in the Prairies (Alberta, Saskatchewan and Manitoba) and along the Arctic coast. Short-eared Owl populations experienced a mean annual decline of between 2.3% and 5.2% from the 1960s or 1970s to 2012, but the population size seems appears to have stabilized between 2002 and 2012.

The main threats to the Short-eared Owl population are habitat loss and degradation (agriculture, urban and commercial development, energy production and mining), activities that affect individuals, nests and eggs (grazing, mowing and harvesting, pesticide use, collisions), and climate change.

The management objectives for the Short-eared Owl in Canada are:

- In the short term: Stabilize or increase the population trend over the 2018-2028 period and maintain the area of occupancy at 1,500,000 km²; and
- In the long term: Ensure a positive 10-year population trend starting in 2028, while promoting an increase in the area of occupancy, including the gradual recolonization of areas in the southern portion of the Canadian range.

The broad strategies that are required to achieve the management objectives are as follows:

- Conservation and management of the species and its habitat across the breeding, migration and wintering ranges;
- Conducting surveys, monitoring and research on the species, its habitats and threats across the breeding, migration and wintering ranges; and
- Promoting awareness and partnerships in relation to conservation priorities.

Table of Contents

Preface.....	i
Acknowledgements	ii
Executive Summary	iv
1. COSEWIC Species Assessment Information	1
2. Species Status Information	1
3. Species Information	3
3.1. Species Description	3
3.2. Species Population and Distribution.....	3
3.3. Needs of the Short-eared Owl.....	7
4. Threats.....	8
4.1. Threat Assessment	8
4.2. Description of Threats	11
5. Management Objectives	14
6. Broad Strategies and Conservation Measures.....	15
6.1. Actions Already Completed or Currently Underway	15
6.2. Broad Strategies	18
6.3. Conservation Measures	19
7. Measuring Progress	23
8. References.....	24
Appendix A: Areas of Interest for the Conservation of the Short-eared Owl in Canada	35
Appendix B: Effects on the Environment and Other Species	37

1. COSEWIC* Species Assessment Information

Date of Assessment: April 2008

Common Name (population): Short-eared Owl

Scientific Name: *Asio flammeus*

COSEWIC Status: Special Concern

Reason for Designation: This owl has suffered a continuing population decline over the past 40 years, including a loss of 23% in the last decade alone.³ Habitat loss and degradation on its wintering grounds are most likely the major threat, while continuing habitat loss and degradation on its breeding grounds in southern Canada and pesticide use are secondary threats. This species nearly meets the criteria for Threatened status.

Canadian Occurrence: Yukon Territory, Northwest Territories, Nunavut, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland and Labrador

COSEWIC Status History: Designated Special Concern in April 1994 and April 2008.

* COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

2. Species Status Information

Approximately 63% of the North American breeding range of the Short-eared Owl is in Canada (COSEWIC, 2008). The species was listed as Special Concern in Schedule 1 of the *Species at Risk Act* (S.C. 2002, c. 29) (SARA) in 2012. The Short-eared Owl is not protected under the *Migratory Birds Convention Act, 1994* (S.C. 1994, c. 22). Although it is protected under most provincial and territorial wildlife legislation, it is listed in only a few pieces of legislation pertaining to species at risk (Table 1).

NatureServe (2015) considers the global population of the Short-eared Owl to be Secure (G5; assessment as of November 2014). The Canadian population is considered Apparently Secure (N4) during the breeding season and Vulnerable (N3) during the non-breeding (wintering) season (assessments as of February 2012). The breeding and non-breeding populations in the United States are considered Secure (N5; assessment as of January 1997). Table 1 shows the subnational (S) rank for each province and territory. Booms et al. (2014) state that the national rankings of secure or apparently secure are

³ Calculated for the 1996-2006 period. See section 3.2 of this document for updated information on the most recent decade of data available (2002-2012), analyzed using a more precise method than that used in COSEWIC (2008).

inconsistent with the state and provincial rankings since 77% of the latter are Critically Imperiled (S1; 27%), Imperiled (S2; 22%) or Vulnerable (S3; 25%).

Partners in Flight, a North American landbird conservation program, lists the Short-eared Owl as a “common bird in steep decline” (Partners in Flight Science Committee, 2012).

Table 1. Short-eared Owl Rank and Designation in Endangered Wildlife Legislation by Province and Territory.

Province/Territory	NatureServe Subnational Rank ^a	Provincial/Territorial Designation
British Columbia	S3B, S2N	Not listed; <i>Identified Wildlife</i> and Blue List ^b
Alberta	S3	May Be at Risk ^c
Saskatchewan	S3B, S2N	Not listed
Manitoba	S2S3B	Threatened ^d
Ontario	S2N, S4B	Special Concern ^e
Quebec	S3B S3N ^k	Likely to be Designated Threatened or Vulnerable ^f
New Brunswick	S3B	Special Concern ^g
Nova Scotia	S1S2	Not listed ^h
Prince Edward Island	S1S2B	Not listed
Newfoundland and Labrador	S3B (NF), S3S4B (L)	Vulnerable ⁱ
Yukon	S3B	Not listed
Northwest Territories	S3S4B	Not listed ^j
Nunavut	SNRB	Not listed

^a S1 – Critically Imperiled; S2 – Imperiled; S3 – Vulnerable; S4 – Apparently Secure; S5 – Secure; S#S# – Range between two ranks, used to indicate the range of uncertainty in the species conservation status; SNR – conservation status not yet assessed; B - Breeding population; N – Non-breeding population. ^b The species is not listed under British Columbia’s *Wildlife Act* (R.S.B.C. 1996, c. 488) but does appear under section 11(1) of the *BC Government Actions Regulation* (BC Reg 17/04) of the *BC Forest and Range Practices Act* as an *Identified Wildlife* species in the *Identified Wildlife Management Strategy*. Therefore, the province can designate *wildlife habitat areas* (5 -10 ha) on communal roosting sites or on breeding or wintering sites, to protect the species on provincial Crown lands. Blue list: Species and ecological communities are assigned to the red or blue list on the basis of the provincial conservation status rank (SRANK) assigned by the Conservation Data Centre. These lists may be used to designate an official status for a species under the *Wildlife Act*; ^c Established by Alberta’s Endangered Species Conservation Committee and protected by the *Wildlife Act*; ^d Manitoba’s *Endangered Species and Ecosystems Act* (C.C.S.M. c. E111); ^e Ontario’s *Endangered Species Act* (S.O. 2007, c. 6); ^f Quebec’s *Act respecting threatened or vulnerable species* (C.Q.L.R., c. E-12.01); ^g New Brunswick’s *Species at Risk Act* (S.N.B. 2012, c. 6); ^h Nova Scotia’s *Endangered Species Act* (S.N.S. 1998, c. 11); ⁱ Newfoundland and Labrador’s *Endangered Species Act* (S.N.L. 2001, c. E-10.1); ^j *Species at Risk (NWT) Act* (S.N.W.T. 2009, c.16); ^k CDPNQ, 2016.

The Short-eared Owl is also listed in Appendix II of the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES) and in Schedule 1 of the *Wild Animal and Plant Trade Regulations* pursuant to section 21 of the *Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act* (S.C. 1992, c. 52), which regulate trade in the species.

3. Species Information

3.1. Species Description

Wiggins et al. (2006) describe the Short-eared Owl as a medium-sized owl approximately 34 to 42 cm in length. Individuals have a large, round head, with small tufts of feathers that look like ears, although these are rarely seen. The eyes of the adults are yellow and framed by black feathers on a pale facial disk. Wings are fairly long and the tail is short. Adults have a brown back and creamy-buff chest with brown streaks that provide camouflage. Sexes are similar in appearance but females are on average slightly larger (378 g vs. 315 g) and tend to be darker ventrally and dorsally (Wiggins et al., 2006). Juveniles are similar to adults, but the upperparts and head are more dusky and they lack the facial pattern of adults (Wiggins et al., 2006). The Short-eared Owl is conspicuous only when it flies, often at dawn and dusk. Its flight is erratic and moth-like.

3.2. Species Population and Distribution

The Short-eared Owl has a nearly global distribution, occurring on all continents except Australia and Antarctica (Holt et al., 1999; Wiggins, 2004). In the northern hemisphere, the species has one of the largest ranges among owls, breeding in open habitats across the North Temperate Zone and on a large number of oceanic islands, including the Greater Antilles and Hawaii (Wiggins et al., 2006). Although the species has an extensive breeding range in North America (Figure 1), it occurs irregularly within that range (COSEWIC, 2008). The only subspecies occurring in North America is *A. f. flammeus*.

Partners in Flight estimates the global Short-eared Owl population at 3,000,000, the North American population at 600,000 and the Canadian breeding population at about 300,000 (Partners in Flight Science Committee, 2013). In Canada, the species occurs in all provinces and territories, but is most common in the Prairie provinces (Alberta, Saskatchewan and Manitoba) and along the Arctic coast (Nunavut, Northwest Territories and Yukon). Recent observations north of the known breeding range in the Northwest Territories and Nunavut may be the result of increased survey efforts or a possible range expansion (Therrien, 2010; Reid et al., 2011, Smith et al., 2013).

During winter, the species is a regular resident in open habitats along the southern coast of British Columbia and in southern Ontario, and an occasional resident in coastal areas of Atlantic Canada (Figure 1; Schmelzer, 2005). It also occurs sporadically in the Prairie provinces and Quebec, where the number of wintering individuals fluctuates substantially from year to year (COSEWIC, 2008; National Audubon Society, 2014). Owls nesting in the Prairie provinces move southward after breeding, wintering primarily in the Great Plains region of the United States (Clark, 1975). During winter, individuals congregate (usually fewer than 10) and roost in areas with high food availability (Cadman and Page, 1994).

The migratory routes and stopover sites are largely unknown. Fragmentary data suggest that some individuals that breed in Alaska migrate southward, sometimes as far as Mexico.

In addition, some birds that breed in northern Quebec move to wintering locations in New York State (see results and references in Keyes, 2011).

