COSEWIC
Assessment and Status Report

on the

Eastern Whip-poor-will
Antrostomus vociferus

in Canada

SPECIAL CONCERN
2022

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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

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Eastern Whip-poor-will (adult male brooding two nestlings) from Torrance Barrens Conservation Reserve, Muskoka, Ontario (2020); photo by Elora Grahame.

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COSEWIC
Assessment Summary

Assessment Summary – December 2022

Common name
Eastern Whip-poor-will

Scientific name
Antrostomus vociferus

Status
Special Concern

Reason for designation
Similar to many other aerial insectivores, this well-known nocturnal bird has experienced a long-term population decline in Canada. However, reanalysis of trend data suggests that the decline may not have been quite as severe as thought at the time of the previous assessment, and new data suggest that abundance may now be stable or increasing. Concern remains regarding the reduction in the bird's insect prey base, attributed to ongoing pesticide use, in addition to other threats such as habitat loss and degradation and increasingly frequent and severe hurricanes along its migration routes. Although numbers remain relatively large, this species is at risk of becoming Threatened if threats are not adequately mitigated.

Occurrence
Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia and Prince Edward Island.

Status history
Designated Threatened in April 2009. Status re-examined and designated Special Concern in December 2022.

COSEWIC
Executive Summary

Eastern Whip-poor-will
Antrostomus vociferus

Wildlife Species Description and Significance

The Eastern Whip-poor-will is a nightjar with a large, flattened head and cryptic grey-brown plumage. It has a small bill, but its gape is large and ringed with sensory bristles for capturing flying insects. The species is commonly evoked as a symbol of rural life. It has attained significant status in popular culture, being mentioned in countless songs, poems, books, and movies.

Distribution

The breeding range of the Eastern Whip-poor-will extends from east-central Saskatchewan to Nova Scotia, and south into the United States as far as Oklahoma in the west and South Carolina in the east. The breeding range encompasses approximately 2,833,000 km^2, roughly 553,000 km^2 of which is in Canada. During winter, the species ranges from coastal South Carolina (rarely) through Florida and along the Gulf Coast of the United States into Mexico and Central America, as far south as Costa Rica and western Panama.

Habitat

For nesting, the Eastern Whip-poor-will avoids both wide-open spaces and closed-canopy forests, favouring areas with little ground cover in semi-open or patchy forests with clearings, such as barrens or regenerating woodlands. Forest structure is more important than composition, although common tree associations in both summer and winter are pine and oak. In winter, the Eastern Whip-poor-will occupies primarily mixed woods, and is also fairly common in broadleaf evergreen forests near open areas.

Biology

The Eastern Whip-poor-will can breed the year after hatching. The clutch size is typically two eggs, which are laid directly on the leaf litter, with both parents contributing to raising the young. The incubation period is 19–21 days; the young take their first flights in the third week after hatching. Pairs may raise one or two broods a year, although second broods are uncommon in Canada. The generation length is estimated to be approximately 3.7 years. The diet of the Eastern Whip-poor-will consists of a variety of night-flying insects, including moths, beetles, flies, grasshoppers, and mosquitoes.

Population Sizes and Trends

The Eastern Whip-poor-will population in Canada is estimated to be 140,000 (95% CI [confidence interval] = 65,000 to 250,000) mature individuals, or 7.8% of the global population. An estimated 64% (n = 89,000; 95% CI = 25,000 to 190,000) of the Canadian population is in Ontario.

Although the North American Breeding Bird Survey provides limited coverage of primarily nocturnal species such as the Eastern Whip-poor-will, it is the only available source of long-term trend data on the species. From 1970 to 2019, the average annual trend in Canada was a 0.9% decline (95% CrI [credible interval] = -3.2% to 1.2%), corresponding to a cumulative decline of 35.2% (95% CrI = -79.3% to 76.2%) over 49 years. However, during the most recent 10-year period (2009 to 2019), the data indicate an average annual population increase of 5.3% (95% CrI = -1.2% to 13.3%), amounting to an increase of 68.3% (95% CrI = -10.9% to 247.1%) over the decade. Although there is a 95% probability of a population increase over this period, this short-term estimate is associated with broad uncertainty and low statistical reliability. Consequently, the recent trend may be better estimated by interpolating from the larger long-term trend dataset, which results in an estimated decline of 9.3% over three generations (11 years) (95% CrI = -29.8% to 13.5%). Second-generation breeding bird atlases in Ontario, Quebec, and the Maritimes also show declines over periods of 20−25 years, but this is mainly (or entirely) prior to the most recent three-generation period. Whether the population has actually rebounded or is continuing to decline, the best available evidence suggests that the most recent 11-year trend is substantially less severe than the -35% decline over three generations estimated in the previous status report.

Threats and Limiting Factors

Remaining knowledge gaps limit the understanding of the threats faced by the Eastern Whip-poor-will throughout its annual cycle. Available data suggest that the greatest threats to the species are natural systems modifications (via widespread pesticide use and fire suppression), agricultural expansion, residential and industrial development, and severe weather due to climate change (particularly strong storms). Additional factors threatening the species include direct human disturbance, energy production and mining, transportation corridors, invasive and problematic species, and potentially pollution and logging, but more research is needed.

Protection, Status and Ranks

In Canada, the Eastern Whip-poor-will has been listed as Threatened since 2011 on Schedule 1 of the *Species at Risk Act* (2002) and is also protected under the *Migratory Birds Convention Act*, *1994*. It is designated Threatened under provincial legislation in Manitoba, Ontario, New Brunswick, and Nova Scotia. In Quebec, it is on the *List of Plant and Wildlife Species Which Are Likely to be Designated Threatened or Vulnerable*. The Eastern Whip-poor-will is not afforded protection under the *Endangered Species Act* in the United States, but is protected under the *Migratory Bird Treaty Act*.

Globally, NatureServe ranks the Eastern Whip-poor-will as Secure (G5), but the International Union for Conservation of Nature (IUCN) has recognized it as Near Threatened. In Canada, the breeding population is considered Vulnerable (N3B), while, at a provincial level, it is ranked from S1 (Critically Imperiled) to S3 (Vulnerable) in the six provinces where it regularly occurs. In the United States, the breeding population is considered Secure (N5B). The Eastern Whip-poor-will is included on the “D” Yellow Watch List Species compiled by Partners in Flight.

TECHNICAL SUMMARY

Antrostomus vociferus

Eastern Whip-poor-will

Engoulevent bois-pourri

Range of occurrence in Canada (province/territory/ocean): Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia and Prince Edward Island.

Demographic Information

Generation time (usually average age of parents in the population)	Approximately 3.7 years.	Based on Bird *et al.* (2020)
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Uncertain.	Although there has been a long-term decline, recent BBS estimates suggest it may have ceased.
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations, whichever is longer up to a maximum of 100 years]	-6% (95% CI: -20, 8)	Estimated by applying long-term BBS trend to a two-generation (seven-year) period.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations, whichever is longer up to a maximum of 100 years].	-9.3% (95% CI: = -29.8, 13.5%) over 11 years (2008-2019).	Inferred by applying long-term BBS data to the three-generation (11 year) period.
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations, whichever is longer up to a maximum of 100 years].	Unknown.	Likely <30% reduction, based on applied long-term trends and anticipated threats.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any period [10 years, or 3 generations, whichever is longer up to a maximum of 100 years], including both the past and the future.	Unknown.	Likely <30% reduction, based on applied long-term trends and anticipated threats.
Are the causes of the decline clearly understood?	No.	Many knowledge gaps remain, although long-term decline of aerial insectivores is somewhat understood.
Have the causes of the decline ceased?	Unknown.	Natural system modifications (reduced prey availability) and habitat loss and agricultural intensification (pesticide use) are ongoing. More research is needed on other threats.

Are the causes of the decline clearly reversible?	No.	Habitat conservation is potentially reversible, but reversing other threats will be more challenging.
Are there extreme fluctuations in number of mature individuals?	No.	

Extent and Occupancy information

Estimated extent of occurrence (EOO)	1,754,000 km²	Calculated based on minimum convex polygon around known occurrences in Canada.
Index of area of occupancy (IAO), reported as 2x2 km grid value.	>>2,000 km²	Relatively abundant and widespread species.
Is the population "severely fragmented" i.e., is >50% of its total area of occupancy in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?	a. No. b. No.	Population is not severely fragmented.
Number of "locations"* (use plausible range to reflect uncertainty if appropriate)	Unknown, but certainly over 10.	Uncertain given that the greatest threat is loss of prey availability, which is a broad concern.
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence?	No.	
Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy?	Yes.	There is a continuing loss of known territories.
Is there an [observed, inferred, or projected] continuing decline in number of subpopulations?	Not applicable.	
Is there an [observed, inferred, or projected] continuing decline in number of "locations"?	Unknown.	Incomplete understanding of threats limits consideration of trends in number of locations.
Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality of] habitat?	Likely.	Long-term population decline may in part reflect continuing decline in extent and/or quality of habitat in breeding and wintering areas.
Are there extreme fluctuations in number of subpopulations?	No.	
Are there extreme fluctuations in number of "locations"?	No.	
Are there extreme fluctuations in extent of occurrence?	No.	

* See Definitions and Abbreviations on COSEWIC website for more information on this term.

Are there extreme fluctuations in index of area of occupancy?	No.	

Number of Mature individuals (in each subpopulation)

Subpopulations	N Mature Individuals (give plausible ranges)	Notes on individual estimates
Total	~140,000 (95% CI = 65,000 to 250,000)	Based on 2006-2015 BBS data (Partners in Flight 2020).

Quantitative Analysis

Is the probability of extinction in the wild at least [20% within 20 years or 5 generations whichever is longer up to a maximum of 100 years, or 10% within 100 years]?	Unknown.	Analysis not conducted.

Threats and Limiting Factors

Was a threats calculator completed for this species?	Yes, in March 2021 (see Appendix A)	Overall threat impact: high
Key threats were identified as: i. Natural System Modifications (IUCN 7) – High-medium impact threat ii. Residential & Commercial Development (IUCN 1) – low impact threat iii. Agriculture & Aquaculture (IUCN 2) – low impact threat iv. Transportation & Service Corridors (IUCN 4) – low impact threat v. Climate Change & Severe Weather (IUCN 11) – low impact threat vi. Energy Production & Mining (IUCN 3) – unknown impact threat vii. Biological Resource Use (IUCN 5) – unknown impact threat viii. Human Intrusions & Disturbance (IUCN 6) – unknown impact threat ix. Invasive & Other Problematic Species & Genes (IUCN 8) – unknown impact threat x. Pollution (IUCN 9) – unknown impact threat What additional limiting factors are relevant? i. Low annual productivity ii. Ground nesting iii. Long-distance migration		

Rescue Effect (natural immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	Unknown.	Short-term BBS trends in states bordering Canada vary from strongly negative to strongly positive, but have broad uncertainty. The long-term trend for all of these states is negative.
Is immigration known or possible?	Yes.	Although unconfirmed, immigration is possible.
Would immigrants be adapted to survive in Canada?	Yes.	Habitat and climate in Canada are similar to that in US states bordering Canada.

Is there sufficient habitat for immigrants in Canada?	Unknown.	It is unclear to what extent lack of suitable habitat is a limiting factor on the breeding population in Canada.
Are conditions deteriorating in Canada?[+]	Unknown.	More research is needed.
Are conditions for the source (i.e., outside) population deteriorating?[+]	Unknown.	More research is needed.
Is the Canadian population considered to be a sink?[+]	No.	
Is rescue from outside populations likely?	Unknown.	Immigrants are adapted to survive in Canada, but habitat availability in Canada is unknown, and it is unclear whether the source population could provide recruits to enable rescue.