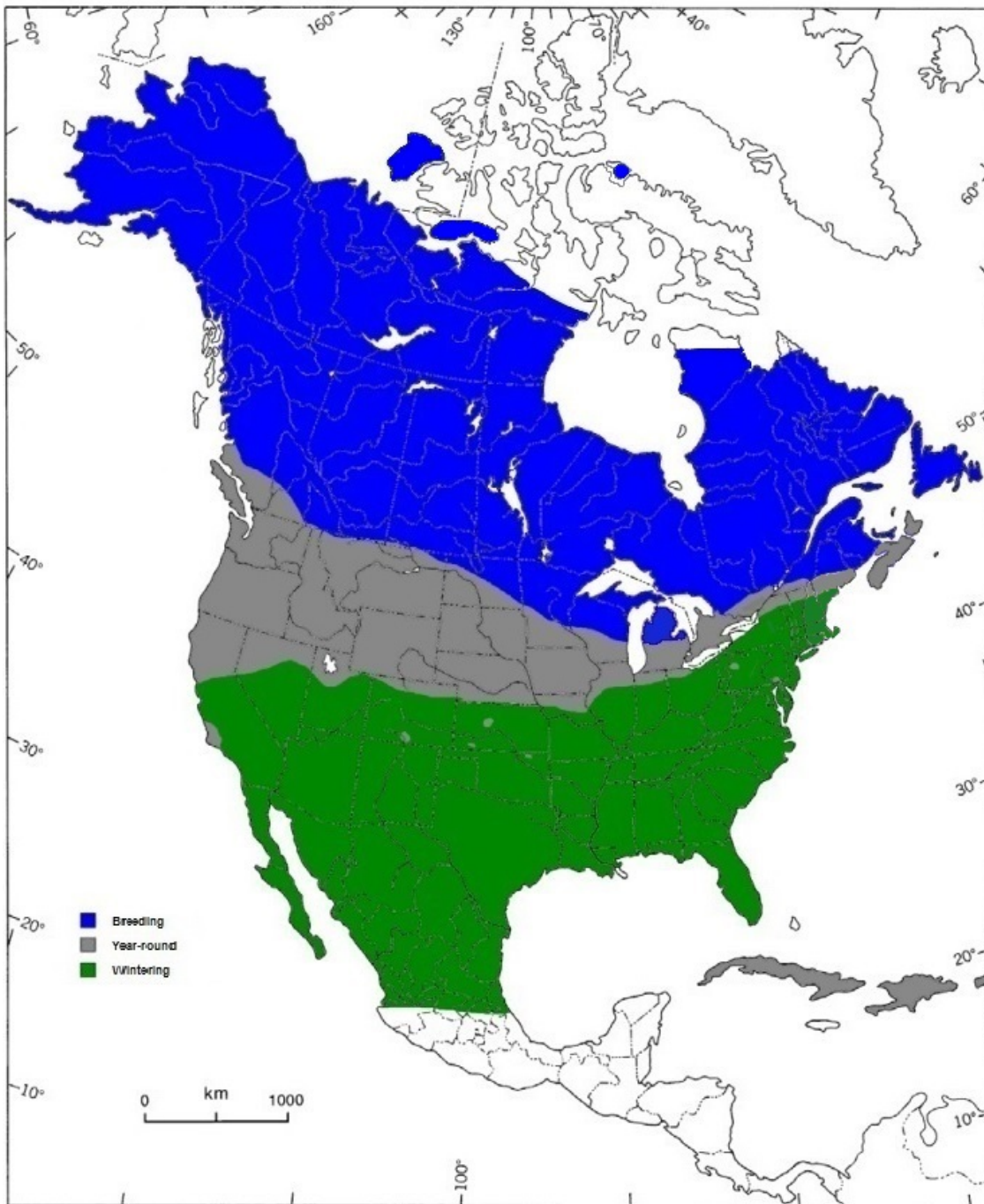


Figure 1. Distribution of the Short-eared Owl in North America (modified from Wiggins et al., 2006, based on observations from Therrien, 2010, Smith et al., 2013 and the Québec Breeding Bird Atlas, 2014).

Population trend analysis is complicated by the species' nomadic behaviour,⁴ the fact that it exhibits periodic irruptions,⁵ knowledge gaps regarding the breeding population in remote areas, and the lack of data collected in a standardized manner (Cadman and Page, 1994; Clayton, 2000; Booms et al., 2014). Data from the Christmas Bird Count (CBC) for the United States suggest that the Short-eared Owl population declined at a mean annual rate of about 2.3% between 1960 and 2012, whereas an analysis of the data for the period 2002 to 2012 indicates a stabilization (National Audubon Society, 2014). Since a high proportion of these birds are likely from the Canadian breeding population, this figure is considered a reasonable estimate of the Canadian population trend (COSEWIC, 2008). The Canadian Breeding Bird Survey (BBS), a program that monitors breeding birds mostly across southern Canada, also shows a steep mean decline of 5.17% per year between 1970 and 2012 (95% C.I.= -1.05% to -9.24%), whereas an analysis of the data for the period 2002 to 2012 (+0.40% per year; 95% C.I.= -14.9% to +22.7%) indicates that numbers have stabilized (Environment Canada, 2014). The data for Alberta (-4.54% and +0.40%) and Saskatchewan (-5.4% and +0.68%) show a similar pattern. The number of routes where Short-eared Owls were detected was insufficient to calculate a trend in other provinces and territories.

Data from the various breeding bird atlas projects across Canada are not sufficient to determine the population trend with certainty (Table 2). In some areas, sharp declines in the number of occupied atlas squares have been reported (e.g. in Quebec), while in other areas, stable occupancy has been observed (e.g. in the Maritimes) or substantial increases (e.g. in Ontario). It should be noted, however, that the time periods considered vary from province to province, and in many cases survey efforts and coverage differ between the first and second atlas projects within a region, making comparison difficult. For example, M.A. Gahbauer (in Cadman et al., 2007) suggests that the increase in the number of occupied atlas squares in the second atlas project in Ontario could be the result of extensive low-level aerial surveys in the Hudson Bay lowlands, while targeted searches to locate the species in southern Ontario by the Migration Research Foundation (2004) showed that agricultural areas away from large watercourses have been abandoned. Furthermore, the irruptive nature of the species complicates the interpretation of atlas data, especially since the data are available over a maximum of two periods of 5 or 6 years, separated by 15 to 20 years.

Data for the Yukon, the Northwest Territories, Nunavut, and Newfoundland and Labrador are scant and were gathered through smaller-scale, ad hoc surveys (see section 6.1). In Saskatchewan, data have been collected continuously as part of the *Saskatchewan Breeding Bird Atlas* (2016). In Quebec, annual monitoring of nest sites has been carried out under the program called "Suivi des populations d'oiseaux en péril (SOS-POP)" to document the absence or presence of the species (SOS-POP, 2016).

⁴ Nomadism: tendency of adults as well as juveniles to move widely in search of food, and to settle and breed where food resources are locally abundant (Andersson, 1980).

⁵ Irruption: Tendency of a species to migrate to places where it is not normally present.

Table 2. Breeding Bird Atlas Data for the Short-eared Owl in Canada.

Provinces	Atlas Periods	Number of Occupied Atlas Squares	References
British Columbia	2008-2012	50	Davidson et al. (2014)
Alberta	1985-1990	NA	Semenchuk (1992)
	2000-2005	NA	Federation of Alberta Naturalists (2007)
Saskatchewan	1966-2014 ^a	192	Smith (1996); <i>Saskatchewan Breeding Bird Atlas</i> ^b (2016)
Manitoba	2010-2014 ^a	82	<i>Manitoba Breeding Bird Atlas</i> (2014)
Ontario	1981-1985	63	Cadman et al. (1987)
	2001-2005	158	Cadman et al. (2007)
Quebec	1984-1989	120	Gauthier and Aubry (1995)
	2010-2014 ^a	67	<i>Québec Breeding Bird Atlas</i> (2014)
Maritimes	1986-1990	29	Erskine (1992)
	2006-2010	32	<i>Maritimes Breeding Bird Atlas</i> (2013)

^a Ongoing projects.

^b The *Saskatchewan Breeding Bird Atlas* is not based on a standardized survey methodology. Data are reported continually in a web-based application (gisweb1.serm.gov.sk.ca/imf/imf.jsp?site=birds). Atlas squares correspond to the National Topographic System 1: 250 000 grids (nrcan.gc.ca/earth-sciences/geography/topographic-information/maps/9765) rather than the standard 10 x 10 km UTM grids.

3.3. Needs of the Short-eared Owl

Short-eared Owls occur in a variety of open native habitats, such as grasslands, Arctic tundra, taiga, bogs, marshes, wetlands, coastal barrens, estuaries and grasslands dominated by sand-sage (*Artemisia filifolia*). They are also found in many types of agricultural habitats (e.g. managed grasslands) (Erskine, 1992; Sinclair et al., 2003; Wiggins et al., 2006). Little specific information is available on habitat preferences at the landscape scale. However, the species uses most of Canada's key ecosystems, which contain a mosaic of habitats offering optimal breeding and foraging sites (Wiggins, 2004; COSEWIC, 2008). At a finer scale, some studies indicate that occupied sites are characterized by medium to tall grasses (taller than 30 cm, see Clayton, 2000; Wiggins, 2004), dry uplands for nesting (Clark, 1975; Tate, 1992) and hunting perches (e.g. scattered trees; Wiebe, 1987; Keyes, 2011). Wintering sites have a thatch density and height resembling that of old fields or native habitats (Huang et al., 2010). However, even where habitat vegetation structure may be suitable, prey density appears to be a better indicator of habitat occupancy (e.g. Poulin et al., 2001). Several studies show that the Meadow Vole (*Microtus pennsylvanicus*), one of the main prey items of the Short-eared Owl,⁶ prefers native prairie with denser vegetative cover and typically avoids cultivated fields and annual cropland (Marinelli and Neal, 1995; Peles and Barrett, 1996; Lin and Batzli, 2001).

In suitable breeding habitats, pairs defend territories ranging in size from 20 ha to more than 100 ha. When food is abundant, multiple pairs may nest within these territories (semi-colonial breeder; Pitelka et al., 1955; Clark, 1975; Tate, 1992; Holt and Leasure, 1993; Wiggins, 2004). Herkert et al. (1999) suggest that the total area of habitat within the landscape is more important than the size of individual patches; small patches may be used if they are located near large habitat patches. Breeding may begin in late March in areas where the species is resident and may extend to late August (Dechant et al., 2001). Eggs are laid on flattened vegetation or in depressions scraped in the ground and lined with grasses (Ehrlich et al., 1988). Flightless young disperse from the nest at 14 to 17 days, remaining within 175 m (Clark 1975) to 200 m of the nest (Hölzinger et al., 1973) until they fledge at 24 to 35 days of age (Wiggins et al. 2006). A pair may re-nest if the first attempt fails (Dechant et al., 2001). Sexual maturity is reached in the second year, and wild individuals have been known to reach 12 years of age (Cramp, 1985).

Site fidelity in the Short-eared Owl is closely tied to resource abundance (Andersson, 1980; Booms et al., 2014). Reduced prey availability may prompt adults to travel distances of over 1,000 km between sites used in consecutive breeding seasons (Clark, 1975). Nomadism may also be more pronounced in northern than in southern populations, while southern populations may remain in the same area year-round (Wiggins et al., 2006). Migration and wintering sites appear to be more stable.

⁶ The diet is composed largely of voles but can be complemented with other small mammals (e.g. lemmings and shrews) and birds (see a more exhaustive list of prey species in Holt, 1993, and Wiggins, 2004).

Limiting factors

Limiting factors influence a species' survival and reproduction, and play a major role in its capacity to reach high population densities or to recover following a decline.