Occurrence Data Sensitivity

Are occurrence data of this species sensitive?	No.

Status History

COSEWIC: Designated Threatened in April 2009. Status re-examined and designated Special Concern in December 2022.

Status and Reasons for Designation

Current Status: Special Concern	**Alpha-numeric codes:** Not applicable
Reasons for designation: Similar to many other aerial insectivores, this well-known nocturnal bird has experienced a long-term population decline in Canada. However, reanalysis of trend data suggests that the decline may not have been quite as severe as thought at the time of the previous assessment, and new data suggest that abundance may now be stable or increasing. Concern remains regarding the reduction in the bird's insect prey base, attributed to ongoing pesticide use, in addition to other threats such as habitat loss and degradation and increasingly frequent and severe hurricanes along its migration routes. Although numbers remain relatively large, this species is at risk of becoming Threatened if threats are not adequately mitigated.	
Reason for change of status ii (reduction in rate of population decline) iii (reanalysis of trend data using a Bayesian approach)	

Applicability of Criteria

A: Decline in total number of mature individuals Not applicable. Estimated rate of reduction in number of mature individuals of about 9% over the past three generations (11 years), and projected trend over the next three generations are below the threshold for Threatened.
B: Small distribution range and decline or fluctuation Not applicable. EOO of 1,754,000 km^2 and IAO of >2000 km^2 exceed thresholds for Threatened.

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

C: Small and declining number of mature individuals Not applicable. Number of mature individuals is estimated to be >65,000, exceeding the threshold for Threatened.
D: Very small or restricted population Not applicable. Number of mature individuals is estimated to be 140,000, exceeding the threshold for Threatened. Threatened D2 also not applicable because thresholds for number of locations and IAO exceeded.
E: Quantitative analysis Not applicable. Analysis not conducted.

PREFACE

The Eastern Whip-poor-will was first assessed by COSEWIC in 2009 and designated Threatened due to both long-term and short-term population declines. Since then, new information has become available on the Eastern Whip-poor-will in Canada, including the completion of the second Quebec and Maritimes breeding bird atlas projects and the first Manitoba breeding bird atlas project (Stewart *et al.* 2015; Artuso *et al.* 2018; Robert *et al.* 2019), initiation of the first Saskatchewan breeding bird atlas project (Birds Canada 2020), implementation of dedicated Eastern Whip-poor-will roadside surveys in Ontario and Quebec, and the development and implementation of the Canadian Nightjar Survey. Updated global, national, and provincial population estimates for the Eastern Whip-poor-will have been prepared by Partners in Flight (PIF) using data from the Breeding Bird Survey, the second Ontario breeding bird atlas project, eBird relative frequency data (June and July, 1970–2017), and range map extrapolation (Will *et al.* 2020). These estimates now take into account measures of uncertainty as described by Stanton *et al.* (2019). Updated population trends estimated using Breeding Bird Survey data continue to show probable long-term population declines for the Eastern Whip-poor-will in Canada, but there is a 95% probability that the most recent three-generation trend in Canada is now positive, although precision is poor (Smith unpubl. data).

Recent studies on the Eastern Whip-poor-will in Canada have provided new knowledge regarding migration patterns, breeding phenology, food supply, habitat use, and the species' responses to landscape characteristics and forest management (e.g. Hunt 2013; Rand 2014; Tozer *et al.* 2014; Farrell *et al.* 2016; English *et al.* 2017a, 2017b, 2018a, 2018b; Korpach *et al.* 2019; Tonra *et al.* 2019). Many studies have also generated new information on threats to aerial insectivores, which include declining insect populations; pollutants and pesticides; and the phenological mismatch between breeding and insect availability due to climate change (e.g. Nebel *et al.* 2010; Hallmann *et al.* 2014; Latta *et al.* 2015; Spiller and Dettmers 2019).

Various projects have been undertaken that target the Eastern Whip-poor-will on federal, provincial, and private lands with funding from the federal Habitat Stewardship Program, the Critical Habitat Interdepartmental Program (previously the Interdepartmental Recovery Fund), and the Aboriginal Fund for Species at Risk. Other activities have included surveys in Department of National Defence establishments (Manitoba, Ontario and Quebec); the General Habitat Description completed under the *Endangered Species Act*, 2007 (Ontario); development of standardized protocols for nightjar surveys; and projects on forest birds at risk to assist in the development of beneficial management practices (Maritimes). The federal recovery strategy for the Eastern Whip-poor-will was published in 2018 (ECCC 2018).

COSEWIC HISTORY

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

COSEWIC MANDATE

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

COSEWIC MEMBERSHIP

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

DEFINITIONS (2022)

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

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

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

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

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

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

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific name: *Antrostomus vociferus* (Wilson, 1812)

English name: Eastern Whip-poor-will

French name: Engoulevent bois-pourri

Classification:

Class : Aves

Order: Caprimulgiformes

Family: Caprimulgidae

Antrostomus vociferus is one of 11 species in the genus *Antrostomus*, all of which are New World species. It was split from its sister species Mexican Whip-poor-will (*A. arizonae*) in 2010 (previously *Caprimulgus vociferus vociferus* and *C. v. arizonae*, respectively) due to differences in voice and morphology (Chesser *et al.* 2010; Cink *et al.* 2020), then reassigned to *Antrostomus* in 2012 (Chesser *et al.* 2012).

Morphological Description

The Eastern Whip-poor-will is a medium-sized crepuscular to nocturnal bird that measures 22 to 26 cm in length and has a mass of 43 to 64 g. Individuals have a large, flattened head with a small bill, but a large gape that is ringed with long, hairlike, sensory feathers, known as rictal bristles. The plumage of both sexes is cryptic, mostly grey and brown, and the tail and wings are rounded. Males have a white collar on the upper breast and substantial white corners on the tail created by the white tips of the outer tail feathers; in females, these areas are buff, and the tail patches are reduced (Cink *et al.* 2020).

Population Spatial Structure and Variability

There are no recognized subspecies of the Eastern Whip-poor-will and there is no evidence of population spatial structure or variability.

Designatable Units

No subspecies of the Eastern Whip-poor-will have been recognized (Cink *et al.* 2020), and there is no evidence that any subpopulations show evidence of the discreteness or evolutionary significance that would support the recognition of more than one designatable unit under COSEWIC (2021) guidelines.

Special Significance

People generally experience the Eastern Whip-poor-will through its haunting song, described as an emphatic whistle and rendered as *Whip-puwi-WEEW* (Sibley 2003). This call is commonly evoked as a symbol of rural life, and has attained significant status in popular culture, being mentioned in countless songs, poems, books, and movies. Specific Aboriginal Traditional Knowledge was not available, but the Eastern Whip-poor-will is part of an ecosystem that is important to Indigenous people, who recognize the interconnectedness of all species. Some Indigenous languages have multiple words for the Eastern Whip-poor-will; for example, Anishinaabemowin (Ojibwe) words used for the species include “waakowazh” in northern Minnesota, “biigokokwe’owesi” in southern Manitoba, and “waawoonesi” (or alternatively “waahonesi”) in the southern Algonquin region.

DISTRIBUTION

Global Range

The breeding range of the Eastern Whip-poor-will extends from east-central Saskatchewan to Nova Scotia and southward into the United States, running, west to east, from Minnesota and South Dakota to Maine, and southward to Oklahoma, northern Georgia, and South Carolina. The breeding range is approximately 2,833,000 km^2. During the winter, the species occurs from coastal South Carolina (rarely) through Florida and along the Gulf Coast of the United States into Mexico and Central America, as far south as Costa Rica and western Panama (Cink *et al.* 2020; Figure 1). Canadian breeders have been detected overwintering from central Mexico to southern Costa Rica (English *et al.* 2017a; Korpach *et al.* 2019).

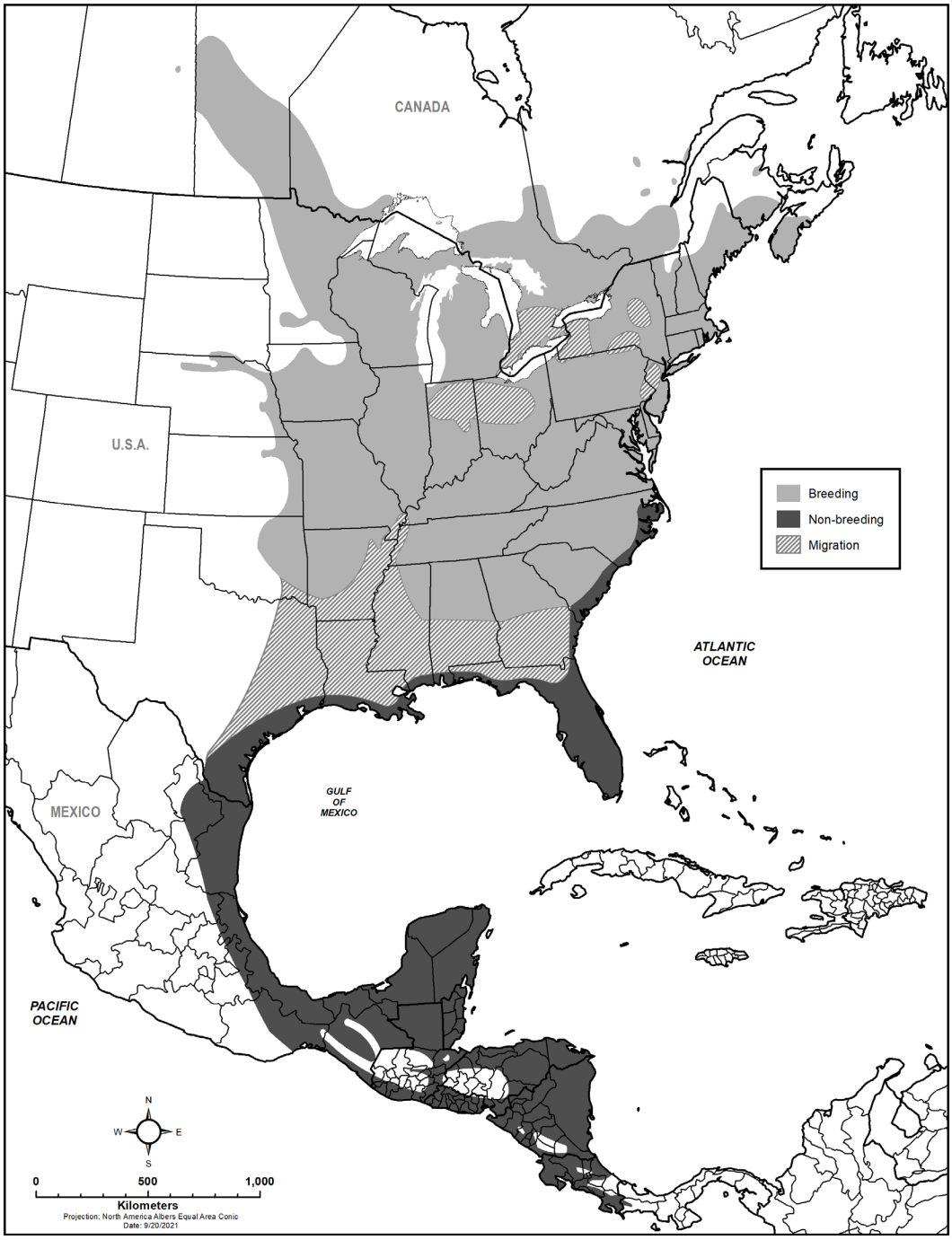

Figure 1. The breeding, migration, and non-breeding (wintering) ranges of the Eastern Whip-poor-will (adapted from Birds of the World 2020 and eBird 2020). The breeding range is based on breeding bird atlases (Cadman *et al.* 2007; Stewart *et al.* 2015; Artuso *et al.* 2018; Robert *et al.* 2019; Birds Canada 2020) and eBird data (2020). Changes in distribution on this map from the previous iteration of the COSEWIC status report on the Eastern Whip-poor-will do not represent extensions in the range of the Eastern Whip-poor-will but instead reflect increased search effort and data availability.

Canadian Range

Approximately 20% (553,000 km^2) of the breeding distribution of Eastern Whip-poor-will is found in Canada (PIF 2020). The species breeds from east-central Saskatchewan (sparsely) eastward through southern Manitoba, parts of southern and central Ontario, southern Quebec, and New Brunswick, with local occurrences in Nova Scotia, and rarely in Prince Edward Island (Godfrey 1986; Horn 2015; Cink *et al.* 2020). The highest concentrations in Canada appear to be in the Frontenac Axis region of eastern Ontario and in south-central and southeastern Manitoba (Fink *et al.* 2020).

According to the Saskatchewan Breeding Bird Atlas project (Birds Canada 2021), the Eastern Whip-poor-will occurs rarely in the province, and only in the east-central portion; provisional data indicate records in just four 10 x 10 km atlas squares from 2017 to 2021. In Manitoba, the main breeding range of the Eastern Whip-poor-will is in a band from the Saskatchewan border north of the Prairie Potholes region, southeastward through the Interlake region on the Boreal Taiga Plains, and through the Boreal Hardwood Transition region to the Ontario and Minnesota borders (Mills 2018; Figure 1). In Ontario, the main breeding range extends from Sudbury down the Georgian Bay shoreline (and Bruce Peninsula) and along the edge of the Shield south of Algonquin Provincial Park to the Rideau Lakes area (Mills 2007; Figure 1). Multiple large concentrations and smaller pockets of the Eastern Whip-poor-will have also been documented between Lake Superior and the Manitoba border over the past decade. In Quebec, the Eastern Whip-poor-will breeds primarily in the St. Lawrence Lowlands and along the lower edge of the Southern Laurentians (Létourneau 2019; Figure 1). In the Maritimes, the Eastern Whip-poor-will is sparsely and irregularly distributed. The species' main breeding range includes the Valley Lowlands and Grand Lake Lowlands ecoregions and Miramichi River Valley of New Brunswick, as well as western Nova Scotia; in Prince Edward Island, breeding evidence for the species was limited to one square, where probable breeding evidence was obtained, during the second breeding bird atlas (Horn 2015; Figure 1).

Extent of Occurrence and Area of Occupancy

The current extent of occurrence (EOO) is approximately 1,754,000 km^2 in Canada (Figure 1). The differences in distribution shown in Figure 1 relative to the previous version of the COSEWIC status report on the Eastern Whip-poor-will likely reflect increased search effort and data availability, rather than extensions in the species' range.

The specific distribution of the Eastern Whip-poor-will is not sufficiently documented to calculate the index of area of occupancy (IAO). However, because the species is relatively abundant and not highly concentrated at any point in its life cycle, the IAO is certainly much greater than 2,000 km^2.

BIOLOGY AND HABITAT USE

Studies in Kansas (long-term; Cink *et al.* 2020) and Ontario (two years, Mills 1986; and three years, English *et al.* 2018b) provide most life history details. The species account for the Eastern Whip-poor-will in Birds of the World (Cink *et al.* 2020; a republished but not updated version of the 2017 Birds of North America account) provides a comprehensive overview of the biology of the species and was also a primary reference for this section. Only key elements relevant to the status assessment are discussed below. Where possible, Canadian primary sources have been emphasized.

Life Cycle and Reproduction

There are few longevity records for the Eastern Whip-poor-will (Cink *et al.* 2020): a female of unknown age was banded in Kansas and was recaptured at the same place 13 years later and a banded male was recaptured after 15 years. These longevity records are similar to those for other members of the Caprimulgidae family (Klimkiewicz 2008; Fransson *et al.* 2010). According to DeGraaf and Rudis (1986), the Eastern Whip-poor-will first breeds at the age of one year. The estimated generation length for the species is 3.7 years (Bird *et al.* 2020).

Eastern Whip-poor-wills lay their eggs directly on the leaf litter. Nests, defined as the site where the eggs are laid and the young are brooded in the early nestling stage, are usually located near short herbaceous plants, shrubs, or seedling trees that provide partial shade, and are often within 20 cm of a fallen tree limb (Cink *et al.* 2020). Nests have also occasionally been observed on bare ground, sand, or decayed wood (Peck and James 1983). There is some evidence of high site fidelity. In Kansas, 25 of 50 nests were used again in the next year, 12 nests were used for three consecutive years, and four nests were used for four consecutive years (Cink *et al.* 2020). In Ontario, a pair was observed re-using its nest from the previous year (within 5 cm), while a returning male was observed re-using his nest from the previous year (within 30 cm) with a new female mate (Grahame *et al.* unpubl. data). In addition, in Ontario, territorial males were recaptured at 64 of 95 sites where they had been captured the previous year. In 42 of these 64 cases, the same individual was recaptured (English *et al.* 2017a).

In Canada, the nesting period begins between mid-May and late May (when the first eggs are laid), and ends anywhere between mid-June and the end of July, depending on latitude (when the young have naturally left the vicinity of the nest, up to seven days after hatching) (Rousseu and Drolet 2017). The typical clutch size is two eggs (two eggs in 31 of 32 clutches, Peck and James 1983; two eggs in 22 of 26 clutches, English *et al.* 2018b). The incubation period is 19 to 21 days (Cink *et al.* 2020). Although English *et al.* (2018b) reported that males do not usually incubate and only visit the nest for brief periods (~5 min) at dusk and dawn, Cink *et al.* (2020) note that both parents incubate (with incubation time not split equally), which is consistent with recent observations in central Ontario of males incubating repeatedly throughout the egg and nestling stages, particularly in the middle of the night when the female is out of the nest to forage (Grahame pers. obs.).

In Ontario, first flights were observed in the third week after hatching, the first feeding sally was at 18–19 days, and young accepted food from parents as late as 30 days after hatching (Mills 1986). Mills (1986) reported one of three pairs double brooding, while a recent Ontario study by English *et al.* (2018b) found that, depending on the year, between 20% and 57% of pairs that fledged a first brood (defined as chicks surviving to 15 days old) attempted a second brood. In contrast, in a more recent Ontario study of over 21 nests, no pairs were observed to double brood, and out of nine documented nest failures where the nesting female could be tracked with radiotelemetry, only one pair subsequently re-nested (Grahame *et al.* unpubl. data). In Kansas, double brooding is not uncommon (about 60% of 20 pairs), with a 32-day average interval between clutches (from the first egg of the first clutch to the first egg of the second clutch; Cink *et al.* 2020). Once incubation on the second nest begins, the male takes responsibility for the first nest (Mills 1986; Cink *et al.* 2020). In Ontario, an average of 0.60 to 1.10 fledglings were produced per nest depending on the year, with the mean productivity per pair ranging from 1.22 to 1.56 annually (English *et al.* 2018b), while in Kansas, at least 140 young fledged successfully from 100 nesting attempts by 20 pairs, with 70% of attempts resulting in at least one individual fledged (Cink *et al.* 2020). However, the depredation of nestlings can occur just before fledging, suggesting that prior estimates of nest success may be too high (Grahame *et al.* unpubl. data.). As chicks get close to fledging, they often wander out of frame of nest cameras and can be very difficult to locate with standard nest-searching techniques. Tagging nestlings with radio transmitters has revealed several instances where nests would likely have been assumed to be successful, if the tags were not found among piles of feathers (Grahame pers. obs.).

Little information is available on adult survival rates in the species. In Kansas, 20 of 26 birds (77%) that were banded as adults returned to the same breeding site the following year (Cink *et al.* 2020). During a three-year study in Ontario, English *et al.* (2018b) estimated the daily clutch survival rate at the egg stage to be 0.955, which suggests an overall egg clutch survival rate of 40% (95% CI: 18, 62), assuming an incubation period of 20 days. The estimated daily survival rate for chicks after hatching varied by year from 0.940 to 0.983, resulting in a mean survival rate at 15 days of age between 40% (95% CI: 17, 63) and 91% (95% CI: 73, 100). See **Interspecific Interactions** and **Threats** for a discussion on predation.

Habitat Requirements

Breeding habitat

Individuals establish multi-purpose breeding territories that are used for mating, nesting, foraging, and raising the young. The estimated home range size (which includes defended territory, foraging area, and any area traversed during normal activities) in Ontario varies from 15 to 500 ha (mean = 136.23 ha, Rand 2014; mean = 58 ha, Korpach pers. comm. 2020), with the estimated core range size in northwestern Ontario varying from 3.73 to 132.43 ha (mean = 30.99 ha, Rand 2014).

The nesting and foraging habitats of the Eastern Whip-poor-will appear to be more dependent on structural characteristics than on species composition (Wilson 1985; Wilson and Watts 2008). The amount of forest cover present in combination with nearby regenerating forest or open areas is believed to strongly influence breeding habitat suitability for the Eastern Whip-poor-will (Wilson 2003; Wilson and Watts 2008). Wilson (2003) found that, in the US Southeast, roughly 50% of the home range of each individual was composed of open habitat, used primarily for foraging. Wilson and Watts (2008) also reported that regenerating forest edges hosted higher densities of foraging birds. Areas with lower light levels, such as closed forest canopies, are generally not occupied (James and Neal 1986), perhaps because of reduced foraging success for this visual insectivore (Cink *et al.* 2020).

Nesting can occur in most types of early-successional forest, as well as rock or sand barrens with scattered trees, savannahs, old burns, abandoned gravel pits, other disturbed sites in a state of early to mid-forest succession, and open conifer plantations (Mills 2007; Tozer *et al.* 2014; ECCC 2018, Cink *et al.* 2020; Korpach pers. comm. 2020). Accordingly, pine (barrens or plantations), oak (barrens and savannahs), and aspen and birch (early to mid-succession) are common tree species associations. Other required elements in nesting habitat are thought to involve ground-level vegetation and woodland size. Areas with little ground cover are preferred (Eastman 1991; Garlapow 2007; Cink *et al.* 2020). Although no data are available on minimum woodland size, small, isolated woodlands, such as small woodlots in agricultural landscapes, are avoided in Maryland (Reese 1996), and Vala *et al.* (2020) found that occupancy was positively correlated to forest patch size in eastern Ontario. Accordingly, the distance from nearby tracts of woodland may also be important (Cink *et al.* 2020).

The species' foraging habitats include semi-open to open habitats such as shrubby pastures; wetlands; grasslands and agricultural fields with perches; and regenerating clear-cuts (ECCC 2018; Robert *et al.* 2019). Power-line rights-of-way and roadway corridors are also commonly occupied (Palmer-Ball 1996), presumably for foraging. In northwestern Ontario, the Eastern Whip-poor-will was not found in small patches of open habitat (<3 ha), suggesting that there may be a minimum threshold for patch size (Farrell *et al.* 2016). In addition, a significant positive relationship was found between the species' occupancy in this region and the proportion of open wetland in the surrounding landscape (i.e. within a 5 km radius). Landscapes with up to 17% open wetland were included in the study (Farrell *et al.* 2019).

Migration habitat

There is little information on the habitat used by the Eastern Whip-poor-will during migration, but it is thought to often be similar to the species' breeding habitat (Cink *et al.* 2020; Korpach pers. comm. 2020). When migrating through Mexico, the species may also use coastal scrub (Cink *et al.* 2020). Individuals are occasionally observed in suburban areas with large trees (eBird 2020).