Availability of food resources is a limiting factor for the Short-eared Owl. The Meadow Vole, one of its main prey species, undergoes cyclic population fluctuations every 2 to 5 years (Reich, 1981). These fluctuations affect the breeding success of the Short-eared Owl, whose clutches range from 1 to 11 eggs, with a mean clutch size of 5.6 (Murray, 1976). The Short-eared Owl can, however, breed earlier and increase its clutch size in times of prey abundance (Clark, 1975; Holt and Leasure, 1993; Cadman and Page, 1994).

4. Threats

4.1. Threat Assessment

Table 3 presents the direct threats to the Short-eared Owl. Threat assessment is based on the unified threats classification system of the World Conservation Union–Conservation Measures Partnership (IUCN–CMP) (see Salafsky et al., 2008). Threats are defined as the proximate activities or processes that have caused, are causing or may cause the destruction, degradation and/or impairment of the entity being assessed (population, species, community or ecosystem) in the area of interest (global, national or subnational).

The threats were assessed by dividing the species' range in two parts: one region characterized by the presence of migratory breeders and another characterized by sedentary or wintering breeders. This approach was adopted for threat assessment because the impacts differ between these two regions. For the purposes of the assessment, only existing threats within the Short-eared Owl's range and threats projected to occur within the next 10 years (or 3 generations in the case of the Short-eared Owl) were taken into account. Historical threats and any other relevant information that would help to understand the nature of the threats are presented in section 4.2 Description of Threats.

Table 3. Assessment of existing and projected threats to the Short-eared Owl over the next generations using the IUCN Threats Calculator

Threats	Threat Description	Impact ^a		Scope ^b (3 generations)		Severity ^c (3 generations)		Immediacy ^d	
		Sedentary – wintering breeder region	Migratory breeder region	Sedentary – wintering breeder region	Migratory breeder region	Sedentary – wintering breeder region	Migratory breeder region	Sedentary – wintering breeder region	Migratory breeder region
1	Residential & commercial development	Low	Negligible	Small	Negligible	Slight	Negligible	High	High
1.1	Housing & urban areas	Low	Negligible	Small	Negligible	Slight	Negligible	High	High
1.2	Commercial & industrial areas	Low	Negligible	Small	Negligible	Slight	Negligible	High	High
1.3	Tourism & recreation areas	Low	Negligible	Small	Negligible	Slight	Negligible	High	High
2	Agriculture & aquaculture	Low	Low	Restricted	Small	Slight	Slight	High	High
2.1	Annual & perennial non-timber crops	Low	Low	Restricted	Small	Slight	Slight	High	High
2.3	Livestock farming & ranching	Low	Low	Restricted	Small	Slight	Slight	High	High
3	Energy production & mining	Low	Low	Small	Small	Slight	Slight	High	High
3.1	Oil & gas drilling	Low	Low	Small	Small	Slight	Slight	High	High
3.2	Mining & quarrying	Low	Low	Small	Small	Slight	Slight	High	High
3.3	Renewable energy	Low	Low	Small	Small	Slight	Slight	High	High
4	Transportation & service corridors	Unknown	Unknown	Small	Small	Unknown	Unknown	High	High
4.1	Roads & railroads	Unknown	Unknown	Small	Small	Unknown	Unknown	High	High
4.2	Utility & service lines	Unknown	Unknown	Small	Small	Unknown	Unknown	High	High
5	Biological resource use	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Low	Low
5.1	Hunting & collecting terrestrial animals	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Low	Low
6	Human intrusions & disturbance	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	High	High
6.1	Recreational activities	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	High	High

Threats	Threat Description	Impact ^a		Scope ^b		Severity ^c		Immediacy ^d	
				(3 generations)		(3 generations)			
7	Natural system modifications	Negligible	Negligible	Negligible	Small	Slight	Negligible	High	High
7.1	Fire & fire suppression	Negligible	Negligible	Negligible	Negligible	Slight	Negligible	High	High
7.2	Dams & water management/use	Negligible	Negligible	Negligible	Small	Negligible	Negligible	High	High
7.3	Other ecosystem modifications	Negligible	Negligible	Negligible	Small	Slight	Negligible	High	High
8	Invasive & other problematic species & genes	Negligible	Negligible	Restricted	Negligible	Negligible	Negligible	High	Low
8.1	Invasive alien (non-native) species	Negligible	Negligible	Restricted	Negligible	Negligible	Negligible	High	Low
8.2	Problematic native species	Negligible	Negligible	Restricted	Negligible	Negligible	Negligible	High	Low
11	Climate change & severe weather	Negligible	Negligible	Restricted	Small	Negligible	Negligible	High	High
11.1	Habitat shifting & alteration	Negligible	Negligible	Restricted	Small	Negligible	Negligible	High	High
11.4	Storms & flooding	Negligible	Negligible	Small	Negligible	Negligible	Negligible	High	Moderate

^a Impact is calculated based on scope and severity. Categories include: very high, high, medium, low, unknown and negligible

^b Scope is the proportion of the population that can reasonably be expected to be affected by the threat within the next 10 years. Categories include: pervasive (71-100%), large (31-70%), restricted (11-30%), small (1-10%), negligible (<1%) and unknown. Categories can also be combined (e.g. large to restricted = 11-70%).

^c Severity is, within the scope, the level of damage to the species (assessed as the % decline expected over the next three generations due to threats that will occur in the next 10 years. Categories include: extreme (71-100%), serious (31-70%), moderate (11-30%), slight (1-10%), negligible (<1%) and unknown. Categories can also be combined (e.g. moderate to slight = 1-30%).

^d Immediacy describes how immediate the threat is. Categories include: high (continuing), moderate (possibly short-term [<10 years or three generations]), low (possibly long-term [>10 years or three generations]), negligible (past or no direct effect) and unknown.

4.2. Description of Threats

This section describes the threats listed in Table 3. Threats to the Short-eared Owl can affect habitat through loss or degradation but can also affect individuals, nests and eggs. Human activities that remove or fragment large expanses of habitat required during the various life cycle stages are considered the primary factor driving declines in Short-eared Owl populations (Dechant et al., 2001; Wiggins, 2004; Wiggins et al., 2006).

Residential and commercial development

1.1 Housing & urban areas; 1.2 Commercial & industrial areas; 1.3 Tourism & recreation areas

In the past, habitat loss due to urban expansion, recreational activities and resort development represented a major localized threat, particularly in productive habitats occupied year-round, such as coastal marshes and adjacent grasslands (Wiggins, 2004; Wiggins et al., 2006). This threat affects the species in some areas where it is found in high densities (e.g. the Fraser River delta of British Columbia; Campbell et al., 1990). Despite this, high densities of breeding and wintering Short-eared Owls in urbanized areas have been reported (e.g. at Sea Island near the Vancouver airport; Butler and Campbell, 1987).

Agriculture and aquaculture

2.1 Annual & perennial non-timber crops; Livestock farming & ranching

Agriculture, particularly intensive agriculture, poses a threat to the Short-eared Owl, through the conversion of native habitats (e.g. grassland, wetland) to farmland. Samson and Knopf (1994) reported dramatic losses of native grasslands in Alberta (61% of mixed grass prairie), Saskatchewan (81% of mixed grass prairie and 86% of shortgrass prairie), and Manitoba (99% of tallgrass prairie and more than 75% of mixed grass prairie), as well as further south in the western and central Great Plains region of the United States. Although the expansion of agriculture to the detriment of native habitat affected a large portion of the species' range in the past (i.e. breeding, wintering and year-round areas; Gauthier et al., 2003; Canadian Prairie Partners in Flight, 2004; Samson et al., 2004; Watmough and Schmoll, 2007; Pool et al., 2014), the area of agricultural land has decreased only slightly in Canada as a whole in recent years (Statistics Canada, 2011), and very little native habitat remains on land that is suitable for farming. Conversion rates could accelerate if alternative crops (e.g. biofuel crops) that grow well on marginal lands are developed (Liu et al., 2011). As for wetlands, the rate of loss along the St. Lawrence River appears to have also slowed in recent years (Ducks Unlimited Canada, 2010) after decades of intensive draining (e.g. 80% of wetlands have been lost since European settlement) (James, 1999; Painchaud and Villeneuve, 2003). In the Canadian Prairies, the rate of wetland loss has been slower but continuous since the early 1900s (see references in Canadian Partners in Flight, 2004).

Livestock farming and ranching is very common across much of the Canadian Prairies and the Great Plains region of the United States (Samson and Knopf, 1994). Grazing can affect Short-eared Owl habitat structure by reducing the height and density of the herbaceous layer. Although habitats consisting of short and relatively sparse grasses can be used for foraging (Vukovich and Ritchison, 2008), it has been shown that overgrazing by domestic ungulates may limit the densities of herbivorous small mammals, such as voles, and may thus have an impact on higher trophic levels (Villar et al., 2014).

Although Short-eared Owls nest on agricultural land, their breeding success in such habitats is lower than in native habitats (Campbell et al., 1990; Cadman and Page, 1994; Herkert et al., 1999; Keyes, 2011). In agricultural areas, egg loss and nestling mortality (e.g. trampling by livestock, mechanical trauma and so on; Arroyo and Bretagnolle, 1999) may occur as a result of grazing, mowing or harvesting activities, which are generally carried out before the young leave the nest. Fondell and Ball (2004) found that reproductive success is significantly lower on grazed grasslands than on ungrazed grasslands (10% vs. 60%), in large part because of greater predation on eggs and chicks. Mowing and harvesting activities can also lead to increased likelihood of predation on broods because the nests are less concealed from predators (Keyes, 2011). Recent agricultural practices promote earlier and more frequent haying (With et al., 2008), which can increase the risk of loss of eggs and young. However, Dechant et al. (2001) suggest that occasional mowing or burning (e.g. every 2 to 8 years) outside of the breeding period may be required in some cases to maintain the species' habitat. These techniques may, for example, keep shrubs from invading tallgrass prairie.

The pesticides used to control pest species (e.g. pigeons, European Starlings and rodents) may pose a threat to the Short-eared Owl. First and foremost, pesticides used to control crop pests may indirectly affect the survival of individuals and reproductive success by decreasing prey populations. The ingestion of prey contaminated with pesticides (e.g. 4-amino-pyridine [Avitrol®], strychnine and fenthion) has also been shown to cause traumatic shock and death in raptors (including Short-eared Owls) Mineau et al., 1999; Campbell, 2006). One event that caused mass mortality of raptors (including five Short-eared Owls) in Israel has been linked to the application of an insecticide used to control rodent infestations (Mendelssohn and Paz, 1977). Nonetheless, the concentrations of contaminants to which Short-eared Owls have been exposed (Peakall and Kemp, 1980; Henny et al., 1984) generally do not have a significant effect on eggshell thickness, tissue damage or embryo mortality (Cadman and Page, 1994; Wiggins et al., 2006). Because the Short-eared Owl's diet is primarily herbivorous, it is likely less prone to pesticide bioaccumulation⁷ than carnivorous species. There are nonetheless concerns about neonicotinoids,⁸ pesticides that contaminate soils and streams and are known to adversely affect insectivorous birds by reducing invertebrate prey populations available to them (Mineau and Palmer, 2013;

⁷ Bioaccumulation means the capacity of a living organism to gradually absorb and concentrate a contaminant or toxic substance that is present in the environment.