Winter habitat

Tonra *et al.* (2019) investigated the winter home ranges of the Eastern Whip-poor-will from southern Texas to southern Costa Rica. They found that the species predominantly uses closed-canopy forest on the wintering grounds. In the southeastern United States, the species primarily occupies mixed woods during winter, but is also fairly common in broadleaf evergreen forests near open areas (Hamel 1992). Common tree associations in Florida are pine and oak (Cink *et al.* 2020).

Movement, Dispersal, and Migration

The Eastern Whip-poor-will is a Neotropical migrant and there are no known resident populations (Cink *et al.* 2020). GPS-tagged breeding individuals from across the US Midwest wintered from southern Mexico to Guatemala (n = 52, MC [migratory connectivity] = 0.22 ± 0.12; Skinner 2021; Skinner *et al.* 2022). In contrast, a study comparing Manitoba and northwestern Ontario ("western") breeders to southern Ontario ("eastern") breeders found that this spatial division was initially maintained in migration until the two groups converged near the Gulf of Mexico. Migratory connectivity was re-established on the wintering grounds, with the western breeders (n=13) overwintering at sites farther south than eastern breeders (n=19; Korpach *et al.* unpubl. data). Geolocator tags and archival GPS receiver tags on Canadian breeders have identified overwintering sites from central Mexico to southern Costa Rica (English *et al.* 2017a; Korpach *et al.* 2019). Migration routes and stopover sites are poorly documented, but migration appears to occur primarily overland, through Mexico and Central America (Ridgely and Gwynne 1989; Stiles and Skutch 1989; Howell and Webb 1995). In an Ontario study, all six GPS-tracked individuals avoided crossing the Gulf of Mexico during fall migration (Korpach *et al.* 2019), but four of 22 geolocator-tagged individuals from another Ontario study appeared to cross the Gulf of Mexico during either spring or fall migration (English *et al.* 2017a). In a recent study by Skinner *et al.* (2022), the migratory paths of individuals tracked from the midwestern US were consistent with the circumvention of the Gulf of Mexico during both fall (n = 52) and spring (n = 13) migration. Korpach *et al.* (2022) found that GPS-tracked individuals (n = 10) generally avoided urban areas during migration, and selected routes through connected areas of dark sky for travel; migratory stopover sites were almost exclusively in dark, rural areas.

During spring migration, Eastern Whip-poor-wills generally arrive in Ontario from late April to early May (Speirs 1985; eBird 2020; Grahame pers. obs.) and in Nova Scotia in mid-May (Tufts 1986; eBird 2020). In Ontario, English *et al.* (2017a) used geolocators to estimate arrival dates at breeding ground longitudes between April 19 and May 7 for males, with females arriving more than a week later on average. The shortest spring migration time was 23 (± 2) days, with a mean rate of 180 km/day. Fall departures from Ontario are generally between early September and early October (Speirs 1985). English *et al.* (2017a) estimated that males depart from the breeding grounds between September 25 and October 11. Most individuals in this study paused their migration just north of the Gulf of Mexico for up to 15 days; the shortest duration of migration was 27 (± 4) days at a mean rate of 135 km/day. In another Ontario study (Korpach *et al.* 2019), GPS-tagged individuals

(n = 7) began fall migration on September 27 or 28. Migration lasted 19 to 24 nights with individuals stopping one to four times for two to nine nights each. The mean migration rate was 196 km/day.

No information is available on the dispersal of the Eastern Whip-poor-will from natal sites, but adults exhibit high fidelity to both nesting and wintering sites (English *et al.* 2017a; Cink *et al.* 2020). In Ontario, territorial males were recaptured at 64 of the 95 sites where they had been captured the previous year. In 42 of these 64 cases, the same individual was recaptured. In the same study, three of the four males that were tracked for two years appeared to overwinter in the same area (the wintering site of the fourth male was uncertain) (English *et al.* 2017a). Emerging data on migration in the species also suggests that, at the individual level, migration routes may be more variable than the high site fidelity demonstrated on the breeding and wintering grounds, but more study is needed (Grahame pers. obs.).

Physiology

The physiology of the Eastern Whip-poor-will is not well known. In Ontario, seven individuals were observed to maintain a high body temperature (≥ 29°C) over a range of ambient temperatures (2–34°C) (Hickey 1993). However, an ongoing Ontario study has recorded the Eastern Whip-poor-will on territory in early May when temperatures regularly dip below 0°C at night, so further investigation of torpor in colder temperatures is warranted (Grahame pers. obs.). Energy dynamics related to migration is another important area that requires more research.

Diet

The Eastern Whip-poor-will is strictly insectivorous, eating a variety of night-flying species from multiple insect orders, including moths (Lepidoptera), beetles (Coleoptera), flying ants (Hymenoptera), flies (Diptera), and grasshoppers (Orthoptera) (Garlapow 2007; Cink *et al.* 2020). Garlapow (2007) found that, in Massachusetts, nearly 98% of prey items in 70 fecal samples were Lepidoptera (60.9%) or Coleoptera (36.7%; specifically, scarab beetles, Scarabaeidae) and that individuals preyed upon these taxa in proportions that were greater than their relative abundance, suggesting a selection for these items. The Eastern Whip-poor-will feeds primarily by sallying from a perch like tyrant flycatchers, rather than hawking like the Common Nighthawk (*Chordeiles minor*) and swallows (Hirundinidae; Mills 1986), and has occasionally been observed sallying from the ground, as well as searching for insects in rotten logs and leaves (Cink *et al.* 2020). The species forages at dusk and dawn and during moonlit periods at night, with nocturnal activity increasing with increasing moon height and moon face illumination (Mills 1986).

Interspecific Interactions

Predators:

As a ground-nester, the Eastern Whip-poor-will is especially vulnerable to predation during the breeding season (Cink *et al.* 2020). In Canada, key nest predators likely include Raccoon (*Procyon lotor*), Coyote (*Canis latrans*), and domestic cats (*Felis catus*) (ECCC 2018). In an Ontario study by English *et al.* (2018b), eggs or nestlings were lost to Fisher (*Pekania pennanti*), Raccoon, Gray Ratsnake (*Pantherophis spiloides*), White-tailed Deer (*Odocoileus virginianus*), North American Porcupine (*Erethizon dorsatum*), and possibly ants. An ongoing Ontario study has documented the depredation of nests, predominantly by Red Fox (*Vulpes vulpes*) and Raccoon, but also by Long-tailed Weasel (*Mustela frenata*) and Eastern Chipmunk (*Tamias striatus*) (Grahame pers. obs.). In Kansas, tracks left near 15 depredated nests included those of Striped Skunk (*Mephitis*, 33%), Raccoon (27%), Coyote (20%), Red Fox (13%), and snakes (7%) (Cink *et al.* 2020). The Blue Jay (*Cyanocitta cristata*) and Great Crested Flycatcher (*Myiarchus crinitus*) have also been observed preying on eggs in unattended nests. No quantitative data are available on the depredation of adults and juveniles outside the breeding season (Cink *et al.* 2020). In Ontario, Grahame (pers. obs.) has documented one tagged adult male that was eaten by an aerial predator, likely a Barred Owl (*Strix varia*).

Non-predatory interspecific interactions

In the United States, the Chuck-will's-widow (*Antrostomus carolinensis*) is known to displace the Eastern Whip-poor-will from shared foraging areas; however, in Kansas, Eastern Whip-poor-wills were observed almost as often displacing Chuck-will's-widows from calling perches or foraging areas. These interactions did not result in the abandonment or change in the shape of territories (Cink *et al.* 2020). In Maryland, it has been suggested that the northward range expansion of the Chuck-will's-widow may be occurring at the expense of displaced Eastern Whip-poor-wills (Reese 1996).

Adaptability

The adaptability of the Eastern Whip-poor-will to various pressures is not well studied. There is some evidence, however, that the species may be somewhat tolerant to changing habitat and climate. Several studies have found that the occurrence of breeding Eastern Whip-poor-wills is positively correlated with the amount of human-created early successional forest habitat, but more study is needed (Wilson and Watts 2008; Hunt 2013; Tozer *et al.* 2014). In Red Pine (*Pinus resinosa*) stands in central Ontario, Tozer *et al.* (2014) found that the model-predicted site occupancy of breeding Eastern Whip-poor-wills was 3.3 times higher in locations with young (<16 years since harvest) clear-cuts, compared to stands where young clear-cuts were absent, and that an aggregated mean total of 12 ha of clear-cuts (composed of various sizes and ages) per 100 ha of mature pine-dominated forest is associated with significantly higher occupancy. Additionally, in boreal forest in northern Ontario, Farrell *et al.* (2016) found that local site occupancy by the Eastern Whip-poor-will (detected using acoustic recorders positioned ≤3 m from the edge of

the habitat clearing) did not differ significantly among recent clear-cuts, burned stands, and open wetlands, suggesting that the species shows a similar preference for natural and managed open sites. In contrast to these studies, Farrell *et al.* (2019) found that site occupancy by the Eastern Whip-poor-will was not related to the amount of clear-cut areas in the surrounding landscape at any scale (i.e. within a radius of 0.5 km to 5.0 km from the site), indicating that the species' association with clear-cut habitats at a local scale does not necessarily translate to higher occurrence of this species at the landscape scale.

Limiting Factors

The main limiting factors for the Eastern Whip-poor-will are low annual productivity, ground nesting, and long-distance migration. The clutch size is small (two eggs) and double brooding is uncommon to rare in Canada (Mills 1986). Ground nesting makes the species vulnerable to terrestrial predators (ECCC 2018; English *et al.* 2018b; Cink *et al.* 2020); see **Interspecific Interactions** and **Threats** for details.

POPULATION SIZES AND TRENDS

Data Sources, Methods, and Uncertainties

North American Breeding Bird Survey (BBS)

The purpose of the BBS is to monitor the abundance of breeding bird species through standardized roadside surveys conducted primarily by volunteers, and coordinated in Canada by the Canadian Wildlife Service. The program began in 1966 and is the primary source for assessing long-term, large-scale population changes in over 400 breeding bird species in Canada and the United States. Surveys are run along a 39.2-km route, with 50 stops spaced 0.8-km apart. Data on breeding birds are recorded at each of the 50 stops, with observers documenting the total number of individuals of all bird species heard from any distance or visually observed within 0.4 km of each stop during a 3-minute observation period (Government of Canada 2018).

Partners in Flight (PIF) relies primarily on BBS data to generate population size estimates for the Eastern Whip-poor-will. The BBS's main advantages are that data are gathered from across North America and a standardized survey protocol is followed throughout each species' breeding range. However, BBS data do have some limitations for this species, primarily relating to detectability. The BBS protocol stipulates that observations at the first stop begin one-half hour before sunrise, and therefore the probability of detecting the Eastern Whip-poor-will beyond the first few stops is very low. However, since the routes are always surveyed in the same order, this restricts the sample size but does not introduce bias.

BBS data currently provide the most comprehensive source of population trend estimates for the Eastern Whip-poor-will in Canada. Although BBS routes are biased toward roadsides, this is unlikely to have any influence on the trend data for the Eastern

Whip-poor-will, since this species commonly visits the edges of the little-used roads where BBS routes are preferably run, it sings loudly enough to be heard from a distance, and the focus is on among-year differences. The BBS provides good coverage of the Canadian range of the Eastern Whip-poor-will, although fewer routes are run in the Prairie provinces than in Ontario and Quebec, which reduces the accuracy of this survey in assessing population trends at the western edge of the species' Canadian range.

The BBS's most significant limitation in estimating population trends, as described above, is that the time window for detecting the Eastern Whip-poor-will is restricted to the beginning of each survey. This results in trends that can be imprecise because they are based on low counts and small samples (Dunn 2002; Sauer *et al.* 2017), and the variance between years can be substantial. The interpolation of trends from longer time periods may therefore be more appropriate for this species because the greater sample size can mitigate some of the variability.

Breeding bird atlases

Breeding bird atlases cover the entirety of the Eastern Whip-poor-will's Canadian breeding range. These projects involve observers spending a prescribed minimum amount of time (e.g. 20 hours) in a particular census area (generally 10 km x 10 km squares) over a period of years (usually at least five) during peak breeding season. They have been helpful in ascertaining both the extent of occurrence and, within that, the area of occupancy of many species. Atlas projects since 2000 include Saskatchewan (currently underway, 2017–2021; Birds Canada 2021), Manitoba (2010–2014; Artuso *et al.* 2018), Ontario (2001–2005; Cadman *et al.* 2007; currently underway, 2021–2025; Birds Canada 2022), Quebec (2010–2014; Robert *et al.* 2019), and the Maritimes (2006–2010; Stewart *et al.* 2015). The Ontario, Quebec, and Maritimes breeding bird atlas projects allow a 20-year comparison with previous atlas projects, and are able to depict changes in breeding distribution and abundance.

Breeding bird atlases provide excellent opportunities to document species distribution, and, in the case of repeated atlases, illustrate changes in distribution over time. Relative abundance and probability of observation can also be derived from the data collected in atlas projects. However, one general limitation of atlas projects is that they are typically conducted for five-year periods at 20-year intervals, with no data collection in between. Within the Canadian range of the Eastern Whip-poor-will, changes over time based on atlas results are available for Ontario, Quebec, and the Maritimes, but the second Ontario and Maritimes atlas projects were conducted entirely before the most recent three-generation period, and the survey period for the Quebec atlas overlapped with less than half of it; therefore, they provide limited insight into recent trends.

Other surveys

The Christmas Bird Count (CBC) originated in 1900 and tracks winter bird populations through annual surveys within fixed 24-km-diameter count circles (Birds Canada 2021). Within each count circle, CBC volunteers record all species and numbers of individuals

observed on a single day between December 14 and January 5 of a given year. The program provides population trend estimates for most wintering birds in Canada and the US, including the Eastern Whip-poor-will. However, since the sampling of the Eastern Whip-poor-will is largely limited to the small portion of the population overwintering in the southern United States and the species' detectability in winter is fairly poor, the CBC trends provide no useful insights into the Canadian population.

Of greater relevance to the Eastern Whip-poor-will is the Canadian Nightjar Survey, established and developed by WildResearch from 2010 to 2020; with the long-term national coordination of the survey transferred to Birds Canada in 2021. The survey is tailored specifically to nightjar species, aiming to provide information on the distribution, abundance, habitat associations, and population trends for these species. The program consists of roadside surveys conducted by volunteers at dusk, once a year between June 15 and July 15. However, it was only recently expanded to cover the range of the Eastern Whip-poor-will, and therefore cannot provide trend data yet for this species.

The Ontario Whip-poor-will Project, coordinated by Birds Canada, was run from 2010 to 2012. The project involved volunteers conducting roadside surveys at dusk, and provided information on the distribution of hundreds of Eastern Whip-poor-wills in Ontario. Unfortunately, the project only lasted for three years, and population trends cannot be estimated from the data.

The eBird program is a global database of checklist data that documents bird distribution and abundance. It allows naturalists around the world to enter records of birds they have seen or heard, and provides broad coverage of many species' ranges, including the Eastern Whip-poor-will. Unlike other data sources, it is not tied to a strict sampling regime. Screening eBird data for a minimum level of effort and then statistically controlling for indirect measures of search effort has yielded trend estimates that mirror BBS data for many species (Walker and Taylor 2017). Therefore, eBird data might be a useful source of trend estimates in cases where the BBS trends are subject to biases, as may be the case for the Eastern Whip-poor-will, but an analysis of this has yet to be undertaken.

Abundance

The global population of the Eastern Whip-poor-will is currently estimated to be 1.8 million (95% CI: 1.4 million, 2.2 million) mature individuals, approximately 140,000 (7.8%; 95% CI: 64,000, 250,000) of which breed in Canada. Ontario accounts for 64% of the Canadian total (89,000, 95% CI: 25,000, 190,000). These population estimates are primarily based on BBS data from 2006 to 2015 (PIF 2020; Table 1). The current estimate is more than double the size of the population reported in the previous status report, but this is believed to primarily reflect refinements to the population estimation methods, rather than represent an actual change in abundance.

Table 1. Regional population size estimates for the Eastern Whip-poor-will in Canada based on 2006–2015 Breeding Bird Survey data (Partners in Flight 2020). Data are insufficient to derive estimates for the small populations in Saskatchewan, Prince Edward Island, and Nova Scotia.

Province	Population Estimate*	% Canadian Population	Lower 95% Bound*	Upper 95% Bound*
Manitoba	16,000	11.4	960	47,000
Ontario	89,000	63.6	25,000	190,000
Quebec	26,000	18.6	4,300	64,000
New Brunswick	8,900	6.4	0	25,000
Canada Total	**140,000**	**100**	**65,000**	**250,000**

*Details of the methods are presented in Will *et al.* 2020 and Stanton *et al.* 2019. Note that the lower and upper bounds are influenced by sample size, and therefore are proportionally somewhat narrower at the national scale.

Fluctuations and Trends

Long-term historical trends:

The long-term BBS data in Canada indicate an average annual trend of -0.9% (95% CI: -3.2%, 1.2%) between 1970 and 2019, corresponding to a cumulative decline of -35.2% (95% CI: -79.3%, 76.2%) over 49 years (Figure 2; Table 2). Over the same time period, New Brunswick shows the steepest average annual decline (-2.9%; 95% CI: -7.1%, 1.1%), followed by Quebec (-1.6%; 95% CI: -4.7%, 1.5%), and Ontario (-1.3%; 95% CI: -4.4, 1.2), while the average annual trend is close to stable in Manitoba (0.3%; 95% CI: -3.6, 4.3). In the United States, the long-term decline has been steeper, with an average annual rate of -2.1% (95% CI: -2.8, -1.8), corresponding to a cumulative decline of 65.0% (95% CI: -74.8%, -58.3%). All seven US states bordering Canada that have sufficient data to generate population trends show probable long-term declines (Smith unpubl. data 2020).

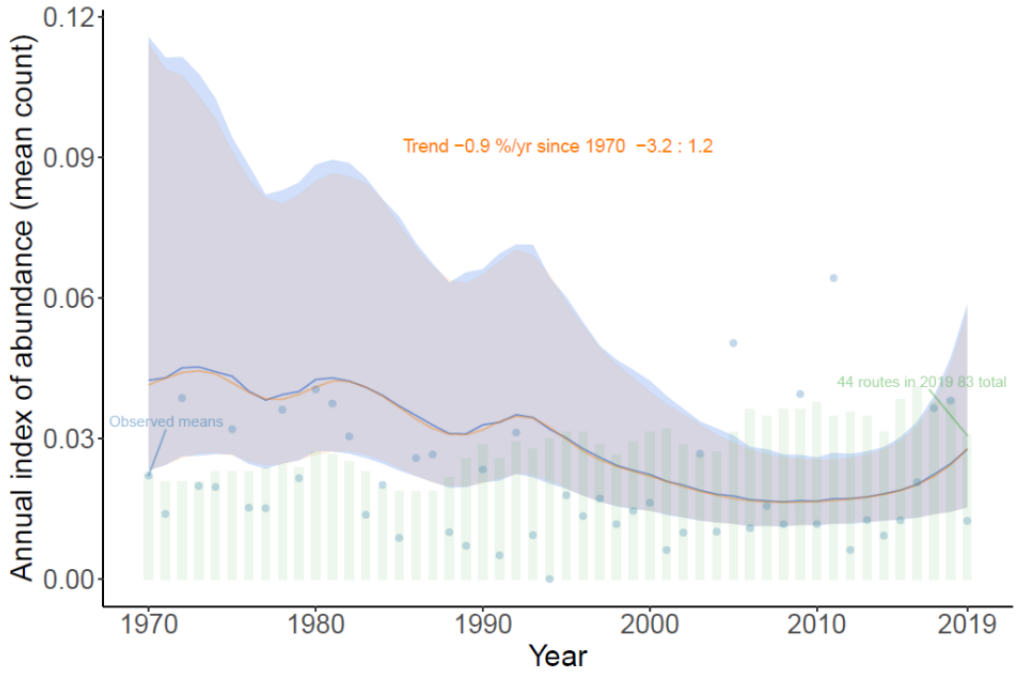

Figure 2. Annual index of population abundance for the Eastern Whip-poor-will in Canada, based on Breeding Bird Survey data from 1970 to 2019 (n = 83 routes). The GAM (generalized additive model) trend (orange) represents the best curvilinear fit of data, whereas the slope trend (blue) represents a straight-line comparison between start and end points. The grey (overlap of blue and orange) and blue shading show the 95% credible intervals for the GAM and slope trends, respectively. The blue dots indicate the observed mean index of abundance each year, while the green bars show the number of survey routes in Canada with Eastern Whip-poor-will detections (A. Smith unpubl. data).

Table 2. Short-term (three generations, 2009–2019) and long-term (1970–2019) population trends for the Eastern Whip-poor-will in Canada, based on Breeding Bird Survey data (A. Smith unpubl. data)

Region	Annual % Rate of Change (95% Lower/Upper CI)	Cumulative % Change (95% Lower/Upper CI)	Probability of Decline >30%	# Routes	Reliability
Short-term					
Canada	5.34 (-1.15, 13.25)	68.3 (-10.9, 247.1)	0.00	74	Low
Manitoba	7.43 (-2.59, 19.71)	104.8 (-23.1, 504.4)	0.02	14	Low
Ontario	2.58 (-6.25, 13.12)	29.0 (-47.5, 243.2)	0.08	38	Low
Quebec	8.64 (-1.41, 20.89)	128.9 (-13.2, 566.8)	0.01	14	Low
New Brunswick	-7.10 (-19.98, 5.43)	-52.1 (-89.2, 69.6)	0.71	8	Low
Long-term					
Canada	-0.88 (-3.17, 1.16)	-35.2 (-79.3, 76.2)	0.56	83	Low
Manitoba	0.31 (-3.65, 4.26)	16.4 (-83.8, 671.7)	0.29	15	Low
Ontario	-1.28 (-4.35, 1.24)	-46.8 (-88.7, 83.3)	0.67	46	Low
Quebec	-1.56 (-4.66, 1.49)	-53.8 (-90.3, 106.0)	0.71	14	Medium
New Brunswick	-2.90 (-7.10, 1.08)	-76.3 (-97.3, 69.4)	0.86	8	Low

The Ontario, Quebec, and Maritimes breeding bird atlases also suggest long-term declines in Eastern Whip-poor-will abundance. In Ontario, the probability of observation, adjusted for the greater effort in the second atlas project, was estimated to be 51% lower in the second breeding bird atlas (2001–2005) than the first (1981–1985). This decline was generally consistent across the Ontario range of the Eastern Whip-poor-will, but resulted in a range contraction in some areas, including southwestern Ontario and around Sudbury (Mills 2007). In Quebec, the number of squares with Eastern Whip-poor-will records increased from 168 in the first atlas (1984–1989) to 238 in the second atlas (2010–2014). However, this apparent increase is a result of increased survey effort, as the probability of observation is reported to have decreased substantially between atlases (Létourneau 2019). In the Maritimes, the number of squares with records of the Eastern Whip-poor-will decreased from 62 squares in 15 regions in the first atlas (1986–1990) to 38 squares in 13 regions in the second atlas (2006–2010) despite the increased survey effort in the latter, which was accompanied by a decline in probability of observation and a contraction in the overall distribution of records (Horn 2015). These trends are consistent with BBS trend results over the same period. Notably, all of these comparisons span periods that largely or entirely predate the most recent three-generation period for the Eastern Whip-poor-will (2011–2022).