⁸ A group of insecticides with a chemical formula similar to that of nicotine that kill insects by their action on the central nervous system.

Hallmann et al., 2014). Although the Short-eared Owl is not insectivorous, some of its prey species are, and this could impact its populations.

3. Energy production and mining

3.1 Oil & gas drilling; 3.2 Mining & quarrying; 3.3 Renewable energy

Exploration for new energy resources (e.g. oil, gas, coal and hydroelectricity) and minerals (including aggregates), their development (e.g. tailings and flooding of land to create reservoirs) and their transportation (e.g. pipelines, transmission lines and roads) can cause habitat loss, degradation and fragmentation (e.g. wetlands) within the Short-eared Owl's range (e.g. Abraham et al., 2011; Pellerin and Poulin, 2013; ESTR Secretariat, 2014). Although the direct impacts of these threats on Short-eared Owl populations have not yet been demonstrated, habitat loss, degradation and fragmentation are known to have adverse effects on the species.

4. Transportation and service corridors (collisions)

4.1 Roads & railways; 4.2 Utility & service lines

Mortality of Short-eared Owls has occurred as a result of collisions with aircraft, automobiles, antennas, windows, power lines, barbed-wire fences and wind turbines (Cadman and Page, 1994; Fajardo et al., 1994; Bevanger and Overskaug, 1998; Kingsley and Whittam, 2005; Preston and Powers, 2006; Longcore et al., 2013). However, questions remain about the significance of this factor in the population's decline (COSEWIC, 2008).

5. Climate change and severe weather

11.1 Habitat shifting & alteration; 11.4 Storms & flooding

The effects of climate change on the Short-eared Owl population are difficult to predict because different bird species respond differently to spatial and temporal variations in their environment (Taper et al., 1995). One of the main effects could be through changes in the availability of prey. Indeed, climate change scenarios predict a reduction in snow cover in the Canadian Prairies (Sauchyn and Kulshreshtha, 2008), which would negatively impact Meadow Vole populations (Heisler et al., 2014). Another factor, the increased frequency of severe weather events (cold snaps, hurricanes, wind storms; Huber and Gullledge, 2011), could have impacts throughout the species' range.

Climate change could also lead to an increase in predator populations, such as Red Fox (*Vulpes vulpes*), which compete with the Short-eared Owl for prey and which may pose a threat through direct predation on eggs and chicks (Gallant et al., 2012; Berteaux et al., 2015).

Habitats in northern regions are likely to sustain the most significant impacts associated with climate change (Screen and Simmonds, 2010). Potential changes to the Arctic tundra through increased shrub cover (Myers-Smith et al., 2011; Miller and Smith, 2012; Zhang et al., 2013) would reduce the area of suitable habitat for the Short-eared Owl in

that ecosystem. At the same time, the warming observed in the Arctic could allow for further range expansion toward northern Canada (Therrien, 2010; Smith et al., 2013).

Other threats

Hunting (threat 5.1 in Table 3; in the northern part of the range) and recreational activities (threat 6.1; e.g. use of all-terrain vehicles in coastal habitats) are likely negligible or minor threats to the Short-eared Owl. Fire suppression (threat 7.1; resulting in succession from open habitat to habitat that is too shrubby for the species), old-field succession to wildland or forests (threat 7.3), invasive alien species (threat 8.1; particularly shrubs such as Buckthorn (*Rhamnus cathartica*), and some native species (threat 8.2; e.g. nest predators such as the Red Fox and the Striped Skunk [*Mephitis mephitis*]) could represent threats. The impact of these threats is presumably more limited than that of the other threats described in this section.

5. Management Objectives

The management objectives for the Short-eared Owl in Canada are:

- In the short term: Stabilize or increase the population trend over the 2018-2028 period and maintain the area of occupancy⁹ at 1,500,000 km²;
- In the long term: Ensure a positive 10-year population trend starting in 2028, while promoting an increase in the area of occupancy, including the gradual recolonization of areas in the southern portion of the Canadian range.

These objectives address the species' long-term decline, which was the reason for its designation as Special Concern (COSEWIC 2008). The 10-year time frame for the short-term objectives is considered reasonable, given the challenge of stabilizing or increasing the population trend of such a widespread species. The area of occupancy provided corresponds to the COSEWIC (2008) estimate and maintaining it should focus on the conservation of native habitats as well as on beneficial management practices in habitats disturbed by human activities, in order to ensure that such habitats are suitable for the Short-eared Owl, i.e. capable of sustaining prey populations and supporting the entire life cycle, particularly the reproductive phase. As for the long-term objectives, promoting an increase in the area of occupancy will necessitate considerable effort, including habitat restoration in human-disturbed landscapes. Appendix A presents a preliminary list of areas of conservation interest in regions with repeated observations of the Short-eared Owl over the past decades or in regions disturbed by human activity.

These objectives may be reviewed during preparation of the report required five years after the management plan is posted to assess implementation of the management plan and the progress towards meeting its objectives (s. 72, SARA).

⁹ The area of occupancy is defined as the area within the range of the species that is occupied (COSEWIC, 2009).

6. Broad Strategies and Conservation Measures

6.1. Actions Already Completed or Currently Underway

Conservation and Management

- Regional status reports and management plans have been produced or recovery teams have been created in a number of provinces:
 - Alberta (status report: Clayton, 2000);
 - British Columbia (guidelines for raptor conservation: British Columbia Ministry of Environment, 2013);
 - Quebec (recovery team: Équipe de rétablissement des oiseaux de proie; recovery plan in preparation);
 - Newfoundland and Labrador (management plan: Schmelzer, 2005).
- Stewardship and habitat conservation programs (not specific to the Short-eared Owl, but could benefit the species):
 - Alberta's Operation Grassland Community (since 1989) and the Prairie Conservation Action Plan work with landowners and ranchers to conserve prairie habitat and wildlife;
 - The Action Plan for Multi-Species at Risk in Southwestern Saskatchewan: South of the Divide is aimed at the protection and recovery of species at risk (ongoing - could be beneficial to Short-eared Owl habitat) (Environment and Climate Change Canada, 2017);
 - South Coast Conservation Program in British Columbia www.sccp.ca/;
 - Alberta's Multiple Species at Risk: *At Home on the Range: Living with Alberta's Prairie Species at Risk* www.multisar.ca/;
 - Under the Permanent Cover Program in the Prairies and in British Columbia (in the early 1990s; McMaster and Davis, 2001) and the Ontario Permanent Cover Program, farmers could receive funds for keeping environmentally sensitive land out of production;
 - The Conservation Cover Incentive Program for the Upper Assiniboine River Basin in Saskatchewan and Manitoba, the Grand River Watershed in Ontario and the Mill River Watershed in Prince Edward island is aimed at providing incentives for landowners to protect or restore ecosystems;
 - Manitoba's pilot municipal property tax credit program promotes the creation or maintenance of conservation cover;
 - In Quebec, the Important Bird Areas (IBA) program has led to the development of conservation plans for a number of sites, including some on Île aux Grues; ZIP committees (ZIP, Zones d'interventions prioritaires) have a mandate to bring together the main users of the St. Lawrence River to solve local and regional issues affecting St. Lawrence ecosystems and their uses.
 - The Alternate Land Use Services program (ALUS) provides incentives for landowners to set aside marginal agricultural land (Manitoba since 2006;

- Ontario since 2007; Prince Edward Island since 2008; Alberta since 2010; and Saskatchewan since 2011);
 - The Delta Farmland and Wildlife Trust Grassland Set-aside Stewardship Program encourages farmers of the lower Fraser River delta to restore the soil, promote the establishment of small mammal populations as prey for raptors, and provide foraging, resting and breeding habitat for wildlife;
 - Environment Canada's National Conservation Plan¹⁰ should lead to the protection and restoration of grassland bird habitats and ecosystems;
 - Ongoing programs to help breeding and migratory populations of waterfowl (e.g. Ducks Unlimited, Prairie Habitat Joint Venture, Eastern Habitat Joint Venture and Nature Conservancy Canada).
- Development of guidelines for various industries:
 - Standardized guidelines for petroleum industry activities (Scobie and Faminow, 2000; Environment Canada, 2009);
 - In British Columbia, the Identified Wildlife Management Strategy species account (www.env.gov.bc.ca/wld/frpa/iwms/documents/Birds/b_shortearedowl.pdf) and General Wildlife Measures propose practices that may be beneficial to the species;
 - The Ontario Ministry of Natural Resources and Forestry provides direction to protect occupied Short-eared Owl nests within a forestry context. The *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales* (OMNR, 2010) provides standards and guidelines related to occupied nests.
 - Policy development regarding:
 - Wetlands (e.g. Federal Policy on Wetland Conservation);
 - Zoning;
 - Pesticide use.

Surveys, Monitoring and Research

- In Newfoundland and Labrador, a program of surveys on large tracts of open habitat or at sites where owls had previously been documented during the breeding season was initiated in 2003 and 2004 (Schmelzer, 2005).
- In southern Ontario, the Migration Research Foundation (2004) initiated monitoring of the Short-eared Owl (2003, 2006-2007) to document the breeding and wintering populations in the region. In addition, Bird Studies Canada began documenting the wintering Short-eared Owl population in southern Ontario in 2003. In 2010-2011, the program officials initiated Short-eared Owl data reporting from across Canada to identify breeding and wintering locations.

¹⁰ <https://www.ec.gc.ca/ee-ea/default.asp?lang=En&n=CFBA8C3D>

- In Quebec, the Zoo sauvage de Saint-Félicien and Quebec's Ministère des Forêts, de la Faune et des Parcs have been implementing an inventory protocol and documenting spatial habitat use in the Saguenay–Lac-Saint-Jean region since 2012. Regroupement QuébecOiseaux has been monitoring Short-Eared Owl nest sites under the SOS-POP program since 1994.
- Survey protocols specific to the Short-eared Owl have been developed in Manitoba (Manitoba's Nocturnal Owl Survey), Newfoundland and Labrador (Schmelzer, 2005), Saskatchewan (Saskatchewan Ministry of Environment, 2014), Alberta (Government of Alberta, 2013a) and Quebec (Gagnon et al., 2015).
- A study on the Short-eared Owl was carried out (Keyes, 2011) to identify the breeding-ground origins of individuals or museum specimens in the context of nomadic, migratory and/or philopatric movements, to develop a practical visual survey protocol aimed at improving monitoring efforts and facilitating assessments of across-season landscape-level habitat use, and to describe nest site characteristics, nest success and causes of nest failure.
- Migratory movements were followed at various locations in North America using banding, radio-telemetry, stable isotope analysis and satellite transmitters (Bird Studies Canada, U.S. Fish and Wildlife Service, Wildlife Diversity Program, Alaska Department of Fish and Game, New York State Department of Environmental Conservation, Canadian Wildlife Service, Raptor Research Foundation, Migration Research Foundation, etc.).
- Bird Studies Canada has established a volunteer-based nocturnal owl monitoring program in the Atlantic region, Alberta, British Columbia, Manitoba, Ontario, Quebec, Saskatchewan and the Northwest Territories. Guidelines for nocturnal owl monitoring in North America were published by the Beaverhill Bird Observatory and by Bird Studies Canada (Takats et al., 2001).

Awareness and Partnerships

- Scientific workshops have been held to identify Short-eared Owl conservation needs, at the inaugural meeting of the Canadian Short-eared Owl Working Group in Winnipeg in November 2006, at the annual meeting of the Raptor Research Foundation in Pennsylvania in September 2007 (Raptor Research Foundation, 2007), at the World Owl Conference in the Netherlands in November 2007 and at the annual meeting of the Raptor Research Foundation in Missoula in 2008 (Raptor Research Foundation, 2008). Also, a symposium entitled "Short-eared Owls: The Need for a Conservation Plan" was held at the 2011 Raptor Research Foundation Annual Meeting in Duluth Raptor Research Foundation, 2011).
- Many organizations are working on raising awareness about the species within the general public and among landowners and encouraging people to report their sightings of Short-eared Owls (e.g. Bird Studies Canada, the Zoo sauvage de Saint-Félicien, Regroupement QuébecOiseaux; Union québécoise de réhabilitation des oiseaux de proie; Équipe de rétablissement des oiseaux de proie du Québec; the Government of the Northwest Territories; and the

British Columbia Grassland Conservation Council
www.bcgrasslands.org/index.php/what-we-do.

6.2. Broad Strategies

The broad strategies to achieve the Short-eared Owl management objectives are as follows:

1. Conservation and management of the species and its habitats across the breeding, migration and wintering ranges;
2. Conducting surveys, monitoring and research on the species, its habitats and threats across its breeding, migration and wintering ranges; and
3. Promoting awareness and partnerships with regard to conservation priorities.

6.3. Conservation Measures

Table 4. Conservation Measures and Implementation Schedule.

Conservation Measures	Priority ^a	Threats or Concerns Addressed	Timeline
Broad Strategy: Conservation and management of the species and its habitats across the breeding, migration and wintering ranges			
<p>Identify and implement national and regional conservation priorities using multi-species or ecosystem approaches to the conservation and management (including restoration where needed) of large tracts of grasslands, wetlands and other open habitats:</p> <ul style="list-style-type: none"> • Prioritize the conservation of native habitat at risk of being lost or degraded owing to changes in land use (particularly when the land is used year-round). • Use or draw on existing habitat management and conservation programs in Canada (see list in section 6.1) and the United States (e.g. the Conservation Reserve Program and the Wetlands Reserve Program). • Promote beneficial management practices (e.g. Rangeland Conservation Service Ltd., 2004; Haddow et al., 2013) to eliminate, reduce or mitigate threats: <ul style="list-style-type: none"> - Establish an automatic exclusion zone around nests, taking into account disturbance type and intensity, in order to minimize disturbance during incubation and to protect young, which can disperse as far as 175 to 200 m from the nest before they can fly (Clark, 1975; Hölzinger et al., 1973; see also Government of Alberta, 2011; Government of Alberta, 2013b; and Government of Saskatchewan, 2015). - Promote reduced-till farming practices and delayed harvests to limit the presence of machinery in occupied habitats during the breeding season; encourage winter wheat production and seeding in the fall, which reduces the presence of machinery during the following breeding season. - Promote the creation of vegetated buffers along the edges of streams and wetlands (to provide cover for nesting owls and prey populations, for example). - Develop and promote integrated pest management to minimize impacts on prey species and provide low-cost management of agricultural pests. - Regularly evaluate the effectiveness of beneficial management practices, and adapt them if necessary. • Evaluate the effectiveness of habitat restoration methods. 	High	All threats	2018-2028

Conservation Measures	Priority ^a	Threats or Concerns Addressed	Timeline
Promote compliance with: <ul style="list-style-type: none"> • environmental laws and regulations that prevent disturbance to adults, nests and eggs, for all types of activities and land tenures, using an approach similar to the one developed by Environment and Climate change Canada to prevent the incidental take of migratory birds^b; • policies: <ul style="list-style-type: none"> - wetland management; - site reclamation using local native vegetation; • land use tools: <ul style="list-style-type: none"> - zoning (e.g. to prevent the loss of native habitat). 	High	All threats	2018-2028
Encourage the implementation of existing reduction policies and programs for pesticides, greenhouse gases and other pollutants, and fill the gaps related to other threats (if applicable).	Medium	2. Aquaculture & agriculture (2.1 Annual & perennial non-timber crops); 11. Climate change & severe weather (11.1 Habitat shifting & alteration; 11.4 Storms & flooding)	2018-2028
Reassess the NatureServe ranks to obtain a better correspondence between national and subnational ranks.	Medium/Low	Conservation priority for species	2020

Conservation Measures	Priority ^a	Threats or Concerns Addressed	Timeline
Broad Strategy: Conducting surveys, monitoring and research on the species, its habitats and threats across the breeding, migration and wintering ranges			
<p>Update the protocols developed in the provinces and territories on the basis of recent recommendations (e.g. Calladine et al., 2008, 2010; Keyes, 2011) in order to develop and implement a standardized national monitoring protocol to clarify:</p> <ul style="list-style-type: none"> • abundance and population trends; • annual and seasonal movements; • population dynamics, including: <ul style="list-style-type: none"> - response of the population to different land management regimes and fluctuations in the populations of key prey species and populations of other predators; <ul style="list-style-type: none"> ▪ consider including prey population surveys (e.g. small mammal and hare surveys in the Northwest Territories^c) - links between the Canadian populations (e.g. stable isotopes, radio-telemetry, satellite telemetry, geolocators) 	High	Knowledge gaps	2018-2028
<p>Conduct research and gather Aboriginal traditional ecological knowledge on:</p> <ul style="list-style-type: none"> • breeding, foraging, migrating, and wintering habitat requirements at multiple spatial/temporal scales • the availability and distribution of habitat at multiple spatial/temporal scales • the impacts of predators in the various habitat types used by the species • the interactive effects of ecosystem changes (e.g. climate change) on birds associated with grasslands and northern regions as well as their habitats • the impacts of certain presumed secondary threats (e.g. windfarms) 	High	Knowledge gaps	2018-2028
<p>Establish a geospatial database on land use (habitats and threats) and do regular monitoring in order to adapt conservation priorities.</p>	Medium	All threats; Knowledge gaps	2018-2028
<p>Develop a habitat suitability model for the Short-eared Owl or a multiple species model (e.g. grassland birds) incorporating:</p> <ul style="list-style-type: none"> • updated data from existing monitoring programs and databases (e.g. the nocturnal owl surveys managed by Bird Studies Canada; eBird, ÉPOQ, SOS-POP); • vegetation cover; • prey and predator populations. 	Medium	Knowledge gaps	2018-2028

Conservation Measures	Priority ^a	Threats or Concerns Addressed	Timeline
Broad Strategy: Promoting awareness and partnerships in relation to conservation priorities			
Establish conservation priorities for the Short-eared Owl and its habitats by continuing or forming partnerships with: <ul style="list-style-type: none"> • the United States and Mexico through initiatives such as Partners in Flight; • the provincial and territorial authorities; • Aboriginal peoples (including wildlife management boards); • other landowners and land-use managers (e.g. industry, farmers and associations such as the Canadian Cattlemen’s Association and the Union des producteurs agricoles); • the research community (e.g. the Canadian Short-eared Owl Working Group) and the managers of volunteer programs (in Europe and Russia, for example). 	High	All threats	2018-2028
Determine effective methods to promote conservation measures to land managers, Aboriginal peoples and other stakeholders in an effort to increase their engagement: <ul style="list-style-type: none"> • participation in key stakeholder meetings (e.g. meetings of farmer associations); • targeted newsletter for landowners in areas where the species is recurrent. 	Medium	All threats	2018-2028

^a “Priority” reflects the degree to which the measure contributes directly to the conservation of the species or is an essential precursor to a measure that contributes to the conservation of the species. High priority measures are considered those most likely to have an immediate and/or direct influence on attaining the management objective for the species. Medium priority measures may have a less immediate or less direct influence on reaching the management objective, but are still important for the management of the population. Low priority conservation measures will likely have an indirect or gradual influence on reaching the management objective, but are considered important contributions to the knowledge base and/or public involvement and acceptance of the species.

^b Environment and Climate Change Canada’s website on the incidental take of migratory birds: www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=C51C415F-1

^c www.nwtwildlife.com/

7. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the management objectives. Success in the implementation of this management plan will be measured every five years using the following indicators:

- In the short term: the population trend over the 2018-2028 period is stabilized or increased and the area of occupancy is maintained at 1,500,000 km².
- In the long term: a positive 10-year population trend is reached starting in 2028 and the area of occupancy is increased, including the gradual recolonization of areas in the southern portion of the Canadian range.

Given the current gaps in the monitoring of population trends and the general nature of the estimation of the area of occupancy, these indicators will be clarified on the basis of the protocols developed as part of the framework of conservation measures defined in section 6.3.

8. References

- Abraham, K.F. and McKinnon, L.M. 2011. Hudson Plains Ecozone+ Evidence for Key Findings Summary. Canadian Biodiversity: Ecosystem Status and Trends 2010, Evidence for Key Findings Summary Report No. 2. Canadian Councils of Resource Ministers. Ottawa, ON.
<http://www.biodivcanada.ca/default.asp?lang=En&n=36A1BD46-1> (accessed January 25, 2017).
- Andersson, M. 1980. Nomadism and site tenacity as alternative reproductive tactics in birds. *Journal of Animal Ecology* 49: 175-184.
- Arroyo, B.E. and V. Bretagnolle. 1999. Breeding biology of the Short-eared Owl (*Asio flammeus*) in agricultural habitats of southwestern France. *Journal of Raptor Research* 33: 287-294.
- Berteaux, D., D. Gallant, B.N. Sacks, and M.J. Statham. 2015. Red foxes (*Vulpes vulpes*) at their expanding front in the Canadian Arctic have indigenous maternal ancestry. *Polar Biology* 38(6): 913-917. DOI: 10.1007/s00300-015-1647-6.
- Bevanger, K. and K. Overskaug. 1998. Utility structures as a mortality factor for raptors and owls in Norway. Pages 381-391 in Chancellor, R.D., B.-U. Meyburg and J.J. Ferrero (eds.). *Holarctic Birds of Prey*. 680 p.
- Booms, R.H., G.L. Holdroyd, M.A. Gabhauer, H.E. Trefry, D.A. Wiggins, D.W. Holt, J.A. Johnson, S.B. Lewis, M.D. Larson, K.L. Keyes and S. Swengel. 2014. Assessing the status and conservation priorities of the Short-eared Owl in North America. *Journal of Wildlife Management* 78: 772-778.
- British Columbia Ministry of Environment. 2013. Guidelines for raptor conservation during urban and rural and development in British Columbia. British Columbia Ministry of Environment.
www.env.gov.bc.ca/wld/documents/bmp/HerptileBMP_complete.pdf
(accessed January 11, 2017)
- Butler, R.W. and R.W. Campbell. 1987. The birds of the Fraser River delta: populations, ecology and international significance. Occasional Paper No. 65, Canadian Wildlife Service. Ottawa, Ontario.
- Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage and A.R. Couturier. 2007. Atlas of the Breeding Birds of Ontario, 2001-2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources and Ontario Nature. Toronto, Ontario. 706 p.