Second breeding bird atlas projects have been completed in five of the US states bordering Canada where the Eastern Whip-poor-will breeds. All showed long-term declines in the species' populations relative to the first atlas. Atlas results in Michigan (1983–1988 versus 2002–2007), Ohio (1982–1987 versus 2006–2011), Pennsylvania (1983–1989 versus 2004–2009), New York (1980–1985 versus 2000–2005), and Vermont (1977–1981 versus 2003–2007) all showed range contractions and declines in block occupancy ranging from 42% to 77% (McGowan and Corwin 2008; Chartier *et al.* 2011; Wilson *et al.* 2012; Renfrew 2013; Rodewald *et al.* 2016). As is the case with the Canadian atlases, these second-generation US atlases completely or largely predated the most recent three-generation period for the Eastern Whip-poor-will, and therefore provide insight into long-term trends only.

Evidence for observed or inferred continuing decline (past 3 generations/10 years):

The national BBS trend over the most recent 10-year period is a 5.3% increase per year (95% CI = -1.2 % to 13.3%), amounting to a cumulative increase of 68.3% (95% CI = -10.9% to 247.1%), with a 95% probability of a population increase over this period. The 10-year trends obtained with the current analytical approach have been positive since 2014 (Figure 3). However, these estimates are accompanied by a great deal of uncertainty, and are considered to have low reliability (Table 2), as they are based on data from only 74 routes and involve very few individuals per route. Over a slightly longer period, 2000–2018, the Eastern Whip-poor-will was detected on just 89 out of 2,661 BBS routes surveyed, and at only 114 out of 178,191 stops surveyed (Knight *et al.* 2021). Because of these small sample sizes, short-term trends can be vulnerable to individual years with unusually high or low counts, and interpolating from the long-term data may therefore provide a more representative indication of the recent trend. This approach yields a three-generation change of -9.3% (95% CI: -29.8, 13.5) over 11 years. Although the 95% credible interval for

the long-term trend also shows high uncertainty, and includes the possibility of a stable or increasing population, the probability of a decline over that period is 80%. Given the uncertainty in the trends, a formal estimate of the change in trends between 1997–2007 and 2009–2019 was completed to provide a supplementary analysis. The resulting estimate suggests that there is relatively strong evidence supporting an improvement in the species' national population trend: the 95% uncertainty bounds on the differences in trends between these time periods support an annual increase of 3.4% per year to 17% per year. The probability that the trend has improved since the original 2009 COSEWIC assessment is >99% (Smith unpubl. data).

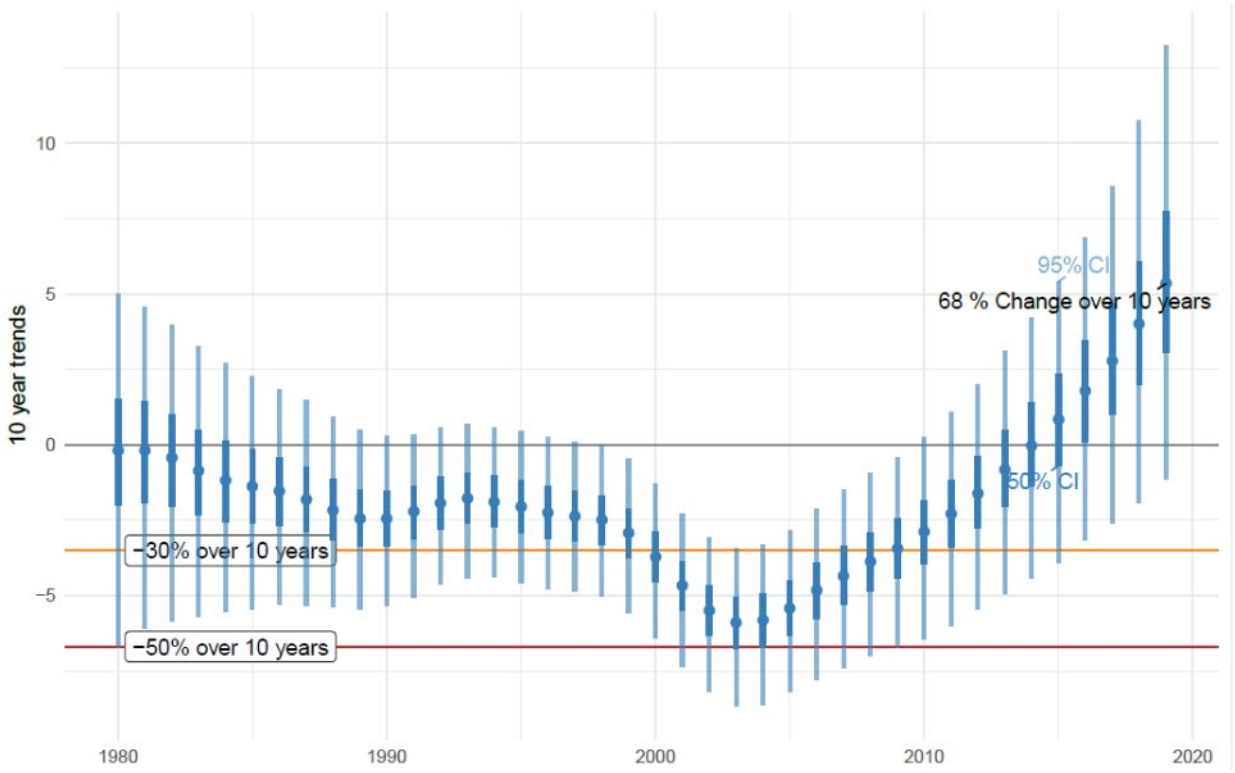

Figure 3. Rolling 10-year (three-generation) trends for changes in the Eastern Whip-poor-will population in Canada based on Breeding Bird Survey data from 1970 to 2019 (A. Smith unpubl. data), highlighting the +68% trend over the most recent ten years. The orange and red horizontal lines show the 10-year trends for the COSEWIC decline thresholds of 30% and 50%, respectively. Each point estimate represents the 10-year trend ending in a particular year. Vertical bars represent the 50% (dark blue) and 95% (light blue) credible intervals.

The national BBS trend for the United States over the most recent 10-year period (2009–2019) is an increase of 0.9% per year (95% CI: -1.2, 3.1), representing a population increase of 9.8% over the decade (95% CI: -11.2, 36.1). There is a 79% probability that the US population has increased over this time period. In the seven US states bordering Canada for which there is sufficient data to generate state trends, the trend is negative only in Maine (91% probability of population decrease), while it is stable to slightly positive in New York (57% probability of increase) and Minnesota (65% probability of increase), and likely positive in Michigan (93% probability of increase), Ohio (95% probability of increase),

Pennsylvania (100% probability of increase), and New Hampshire (100% probability of increase) (Figure 4; Smith unpubl. data 2020).

The North American CBC trend over the most recent 10-year period (2009–2019) is -1.80% per year (95% CI: -5.34, 1.12), which is comparable to the three-generation trend interpolated from the long-term BBS data.

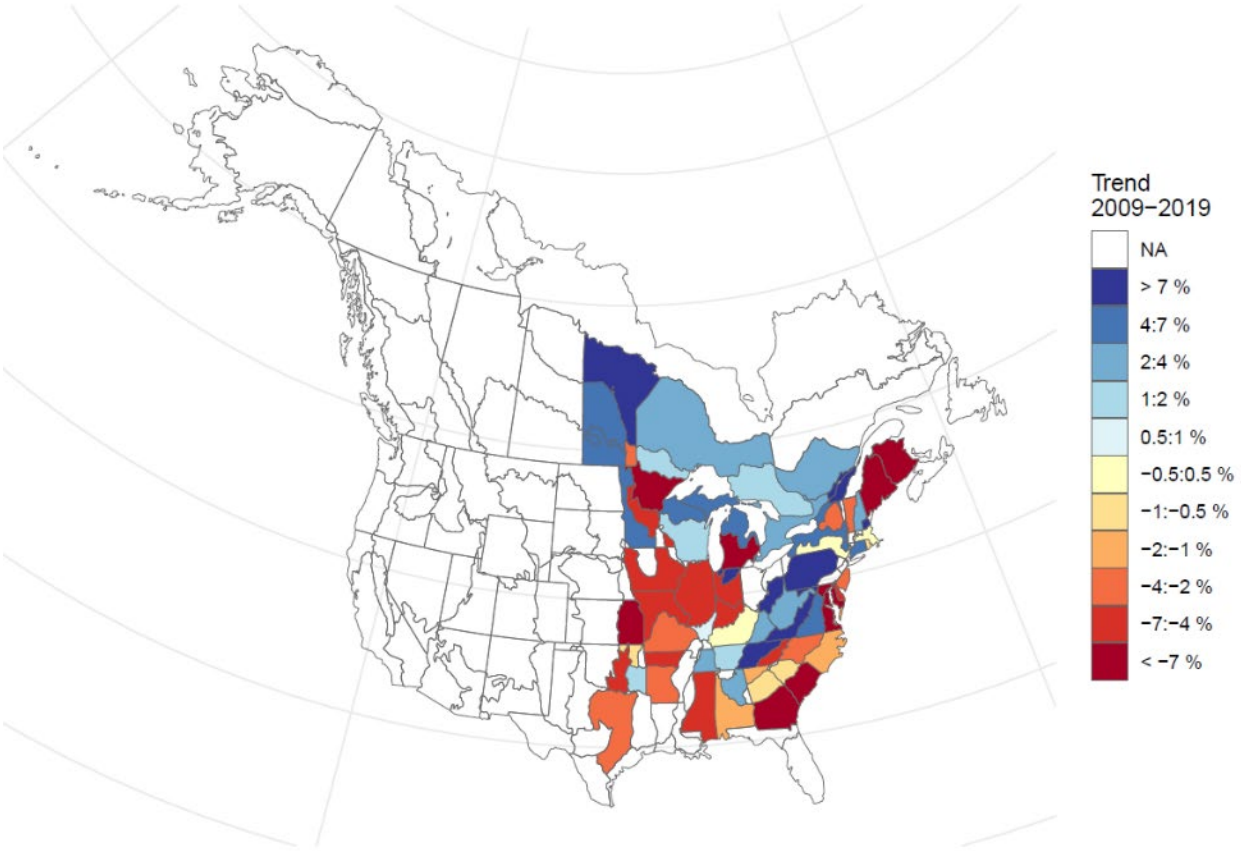

Figure 4. Short-term (2009–2019) annual rates of population change estimated from Breeding Bird Survey data for Bird Conservation Regions in provinces and states with sufficient data to estimate trends for the Eastern Whip-poor-will (A. Smith unpubl. data)

Overview of population trends

The BBS data indicate a considerable declining trend in Eastern Whip-poor-will populations over the past five decades, corroborated by data from breeding bird atlas projects in various provinces and states, as well as by CBC data from the US portion of the wintering range. However, most second-generation breeding bird atlases were largely or entirely completed before the current short-term trend period of 11 years. Only the BBS data provide insight into more recent trends for the Eastern Whip-poor-will specific to Canada. The annual index of abundance has increased continuously during this period,

following a steady 15-year-long decline that immediately preceded the previous status report. However, given the small number of Eastern Whip-poor-will detections on BBS routes in Canada each year, there is broad uncertainty around the recent apparent increase. The long-term BBS trend may therefore provide more reliable insight into this species. Using the long-term BBS trend as the basis for the 3-generation trend is consistent with the approach used in the original assessment of the Eastern Whip-poor-will (COSEWIC 2009), which interpolated a 12-year decline of 35%, based on the long-term BBS trend of -3.5% per year between 1968 and 2007. Whether the population has actually increased over the past 11 years, or has declined at around the average long-term rate of -9.3% over three generations, the best available evidence suggests that the trend over this period has improved compared to the previous status report (COSEWIC 2009), and no longer meets the decline criteria for Threatened status.