- Cadman, M.D. and A.M. Page. 1994. Status report on the Short-eared Owl (*Asio flammeus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, Ontario. 53 p.
- Cadman, M.D., P.F.J. Eagles and F.M. Helleiner. 1987. Atlas of the Breeding Birds of Ontario. Federation of Ontario Naturalists. Don Mills, Ontario. 617 p.
www.birdsontario.org/atlas/atlasbook.jsp?pg=toc (accessed January 11, 2017).
- Calladine, J., G. Garner and C. Wernham. 2008. Developing methods for the field survey and monitoring of breeding short-eared owls (*Asio flammeus*) in the UK: Final report from pilot fieldwork in 2006 and 2007. British Trust of Ornithology, Scotland. School of Biological and Environmental Sciences, University of Stirling, Stirling. 79 p.
- Calladine, J., G. Garner, C. Wernham and N. Buxton. 2010. Variation in the diurnal activity of breeding Short-eared Owls *Asio flammeus*: implications for their survey and monitoring. *Bird Study* 57: 89-99.
- Campbell, D. 2006. Common toxicological problems of Ontario wildlife – Avitrol. Canadian Cooperative Wildlife Health Centre, Wildlife Health Centre Newsletter 12 (1): 10-11.
- Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser and M.C.E. McNall. 1990. The Birds of British Columbia, Vol. 2. Royal British Columbia Museum. Victoria, British Columbia. 636 p.
- Canadian Prairie Partners in Flight. 2004. Landbird Conservation Plan for Prairie Pothole Bird Conservation Region 11 in Canada. Canadian Wildlife Service. Edmonton, Alberta. 143 p.
http://www.phjv.ca/pdf/Landbird_Conservation_Plan.pdf (accessed January 11, 2016).
- CDPNQ (Centre de données sur le patrimoine naturel du Québec). 2016. Data extraction. Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques et Ministère des Forêts, de la Faune et des Parcs, Québec.
- Clark, R.J. 1975. A field study of the Short-eared Owl, *Asio flammeus* (Pontoppidan), in North America. *Wildlife Monographs* 47: 1-67.
- Clayton, K.M. 2000. Status of the Short-eared Owl (*Asio flammeus*) in Alberta. Alberta Wildlife Status Report, No. 28. Alberta Conservation Association. Edmonton, Alberta. 15 p.

- COSEWIC. 2008. COSEWIC assessment and update status report on the Short-eared Owl (*Asio flammeus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 24 pp.
<http://www.sararegistry.gc.ca/default.asp?lang=En&n=5F6A514B-1> (accessed January 11, 2017).
- COSEWIC. 2009. Guidelines for use of the Index of Area of Occupancy (IAO) in COSEWIC assessments. Committee on the Status of Endangered Wildlife in Canada. Ottawa, Ontario.
- Cramp, S. 1985. The birds of the Western Palaeartic, Volume 4. Oxford University Press, Oxford, England. 960 p.
- Davidson, P.J.A., R.J. Cannings, A.R. Couturier, D. Lepage and C.M. Di Corrado (eds.). 2014. The Atlas of the Breeding Birds of British Columbia, 2008-2012. Bird Studies Canada. Delta, British Columbia. <http://www.birdatlas.bc.ca/> (accessed January 11, 2017).
- Dechant, J.A., M.L. Sondreal, D.H. Johnson, L.D. Igl, C.M. Goldade, M.P. Nenneman and B.R. Euliss. 2001. Effects of management practices on grassland birds: Short-eared Owl. Northern Prairie Wildlife Research Center. Jamestown, North Dakota.
<http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1147&context=usgsnpwrc> (accessed January 11, 2017).
- Ducks Unlimited Canada. 2010. Southern Ontario Wetland Conversion Analysis. Final Report. Ducks Unlimited Canada-Ontario Office. Barrie, Ontario.
http://www.ducks.ca/assets/2010/10/duc_ontariowca_optimized.pdf (accessed January 11, 2017).
- Ehrlich, P.R., D.S. Dobkin and D. Wheye. 1988. The Birder's Handbook: A Field Guide to the Natural History of North American Birds. Simon and Shuster, Inc. New York, New York. 785 p.
- Environment Canada. 2009. Petroleum Industry Activity Guidelines for Wildlife Species at Risk in the Prairie and Northern Region. Canadian Wildlife Service, Environment Canada - Prairie and Northern Region. Edmonton, Alberta. 64 p.
- Environment Canada. 2014. North American Breeding Bird Survey - Canadian trends website, Data-version 2012. Environment Canada. Gatineau, Quebec.
www.ec.gc.ca/ron-bbs/P001/A001/?lang=e (accessed March 24, 2014).
- Environment and Climate Change Canada. 2017. Action plan for multiple species at risk in southwestern Saskatchewan: South of the Divide. *Species at Risk Act* Action Plan Series. Environment and Climate Change Canada, Ottawa. xi + 127 pp.
- Erskine, A.J. 1992. Atlas of Breeding Birds in the Maritime Provinces. Nimbus Publishing and Nova Scotia Museum. Halifax, Nova Scotia. 270 p.

- ESTR Secretariat. 2014. Taiga Shield Ecozone+ Evidence for Key Findings Summary. Canadian Biodiversity: Ecosystem Status and Trends 2010, Evidence for Key Findings Summary Report No. 9. Canadian Councils of Resource Ministers. Ottawa, ON. <http://www.biodivcanada.ca/default.asp?lang=En&n=0C4E62D3-1> (accessed January 25, 2017)
- Fajardo, I., V. Pividal and W. Ceballos. 1994. Causes of mortality of the Short-eared Owl (*Asio flammeus*) in Spain. *Ardeola* 41: 129-134.
- Federation of Alberta Naturalists. 2007. Atlas of Breeding Birds of Alberta: A Second Look. 626 p.
- Fondell, T.F. and I.J. Ball. 2004. Density and success of bird nests relative to grazing on western Montana grasslands. *Biological Conservation* 117: 203-213.
- Gagnon, C., J. Lemaître, G. Lupien and J.A. Tremblay. Mise en place d'un inventaire spécifique du hibou des marais pour le Québec. *Le Naturaliste canadien* 139 (1): 12-16.
- Gallant, D., Slough, B.G., Reid, D.G. and Berteaux, D. 2012. Arctic fox versus red fox in the warming Arctic: four decades of den surveys in north Yukon. *Polar Biology*, 35(9): 1421-1431. DOI: 10.1007/s00300-012-1181-8.
- Gauthier, J. and Y. Aubry (eds). 1996. The Breeding Birds of Québec: Atlas of the Breeding Birds of Southern Québec. Province of Quebec Society for the Protection of Birds and Canadian Wildlife Service. Montréal, Quebec. 1,302 p.
- Gauthier, D.A., A. Lafon, T. Toombs, J. Hoth and E. Wiken. 2003. Grasslands: Toward a North American Conservation Strategy. Canadian Plains Research Center. University of Regina. Regina, Saskatchewan; and Commission for Environmental Cooperation. Montréal, Québec. <http://www3.cec.org/islandora/en/item/1964-grasslands-toward-north-american-conservation-strategy-en.pdf> (accessed January 11, 2017).
- Government of Alberta. 2011. Recommended Land Use Guidelines for Protection of Selected Wildlife Species and Habitat within Grassland and Parkland Natural Regions of Alberta. <http://aep.alberta.ca/fish-wildlife/wildlife-land-use-guidelines/documents/WildlifeLandUse-SpeciesHabitatGrasslandParkland-Apr28-2011.pdf> (accessed January 25, 2017).
- Government of Alberta. 2013a. Sensitive Species Inventory Guidelines. Alberta Environment and Sustainable Resource Development. 128 p.
- Government of Alberta. 2013b. Integrated Standards and Guidelines, Enhanced Approval Process. Sustainable Resource Development, Lands Division. Edmonton, AB. <http://aep.alberta.ca/forms-maps-services/enhanced-approval-process/eap-manuals-guides/documents/EAP-IntegratedStandardsGuide-Dec01-2013.pdf> (accessed January 25, 2017).

- Government of Saskatchewan. 2015. Saskatchewan Activity Restriction Guidelines for Sensitive Species Ministry of Environment, Fish and Wildlife Branch. <http://publications.gov.sk.ca/documents/66/92181-Saskatchewan%20Activity%20Restriction%20Guidelines%20for%20Sensitive%20Species%20-%20September%202015-1.pdf> (accessed January 25, 2017).
- Haddow, C., B. Bings and E. Wallich. 2013. Cover Requirements and Habitat Needs of Grassland-nesting Birds in the Cariboo - Chilcotin. Ministry of Forests, Lands and Natural Resource Operations - Resource Practices Board. Victoria, British Columbia. FREP Report 36. https://www.for.gov.bc.ca/ftp/hfp/external!/publish/FREP/reports/FREP_Report_36.pdf (accessed January 11, 2017).
- Hallmann, C. A., R. P. B. Foppen, C.A.M. van Turnhout, H. de Kroon and E. Jongejans. 2014. Declines in insectivorous birds are associated with high neonicotinoid concentrations. *Nature* 511:341-343.
- Heisler, L.M., C.M. Somers and R.G. Poulin. 2014. Rodent populations on the northern Great Plains respond to weather variation at a landscape scale. *Journal of Mammalogy* 95 (1): 82-90.
- Henny, C.J., L.J. Blus and T.E. Kaiser. 1984. Heptachlor seed treatment contaminates hawks, owls, and eagles of Columbia Basin, Oregon. *Raptor Research* 18: 41-48.
- Herkert, J.R., S.A. Simpson, R.L. Westemeier, T.L. Esker and J.W. Walk. 1999. Response of Northern Harriers and Short-eared Owls to grassland management in Illinois. *Journal of Wildlife Management* 63: 517-523.
- Holt, D.W. 1993. Trophic niche of Nearctic Short-eared Owls. *Wilson Bulletin* 105: 497-503.
- Holt, D.W. and S.M. Leasure. 1993. Short-eared Owl (*Asio flammeus*). In A. Poole and F. Gill (eds.). *The Birds of North America*, No. 62, Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, D.C.
- Holt, D.W., R. Berkley, C. Deppe, P.L. Enriquez-Rocha, P.D. Olsen, J.L. Petersen, J.L. Rangel-Salazar, K.P. Segars and K.L. Wood. 1999. Strigidae species accounts. Pages 153-242 in J. del Hoyo, A. Elliott and J. Sargatal (eds.). *Handbook of the birds of the world*, vol. 5. Lynx, Barcelona. 759 p.
- Hölzinger, J., M. Mickley and K. Schilhanzl. 1973. Untersuchungen zur Brut – und Emlirungsbiologie der Sumpfohreule (*Asio flammeus*) in einem süddeutschen Brutgebiet mit Bemerkungen zum Auftreten der Art in Mitteleuropa. *Anz. orn. Ges. Bayern*, 12: 176-197.
- Huang, K., P. Gauthier and J. Karpik. 2010. Short-eared Owl (*Asio flammeus*) and Townsend's Vole (*Microtus townsendii*) Dynamics in Grassland Set-asides. *Fish, Wildlife, and Recreation – British Columbia Institute of Technology*. 27 p