Rescue Effect

If the Eastern Whip-poor-will were to become extirpated in Canada, it is unknown whether individuals from the United States would immigrate to areas of suitable habitat. Although potential immigrants from the US would be adapted to survive in Canada due to the similar habitat and climate in the US states bordering Canada, a long-term decline has also occurred in the US population, including that in all seven states bordering Canada for which there is sufficient data to generate trends. The availability of suitable habitat in Canada may also be declining, limiting immigrants' colonization opportunities.

THREATS

Current and Future Threats

The Eastern Whip-poor-will is vulnerable to the cumulative effects of various threats. These threats are categorized below and in Appendix I, following the IUCN-CMP (International Union for the Conservation of Nature – Conservation Measures Partnership) unified threats classification system (based on Salafsky *et al.* 2008). The threat assessment evaluates the impacts for each of the 11 main categories of threats and their subcategories, based on the scope (proportion of the population exposed to the threat over the next 10-year period), severity (predicted population decline among those exposed to the threat, during three generations), and timing of each threat. The overall threat impact is calculated by taking into account the separate impacts of all threat categories and can be adjusted by the species experts participating in the evaluation.

For the Eastern Whip-poor-will, the overall threat impact is considered to be High, corresponding to an anticipated decline of between 10% and 70% over the next ten years (see Appendix I for details). Most of the threats to this species are ongoing, but given that estimates of recent population trends range from increasing to slightly declining, the impact over the next ten years is likely to fall toward the lower end of the predicted range. Threats are discussed below in order of decreasing severity of impact (greatest to least), ending with those for which the scope or severity is unknown.

IUCN 7, Natural System Modifications (medium-high threat impact):

Fire and fire suppression (IUCN 7.1)

Typical Eastern Whip-poor-will breeding habitat includes the early successional habitat resulting from relatively recent burns (Cink *et al.* 2020), but this type of habitat is now scarce due to more than a century of fire suppression across much of the breeding range, a trend that began with the arrival of European settlers in North America (Ryan *et al.* 2013). In Algonquin Provincial Park, declines in abundance have been attributed largely to fire suppression (Tozer *et al.* 2014). While prescribed burns can be a useful tool for restoring early successional habitat in North America, these practices remain highly controversial, and the amount of intentional burning performed today does not come close to replacing the amount of anthropogenic and natural burning that took place historically across the continent (Ryan *et al.* 2013). Some recent evidence suggests that clear-cuts may provide early successional breeding habitat in the absence of wildfires (Farrell *et al.* 2017; Vala *et al.* 2020), but further research on survival and nest success in clear-cuts versus burned stands is critical.

In eastern Canada, wildfire seasons are lengthening, with fire seasons stretching longer into the fall (Albert-Green *et al.* 2013; Hanes *et al.* 2019). Both the number of large fires per year and total area burned annually have increased significantly in areas where the Eastern Whip-poor-will breeds in Saskatchewan, Manitoba, and northwestern Ontario (Hanes *et al.* 2019). Since the Eastern Whip-poor-will requires a patchwork of land cover types on the breeding grounds, including leaf litter for nesting and forest stands for roosting and foraging (Cink *et al.* 2020; Grahame *et al.* 2021), large-scale, high-severity fires may eliminate natural breeding habitat for years until the necessary land cover is restored through succession. Therefore, while fire suppression has likely limited the amount of early successional areas for the Eastern Whip-poor-will, the increased occurrence of severe large-scale fires may have negative consequences on the species' breeding habitat. In contrast, smaller fires likely provide the patchwork of open and forested land cover that the Eastern Whip-poor-will uses on the breeding grounds.

Ecosystem modification (IUCN 7.3)

Worldwide, over 40% of insect species are estimated to be threatened with extinction (Sánchez-Bayo and Wyckhuys 2019), influenced at least in part by the increasingly widespread use of pesticides, including neonicotinoids (Woodcock *et al.* 2016; Spiller and Dettmers 2019). Research on insectivorous bird populations in the Netherlands showed a substantial decline across species immediately following the introduction of neonicotinoids in the country in the mid-1990s (Hallmann *et al.* 2014), and the loss of insect food supplies is thought to play a considerable role in the decline of aerial insectivores worldwide (Nebel *et al.* 2010; Spiller and Dettmers 2019). Increased pesticide use is considered an important factor in the decline of the Eastern Whip-poor-will throughout a large portion of its annual range (English *et al.* 2017b; Spiller and Dettmers 2019). Stable isotope evidence from museum specimens of the Eastern Whip-poor-will across a 130-year span showed a shift in

diet towards lower quality prey, suggesting a decline in high trophic-level food items thought to result from pesticide use (English *et al.* 2018a). Similarly, research using guano samples from the Chimney Swift (*Chaetura pelagica*) and Vaux's Swift (*Chaetura vauxi*) revealed dietary shifts over the years that are thought to reflect large-scale changes in insect populations resulting from pesticide use (Nocera *et al.* 2012; Pomfret *et al.* 2014).

While there are currently no published data on nest vegetation for this species, an ongoing Ontario study identified only native plant species at 21 Eastern Whip-poor-will nest sites at scales of 1 m and 11.3 m, encompassing the original site of the eggs as well as the surrounding area where the female may subsequently move nestlings, respectively (Grahame *et al.* unpubl. data). It is therefore plausible that prolific invasive plant species such as Garlic Mustard (*Alliaria petiolata)* could degrade nesting habitat to the extent that it cannot be used by breeding Eastern Whip-poor-wills.

IUCN 1, Residential and Commercial Development (low threat impact):

Housing and urban areas (IUCN 1.1), Commercial and industrial areas (IUCN 1.2), Tourism and recreation areas (IUCN 1.3)

The Eastern Whip-poor-will shows strong fidelity to both its breeding and wintering sites (Bakermans *et al.* unpubl. data; Grahame *et al.* unpubl. data; Korpach *et al.* unpubl. data; Cink *et al.* 2020). Therefore, removing habitat when the species is absent can impact individuals upon their return. For adults that have nested previously in a given area, the loss of habitat used before for breeding would result in the need to find new territories, and possibly also new mates. Although, historically, habitat loss may have taken place through natural means such as high-intensity forest fires, habitat loss due to anthropogenic development poses a greater risk as it can occur over larger scales and involve less reversibility. The time-sensitive nature of reproduction in migratory birds is linked to the competition for high-quality breeding habitat, which has been demonstrated conclusively in numerous species. For example, early arrival and prompt nest initiation on the breeding grounds correspond to higher reproductive output (Smith and Moore 2005; Rockwell *et al.* 2012; Saino *et al.* 2017; Berjano and Jahn 2018). In addition, Eastern Whip-poor-wills must synchronize their breeding with the lunar cycle to maximize the availability and accessibility of insect prey such as moths and beetles, which are more easily hunted during moonlit nights (English *et al.* 2017b). The extra time spent searching for a new breeding area, nest site, and mate upon spring arrival may therefore be particularly costly, and the failure to secure a new territory and partner by the subsequent lunar cycle would result in missing the breeding window altogether. Given the maximum clutch size of two in this species, a missed breeding season may have a significant impact on lifetime reproductive output. Furthermore, as demonstrated in other migratory bird species, habitat loss or degradation outside the breeding grounds can have seasonal carry-over effects that influence the reproductive success of the Eastern Whip-poor-will (Harrison *et al.* 2011). Residential and commercial development can result in the loss of Eastern Whip-poor-will habitat during all parts of the species' life cycle.

Purves (2015) showed that the loss of breeding habitat is strongly correlated with the declining abundance of the Eastern Whip-poor-will, although habitat losses on the breeding grounds alone are not sufficient to fully explain the extent of the declines in the species. A more recent study comparing the data from the first and second Ontario Breeding Bird Atlas projects showed that the regions in the first atlas with the largest amount of urban area were the most likely to experience the disappearance of the Eastern Whip-poor-will by the second iteration of the atlas in 2001 (English *et al.* 2017b). This study suggests that urbanization has a lagged effect on Eastern Whip-poor-will abundance, providing evidence of the species' sensitivity to continued anthropogenic disturbance and development, including that associated with recreational facilities such as resorts and summer cottages (English *et al.* 2017b). The density of the European Nightjar (*Caprimulgus europaeus*), a similar species, has been shown to decrease with greater urban and residential development, as well as a lack of woodlands adjacent to heathlands, although it is unclear whether development affects nightjar abundance through habitat loss alone, or in combination with the resulting increase in human disturbance (Liley and Clarke 2003). The direct effects of new residential or industrial development on the nest success and survival of the Eastern Whip-poor-will require further investigation.

IUCN 2, Agriculture and Aquaculture (low threat impact):

Annual and perennial non-timber crops (IUCN 2.1)

Agricultural intensification (specifically, the conversion of small farms to expansive monocultures) leads to habitat loss at all stages of the species' annual cycle, including on the breeding and wintering grounds, and at the stopover sites essential for refueling during migration (English *et al.* 2018a; Spiller and Dettmers 2019). In North America, agriculture is the predominant source of deforestation and accounts for approximately two-thirds of forest conversion (Masek *et al.* 2011). Recent evidence suggests that the Eastern Whip-poor-will uses mainly closed-canopy forest on the wintering grounds (Tonra *et al.* 2019); notably, the extent of suitable intact neotropical forest habitat declined by approximately 9% between 2000 and 2016 (Donald *et al.* 2019). In a region of southern Mexico where the Eastern Whip-poor-will is known to overwinter, deforestation, largely driven by agriculture, occurred at an average annual rate of 0.90% from 1993 to 2007, and the degradation of the structure of forest vegetation as a result of agricultural activity accounted for 1.7 times more change in land cover than deforestation alone (Kolb and Galicia 2012). While small-scale local farms may potentially provide patches of open habitat necessary for foraging, high-intensity agriculture and heavy pesticide use would make large-scale farming operations uninhabitable for the species, particularly given its reliance on insects and on natural perches for foraging and providing camouflage while roosting.

Wood and pulp plantations (IUCN 2.2)

Pine plantations may be used for nesting by the Eastern Whip-poor-will (Purves 2015). For example, a North Carolina study showed an increased density of the Eastern Whip-poor-will in Loblolly Pine (*Pinus taeda*) plantations with regenerating patches (Wilson and Watts 2008). More research is needed on whether measures of fitness such as reproductive output differ between pine plantations and natural open forest stands. If these areas function as population sinks, they would pose a threat to Eastern Whip-poor-will populations.

Livestock farming and ranching (IUCN 2.3)

As Eastern Whip-poor-will is a forest edge ground-nesting bird (Cink et al. 2020), grazing near rural open forest patches is likely detrimental to nest success due to loss of vegetative cover, trampling, and depredation of nests by livestock. Where forest understory is heavily grazed in Manitoba, Eastern Whip-poor-will is generally absent (Artuso pers. comm. 2021). In West Virginia, Eastern Whip-poor-will declines are thought to be due to habitat loss in part due to grazing (Slover and Katzner 2016). An analysis of land use changes from 1995 to 2006 among three coastal sites in the Gulf of Mexico showed that loss of natural systems is largely attributed to conversion of land for livestock ranching and agriculture (Mendoza-González et al. 2012), resulting in potential stopover and winter habitat loss for Eastern Whip-poor-will. As with small-scale agriculture, it is possible that small grazing operations could provide open patches for Eastern Whip-poor-wills, especially if grazing occurs when the species is absent. Across all stages of the annual cycle, more research is needed to assess how Eastern Whip-poor-will abundance and nest success may vary with scale and intensity of grazing.