- Huber, D. G. and J. Gullede. 2011. Extreme weather and climate change: understanding the link, managing the risk. Center for Climate and Energy Solutions, Arlington, Virginia. 13 p.
- James, R.D. 1999. Update status report on the Least Bittern *Ixobrychus exilis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 12 p.
- Keyes, K.L. 2011. Geographic and habitat fidelity in the Short-eared Owl (*Asio flammeus*). Master's thesis. Department of Natural Resource Sciences. Macdonald Campus, McGill University. Montreal, Canada. 110 p.
- Kingsley, A. and B. Whittam. 2005. Wind turbines and birds: A background review for environmental assessment. Prepared for Environment Canada/Canadian Wildlife Service. Gatineau, Quebec. 81 p.
- Lin, Y.T. and G.O. Batzli. 2001. The influence of habitat quality and dispersal, demography, and population dynamics of voles. *Ecological Monographs* 71(2): 245-275.
- Liu, T.T., B.G. McConkey, Z.Y. Ma, Z.G. Liu, X. Li and L.L. Cheng. 2011. Strengths, Weaknesses, Opportunities and Threats Analysis of Bioenergy Production on Marginal Land. *Energy Procedia* 5: 2378-2386. DOI: 10.1016/j.egypro.2011.03.409
- Longcore, T., C. Rich, P. Mineau, B. MacDonald, D.G. Bert, L.M. Sullivan, E. Mutrie, S.A. Gauthreaux Jr., M.L. Avery, R.L. Crawford, A.M. Manville II, E.R. Travis and D. Drake. 2013. Avian mortality at communication towers in the United States and Canada: which species, how many, and where? *Biological Conservation* 158: 410-419.
- Manitoba Breeding Bird Atlas. 2014. Bird Studies Canada and Environment Canada – Canadian Wildlife Service. http://www.birdatlas.mb.ca/index_en.jsp (accessed October 15, 2014).
- Marinelli, L. and D. Neal. 1995. The distribution of small mammals on cultivated fields and in rights-of-way. *Canadian Field Naturalist* 109(4): 403-407.
- Maritimes Breeding Bird Atlas. 2013. Bird Studies Canada and Environment Canada – Canadian Wildlife Service. <http://www.mba-aom.ca/?lang=en> (accessed March 25, 2014).
- Masek, J.G., W.B. Cohen, D. Leckie, M.A. Wulder, R. Vargas, B. de Jong, S. Healey, B. Law, R. Birdsey, R. Houghton, D. Mildrexler, S. Goward and B. Smith. 2011. Recent rates of forest harvest and conversion in North America. *Journal of Geophysical Research* 116: G00K03. <http://dx.doi.org/10.1029/2010JG001471> (accessed January 11, 2017).

- McMaster, D.G. and S.K. Davis. 2001. An evaluation of Canada's Permanent Cover Program: habitat for grassland birds? *Journal of Field Ornithology* 72: 195-210.
- Mendelssohn, H. and U. Paz. 1977. Mass mortality of birds of prey caused by azodrin, an organophosphorus insecticide. *Biological Conservation* 11: 163-170.
- Migration Research Foundation. 2004. Short-eared Owl (*Asio flammeus*) population monitoring in southern and eastern Ontario - Summer 2003. Migration Research Foundation. 29 p.
- Miller, P.A. and B. Smith. 2012. Modelling tundra vegetation response to recent arctic warming. *AMBIO* 41 (3): 281-291.
- Mineau, P., M.R. Fletcher, L.C. Glaser, N.J. Thomas, C. Brassard, L.K. Wilson, J.E. Elliott, L.A. Lyon, C.J. Henny, T. Bollinger and S.L. Porter. 1999. Poisoning of raptors with organophosphorus and carbamate pesticides with emphasis on Canada, U.S. and U.K. *Journal of Raptor Research* 33: 1-37.
- Mineau, P. and C. Palmer. 2013. The impact of the nation's most widely used insecticides on birds. The Plains, VA: American Bird Conservancy. <https://extension.entm.purdue.edu/neonicotinoids/PDF/TheImpactoftheNationsMostWidelyUsedInsecticidesonBirds.pdf> (accessed January 25, 2017).
- Murray, G.A. 1976. Geographic variation in the clutch sizes of seven owl species. *Auk* 93: 602-613.
- Myers-Smith, I. H., B.C. Forbes, M. Wilmking, M. Hallinger, T. Lantz, D. Blok, K.D. Tape, M. Macias-Fauria, U. Sass-Klaassen, E. Lévesque, S. Boudreau, P. Ropars, L. Hermanutz, A. Trant, L. Siegwart Collier, S. Weijers, J. Rozema, S.A. Rayback, N.M. Schmidt, G. Schaeppman-Strub, S. Wipf, C. Rixen, C.B. Ménard, S. Venn, S. Goetz, L. Andreu-Hayles, S. Elmendorf, V. Ravolainen, J. Welker, P. Grogan, H.E. Epstein, and D.S. Hik. 2011. Shrub expansion in tundra ecosystems: dynamics, impacts and research priorities. *Environmental Research Letters* 6: 1-15.
- National Audubon Society. 2014. The Christmas Bird Count Historical Results. <http://netapp.audubon.org/CBCObservation/Historical/ResultsBySpecies.aspx?1> (accessed January 11, 2017).
- NatureServe. 2015. NatureServe explorer v 7.1. <http://explorer.natureserve.org/servlet/NatureServe?searchSciOrCommonName=short-eared%20owl>
- OMNR. 2010. Forest management guide for conserving biodiversity at the stand and site scales. Ontario Ministry of Natural Resources. Toronto, Ontario. 211 p.

- Painchaud, J. and S. Villeneuve. 2003. Portrait global de l'état du Saint-Laurent-Suivi de l'état du Saint-Laurent. Plan d'action Saint-Laurent Vision 2000. National Library of Canada. 18 p.
- Partners in Flight Science Committee. 2012. Species Assessment Database, version 2012. <http://rmbo.org/pifassessment> (accessed January 11, 2017)
- Partners in Flight Science Committee. 2013. Population Estimates Database, version 2013. <http://rmbo.org/pifpopestimates> (accessed January 11, 2017).
- Peakall, D.B. and A.C. Kemp. 1980. Organochlorine levels in owls in Canada and South Africa. *Ostrich* 51:186-187.
- Peles, J.D. and G.W. Barrett. 1996. Effects of vegetative cover on the population dynamics of meadow voles. *Journal of Mammalogy* 77(3): 857-869.
- Pellerin, S. and M. Poulin. 2013. Analyse de la situation des milieux humides au Québec et recommandations à des fins de conservation et de gestion durable. Report prepared for the Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs, 104 p. <http://www.mddep.gouv.qc.ca/eau/rives/Analyse-situation-milieux-humides-recommandations.pdf> (accessed January 26, 2017)
- Pitelka, F.A., P.Q. Tomich and G.W. Treichel. 1955. Breeding behavior of jaegers and owls near Barrow, Alaska. *Condor* 57: 3-18.
- Pool, D.B., A.O. Panjabi, A. Macias-Duarte and D.M. Solhjem. 2014. Rapid expansion of croplands in Chihuahua, Mexico threatens declining North American grassland bird species. *Biological Conservation* 170: 274-28.
- Poulin, R.G., T.I. Wellicome and L.D. Todd. 2001. Synchronous and delayed numerical responses of a predatory bird community to a vole outbreak on the Canadian prairies. *Journal of Raptor Research* 35: 288-295.
- Preston, M.I. and G.A. Powers. 2006. High incidence of vehicle-induced owl mortality in the lower mainland and central Fraser valley, British Columbia. *Wildlife Afield* 3(1):15-22.
- Québec Breeding Bird Atlas. 2014. Québec Breeding Bird Atlas online results Regroupement QuébecOiseaux, Environment Canada – Canadian Wildlife Service and Bird Studies Canada. www.atlas-oiseaux.qc.ca/index_en.jsp (accessed March 25, 2014).
- Rangeland Conservation Service Ltd. 2004. Beneficial Management Practices for the Milk River Basin, Alberta: A Component of the Multi-Species Conservation Strategy for Species at Risk in the Milk River Basin (MULTISAR). Unpublished report prepared for Alberta Sustainable Resource Development, Fish and Wildlife Division and the Alberta Conservation Association. Airdrie, Alberta. 369 p.

- Raptor Research Foundation. 2007. Raptor Research Foundation and Hawk Migration Association of North America, Annual meeting.
http://www.raptorresearchfoundation.org/files/2010/12/2007_program.pdf
(accessed January 11, 2017).
- Raptor Research Foundation. 2008. 2008 Annual Meeting, Missoula, Montana.
http://www.raptorresearchfoundation.org/files/2010/12/2008_program.pdf
(accessed January 11, 2017).
- Raptor Research Foundation. 2011. 2011 Annual Meeting, Duluth, Minnesota
http://www.raptorresearchfoundation.org/files/2011/09/2011_RRF_Program_Book.pdf (accessed January 11, 2017).
- Reich, L. M. 1981. *Microtus pennsylvanicus*. Mammalian Species 159: 1-8.
- Reid, D.G., F.I. Doyle, A.J. Kenney and C.J. Krebs. 2011. Some observations of Short-eared Owl (*Asio flammeus*) ecology on arctic tundra, Yukon, Canada. Canadian Field-Naturalist 125: 307-315.
- Salafsky, N., D. Salzer, A.J. Stattersfield, C. Hilton-Taylor, R. Neugarten, S.H.M. Butchart, B. Collen, N. Cox, L.L. Master, S. O'Connor, and D. Wilkie. 2008. A standard lexicon for biodiversity conservation: unified classifications of threats and actions. Conservation Biology 22: 897-911.
- Samson, F.B. and F.L. Knopf. 1994. Prairie conservation in North America. BioScience 44: 418-421.
- Samson, F.B., F.L. Knopf and W.R. Ostlie. 2004. Great Plains ecosystems: past, present, and future. Wildlife Society Bulletin 32: 6-15.
- Saskatchewan Breeding Bird Atlas. 2016. Saskatchewan Conservation Data Centre
<http://www.biodiversity.sk.ca/birdatlas.htm> (accessed July 7, 2016)
- Saskatchewan Ministry of Environment. 2014. Short-eared Owl survey protocol. Fish and Wildlife Branch, Technical Report No. 2014-6.0. Regina, Saskatchewan. 8 p.
- Sauchyn, D. and S. Kulshreshtha. 2008. Prairies. Pages 275-328 in Lemmen, D.S., Warren, F.J., Lacroix, J. and E. Bush (eds.). From impacts to adaptation: Canada in a changing climate. Government of Canada, Ottawa. 448 p.
www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/assess/2007/pdf/ch7_e.pdf (accessed January 11, 2017)
- Schmelzer, I. 2005. A management plan for the Short-eared owl (*Asio flammeus*) in Newfoundland and Labrador. Wildlife Division, Department of Environment and Conservation. Corner Brook, Newfoundland and Labrador. 16 p.

- Scobie D. and C. Faminow. 2000. Development of standardized guidelines for petroleum industry activities that affect COSEWIC Prairie and Northern Region vertebrate species at risk. Ghostpine Environmental Services. 42 p.
- Screen J. A. and I. Simmonds. 2010. The central role of diminishing sea ice in recent Arctic temperature amplification. *Nature* 464: 1334-1337.
- Semenchuk, G.P. 1992. The Atlas of Breeding Birds of Alberta. Federation of Alberta Naturalists. Edmonton, Alberta. 391 p.
- Sinclair, P.A., W.A. Nixon, C.D. Eckert and N.L. Hughes. 2003. Birds of the Yukon Territory. University of British Columbia Press. Vancouver, British Columbia. 596 p.
- Smith, A.R. 1996. Atlas of Saskatchewan Birds. Environment Canada and Nature Saskatchewan. Regina, Saskatchewan.
- Smith, C.M., N.A. Lawrence and R.A. Buck. 2013. First Nesting Records for the Short-eared Owl (*Asio flammeus*) on Banks Island, Northwest Territories: Evidence of Range Expansion to Arctic Islands in Canada. *Canadian Field-Naturalist* 127: 185-188.
- SOS-POP. 2016. Suivi des espèces en péril (SOS-POP). Regroupement Québécois. <http://quebecoiseaux.org/index.php/dossiers/suivi-des-populations/728-suivi-des-especes-en-peril> (accessed January 11, 2017).
- Statistics Canada. 2011. 2011 farm and farm operator data: Highlights and analysis – Snapshot of Canadian Agriculture. <http://www.statcan.gc.ca/pub/95-640-x/2011001/p1/p1-00-eng.htm> (accessed January 25, 2017)
- Takats, D.L., C.M. Francis, G.L. Holroyd, J.R. Duncan, K.M. Mazur, R.J. Cannings, W. Harris and D. Holt. 2001. Guidelines for nocturnal owl monitoring in North America. Beaverhill Bird Observatory and Bird Studies Canada. Edmonton, Alberta. 32 p.
- Taper, M.L., K. Böhning-Gaese and J.H. Brown. 1995. Individualistic responses of bird species to environmental change. *Oecologia* 101(4):478-486.
- Tate, G.R. 1992. Short-eared Owl (*Asio flammeus*). Pages 171-189 in J. Schneider and D.M. Pence (eds.). Migratory nongame birds of management concern in the northeast. U.S. Fish and Wildlife Service. Newton Corner, Massachusetts. 400 p.
- Therrien, J.-F. 2010. Territorial behavior of Short-eared Owls (*Asio flammeus*) at more than 1000 km north of their current breeding range in northeastern Canada: evidence of range expansion? *Canadian Field-Naturalist* 124: 58-60.

- Villar, N., T. Cornulier, D. Evans, R. Pakeman, S. Redpath and X. Lambin. 2014. Experimental evidence that livestock grazing intensity affects cyclic vole population regulation processes. *Population Ecology* 56: 55-61.
- Vukovitch, M. and G. Ritchison. 2008. Foraging behavior of Short-eared Owls and Northern Harriers on a reclaimed surface mine in Kentucky. *Southeastern Naturalist* 7: 1-10.
- Watmough, M.D. and M.J. Schmall. 2007. Environment Canada's Prairie and Northern Region Habitat Monitoring Program Phase II: recent habitat trends in the Prairie Habitat Joint Venture. Technical Report Series No. 493. Environment Canada, Canadian Wildlife Service. Edmonton, Alberta. 135 p.
- Weir, R.D. 2008. *Birds of the Kingston Region, Second Edition*. Kingston Field Naturalists, Kingston, Canada. 608 p.
- Wiebe, K.L. 1987. Food and foraging behavior of Short-eared Owls in southwestern British Columbia. Unpublished report. Simon Fraser University. Burnaby, British Columbia.
- Wiggins, D.A. 2004. Short-eared Owl (*Asio flammeus*): a technical conservation assessment. USDA Forest Service. Rocky Mountain Region. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5182042.pdf (accessed January 11, 2017).
- Wiggins, D.A., D.W. Holt and S.M. Leasure. 2006. Short-eared Owl (*Asio flammeus*). *The Birds of North America Online* (A. Poole, ed.). Cornell Lab of Ornithology. Ithaca, New York. <https://birdsna.org/Species-Account/bna/species/sheowl/introduction> (accessed January 11, 2017).
- With, K.A., A.W. King and W.E. Jensen. 2008. Remaining large grasslands may not be sufficient to prevent grassland bird declines. *Biological Conservation* 141: 3152-3167.
- Zhang, W., P. A. Miller, B. Smith, R. Wania, T. Koenigk and R. Doscher. 2013. Tundra shrubification and tree-line advance amplify arctic climate warming: results from an individual-based dynamic vegetation model. *Environmental Research Letters* 8: 1-10.

Appendix A: Areas of Interest for the Conservation of the Short-eared Owl in Canada

In the Northwest Territories, the area of interest includes:

1. Coastal tundra zone along the mainland coast of the Beaufort Sea

In British Columbia, the areas of interest include:

1. Fraser River delta
2. Grasslands and wetlands along the Peace River (near the Alberta border)

In the Prairie provinces (Alberta, Saskatchewan and Manitoba), the area of interest includes:

1. The southern portion, mainly the grassland and residual pasture habitats in Bird Conservation Region 11 – Prairie Potholes

In Alberta, the areas of interest include:

1. Agricultural areas, marshes and grasslands east of Lesser Slave Lake, along the Peace River (Grande Prairie, Fairview)
2. Agricultural areas, marshes and grasslands of the Beaverhill Lake region

In Saskatchewan, the areas of interest include:

1. Agricultural areas, marshes and grasslands along the North Saskatchewan River (North Battleford)
2. Agricultural areas, marshes and grasslands along the shores of Last Mountain Lake
3. Agricultural areas, marshes and grasslands along the shores of Quill Lake

In Manitoba, the areas where the species is recurrent are:

1. Marshes and grasslands north of Lake Winnipegosis and near Clearwater Lake
2. Agricultural areas, marshes and grasslands south of Lake Manitoba

In Ontario, the areas of interest include:

1. Marshes and grasslands in the Hudson and James Bay lowlands
2. Agricultural areas, marshes and grasslands along the shores of the Great Lakes
3. Agricultural areas, marshes and grasslands near Lake St. Clair
4. Agricultural areas in the Niagara Peninsula (e.g. Haldimand and Hamilton)
5. Insular agricultural areas near Kingston (e.g. Amherst Island and Wolfe Island; Weir, 2008; Keyes, 2011)

A number of agricultural areas farther from the major rivers and formerly occupied by the species seem to have been abandoned (Migration Research Foundation, 2004)

In Quebec, the areas of interest include:

1. Agricultural areas, marshes and grasslands on the islands in the St. Lawrence River (e.g. Îles de Varennes archipelago and Isle-aux-Grues archipelago) and along the St. Lawrence River and estuary (high marsh of La Pocatière and Baie de Mille-Vaches), particularly on the south shore (Lower St. Lawrence terraces), but also at several low-elevation locations on the north shore (e.g. Havre Saint-Pierre, Blanc Sablon and Manicouagan Peninsula)
2. Agricultural areas, marshes and grasslands of the Saguenay–Lac-Saint-Jean lowlands
3. Agricultural areas in the Abitibi region
4. High marsh and dune environment of the Magdalen Islands
5. High marsh and grasslands of Chaleur Bay
6. Marshes and grasslands of the James Bay lowlands (e.g. Boatswain Bay and Cabbage Willows Bay)
7. Open habitats along the La Grande River (e.g. Radisson)

In the Atlantic provinces, the areas of interest include:

1. Marshes and grasslands along the coast of New Brunswick
2. Marshes and grasslands along the coast of Nova Scotia
3. Marshes and grasslands of Prince Edward Island
4. Marshes and grasslands along the coast of Newfoundland and Labrador

Appendix B: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the [Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals](#)¹¹. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the [Federal Sustainable Development Strategy](#)'s¹² (FSDS) goals and targets.

Conservation planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that implementation of management plans may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the plan itself, but are also summarized below in this statement.

Overall, this management plan should have a positive effect on other species living in the same type of habitats as the Short-eared Owl, because it should reduce threats through the implementation of beneficial management practices. A number of sensitive bird species may benefit from the measures set forth in the management plan, including the Burrowing Owl (*Athene cunicularia*; SARA Endangered), Henslow's Sparrow (*Ammodramus henslowii*; SARA Endangered), Ferruginous Hawk (*Buteo regalis*; SARA Threatened), Sprague's Pipit (*Anthus spragueii*; SARA Threatened); Bobolink (*Dolichonyx oryzivorus* COSEWIC Threatened), Eastern Meadowlark (*Sturnella magna*; COSEWIC Threatened), Long-billed Curlew (*Numenius americanus*; SARA Special Concern), Chestnut-collared Longspur (*Calcarius ornatus*; SARA Special Concern), Baird's Sparrow (*Ammodramus bairdii*; SARA Special Concern), and Yellow Rail (*Coturnicops noveboracensis*; SARA Special Concern).

The possibility that this management plan will inadvertently generate negative effects on the environment and on other species has been considered. The majority of recommended actions are non-intrusive in nature, including surveys and awareness raising. The SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects.

¹¹ www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1

¹² www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1