<u>IUCN 4, Transportation and Service Corridors (low threat impact):</u>

Roads and railroads (IUCN 4.1), Utility and service lines (IUCN 4.2)

The Eastern Whip-poor-will is less abundant in areas with paved roads, even when the overall traffic level is low (English *et al.* 2017b). The species may use these and other linear features for foraging (Cink *et al.* 2020), but the consequences to fitness resulting from the use of these features remain unknown. Many nightjar species are regularly spotted along roads, for various possible reasons. The absence of the canopy cover may allow foraging birds to see prey items silhouetted by the moon (Jackson 2003a) and insects may be attracted to headlights (Jackson 2003b). Paved roads retain heat, which may attract insects and nightjars alike for the thermoregulatory benefits. In a study in south-central Ontario, the Eastern Whip-poor-will was documented using a paved road for foraging, roosting, and singing, while the Common Nighthawk was observed roosting on gravel shoulders, with one individual picking up pieces of small gravel in the middle of the road, presumably to assist with digestion (Grahame pers. obs.).

The Common Nighthawk has been found as roadkill at many sites (Bishop *et al.* 2013), and considerable numbers of Afrotropical nightjars are killed on roadways; these casualties have become a major mortality factor for multiple species (Jackson and Slotow 2002). Nightjars tend to freeze in place when blinded by headlights (Jackson 2003a), and can be difficult to avoid even when driving slowly (Jackson and Slotow 2002). The demographic impact of losing adults is greater than that of juveniles.

Overall, although roads may facilitate foraging, the benefits are likely outweighed by the risk of direct and indirect mortality in both juveniles and adults. Openings for service line corridors may offer some similar benefits, but the net impact is unclear given that little is known about collision risk.

In addition to causing direct mortality, roads have the potential to interfere with breeding success. Although some research is currently ongoing in Ontario, the effects of roads on the nest success of the Eastern Whip-poor-will requires further study throughout the species' breeding range.

IUCN 11, Climate Change and Severe Weather (low threat impact):

Habitat shifting and alteration (IUCN 11.1), Droughts (IUCN 11.2), Temperature extremes (IUCN 11.3), Storms and flooding (IUCN 11.4)

Effects of habitat shifting are likely to be gradual, and more noticeable over a period longer than three generations (11 years). However, the potential for phenological mismatch, in which the availability of key resources becomes misaligned with the passage or arrival of migrants—with possible implications for their survival and reproductive output—is a matter of concern.

Droughts have the potential to reduce prey supply, with impacts on survival and productivity, but could also trigger more frequent forest fires, which could increase the availability of suitable nesting habitat. More research is required to understand the net impact of drought.

Since the 1980s, the sharpest declines among North American aerial insectivorous birds have involved long-distance migrants, particularly those breeding in the Northeast (Böhning-Gaese *et al.* 1999; Nebel *et al.* 2010). For insectivores arriving on the breeding grounds in spring, unseasonable cold snaps may lead to die-offs as insect prey becomes unavailable (Brown and Brown 2000; Newton 2006, 2007). The Eastern Whip-poor-will may be susceptible to more frequent spring cold snaps, since it is a relatively early migrant, but more research is needed given the ability of the species to enter torpor (Cink *et al.* 2020). Birds breeding in the northern portion of the species' range may experience decreased fecundity due to freezing conditions, which may cause the first egg laid to become unviable when the female gets up to forage. This reduces the possible number of young fledged by 50%, because females will not renest if one chick is still viable (Grahame *et al.* unpubl. data). Since double brooding by the species in the northern portion of its range appears to be rare, the loss of half the clutch due to unseasonable cold snaps could be particularly

detrimental depending on the number of nesting pairs affected. Research is currently underway on the effects of temperature on the fall departure date, migration rate, and stopover duration, and on the influence of other factors such as summer climatic conditions on nest success (Grahame *et al.* unpubl. data).

The increased occurrence and intensity of storms associated with climate warming can directly affect demography by causing mass die-offs during migration (Newton 2006; Newton 2007; Diehl *et al.* 2013; Drake *et al.* 2014; Huang *et al.* 2017). Many migrants breeding in the Northeast must cover large expanses of open water while crossing the Gulf of Mexico to reach their breeding grounds and, as a result, may be unable to seek refuge on land should they encounter unfavourable weather conditions during the crossing (Butler 2000). While many Eastern Whip-poor-wills apparently take shorter flights over sections of the Gulf of Mexico or circumvent it altogether, some appear to fly directly across this body of water (English *et al.* 2017).

Birds that avoid direct mortality from catastrophic storms may succumb to starvation resulting from the destruction and degradation of their stopover habitat. For example, in late September of 2005, Hurricane Rita tore through coastal Louisiana, stripping some trees of their foliage and toppling many others. Invertebrate food items remained scarce for an entire month after the storm had passed (Barrow *et al.* 2007; Dobbs *et al.* 2009), drastically limiting the food supply for refueling migrants. Evidence from ongoing research suggests that Eastern Whip-poor-wills breeding in southern Ontario would have just begun to move through the Gulf region when the storm hit (Grahame pers. obs.). Research analyzing the effects of climatic variables on the Eastern Whip-poor-will's fall migration rate and stopover duration is currently underway (Grahame pers. obs.), but more study is needed to understand the scope of the impact of increased storm frequency on fitness and survival throughout this species' annual cycle.

<u>IUCN 3, Energy Production and Mining (unknown threat impact):</u>

Oil and gas drilling (IUCN 3.1), Mining and quarrying (IUCN 3.2)

The continued development of infrastructure for energy production, oil drilling, and mining results in habitat loss for many bird species including the Eastern Whip-poor-will, and activities such as oil exploration and development during the breeding season may result in direct mortality through crushed eggs and reduced survival in juveniles and adults (Van Wilgenburg *et al.* 2013). Although these types of activities are generally not permitted during the breeding season in Canada, exemptions that allow for work to occur during the nesting period would be detrimental to breeding success, and it is possible that significant disruptions may cause returning birds to forgo breeding in the area altogether because of their relatively high breeding site fidelity.

IUCN 5, Biological Resource Use (unknown threat impact):

Logging and wood harvesting (IUCN 5.3)

Recent evidence from a study of overwintering Eastern Whip-poor-wills indicates that closed-canopy forest accounts for a significant proportion of the habitat used on the wintering grounds, which contrasts with the species' use of open forest on the breeding grounds (Tonra *et al.* 2019). This suggests that logging on the wintering grounds could be problematic for the species given its high winter site fidelity (Bakermans *et al.* unpubl. data; Korpach *et al.* unpubl. data), but more research is required.

On the breeding grounds, a point count study in Algonquin Provincial Park showed the increased occupancy by the Eastern Whip-poor-will of sites with clear-cuts harvested ≤16 years prior to surveying, suggesting that clear-cutting could increase breeding occupancy and abundance (Tozer *et al.* 2014). A 2017 study showed no difference in the species' preferences for clear-cuts, burned stands, and open wetlands; these results, combined with those from a more recent study, suggest that clear-cutting potentially provides early successional breeding habitat in the absence of wildfires (Farrell *et al.* 2017; Vala *et al.* 2020). In North Carolina, Eastern Whip-poor-wills showed a preference for patches of regenerating clear-cuts harvested ≤6 years previously located near older stands harvested ≤17 years prior to surveying. This study's results demonstrate the crucial importance of rotating clear-cut harvests to maximize the availability of forest edges and the juxtaposition of open areas, young regenerating forest, and mature forest (Wilson and Watts 2008). However, the differences in the quality of breeding habitat in clear-cuts and burned stands remain unclear, although considerable dissimilarities have been observed in the insect communities in these two habitats (Chaundy-Smart *et al.* 2012). Further study is required to explore potential differences in reproductive success.

IUCN 6, Human Intrusions and Disturbance (unknown threat impact):

Recreational activities (IUCN 6.1)

Hiking, off-leash dogs, off-road vehicles, and camping can be detrimental to the Eastern Whip-poor-will, especially if these activities impact foraging and nesting. At a rock barrens study site in Ontario, campers regularly break off low dead branches and cut snags for firewood, but these features are often used by the species as foraging perches and roosts, and many individuals show high fidelity to them year after year (Grahame *et al.* unpubl. data). Additionally, campers have been observed driving vehicles through known nest territories, including areas of shrubby Common Juniper (*Juniperus communis*), under which nests can be placed. While the negative influence of recreational activities is likely of greater concern during the breeding season given the species' ground-nesting strategy, the Eastern Whip-poor-will also roosts on the ground and uses deadwood throughout its annual cycle, and in areas used heavily for camping, deadwood may be burned faster than it can be naturally replaced.

War, civil unrest and military exercises (IUCN 6.2)

Some Eastern Whip-poor-wills breed on military bases, and since these birds use the ground for nesting, roosting, and foraging, the species is susceptible to disturbance from vehicles, and nests are particularly vulnerable to trampling. More research is needed to determine whether military exercises inhibit reproductive output.

Work and other activities (IUCN 6.3)

The Eastern Whip-poor-will appears to be tolerant of research on the breeding grounds involving regular radiotelemetry at tracking intervals of at least every 30 minutes and nest checks at intervals of at least every three days. However, because nightjars rely almost exclusively on camouflage to nest successfully, an increased frequency of nest visits may alert predators to the nest site (Grahame pers. obs.). Checking nests at night likely reduces the chance of corvids and diurnal raptors (e.g. *Accipiter* spp. or *Buteo* spp.) following researchers to the nest or otherwise discovering the nest during nest checks. Distraction displays by the incubating or brooding female may garner unwanted attention, particularly from aerial predators (Grahame pers. obs.). Visible markers such as flagging tape or well-worn trails to the nest likely increase rates of detection by predators (Martin and Geupel 1993; Grahame pers. obs.)

<u>IUCN 8, Invasive and Problematic Species, Pathogens and Genes (unknown threat impact):</u>

Invasive non-native/alien plants and animals (IUCN 8.1)

Feral and outdoor domestic cats are extremely problematic for birds that nest and forage on, or low to, the ground (Blancher 2013; Loss and Marra 2017), such as the Eastern Whip-poor-will. Nest failure due to feral cat predation has been documented at the egg stage for Puerto Rican Nightjar (*Antrostomus noctitherus*), a very closely related species (Vilella 1995). Given that cats are responsible for the mortality of an estimated 100–350 million birds per year in Canada alone (Blancher 2013), the potential of cats to kill chicks on the breeding grounds and adults throughout the annual cycle warrants further investigation.

Problematic native species/diseases (IUCN 8.2)

White-tailed Deer, Raccoon, and Red Fox are all documented nest predators of the Eastern Whip-poor-will (English *et al.* 2018b; Grahame pers. obs.). Habitat islands created by roadways may facilitate colonization by scavengers or generalists taking advantage of linear travel corridors to move around (Wilcove *et al.* 1986; Andrén and Angelstam 1988). Linear features such as roads and service lines expedite nest predators' movements and increase the frequency with which they encounter Eastern Whip-poor-will nests (Coffin 2007; Grahame pers. obs.), which are typically placed at forest edges (Cink *et al.* 2020). As habitat islands shrink, such areas may become population sinks for the Eastern Whip-poor-will. The lack of apex predators to control deer and mesopredators may be problematic,

since the Gray Wolf (*Canis lupus*) has been largely extirpated in a significant portion of the Eastern Whip-poor-will's breeding range. Restoring wolves to areas from which they have been extirpated may have top-down regulating effects on the predation of smaller prey, and dietary differences between eastern coyotes and wolves suggest that coyotes are not a substitute for wolves in terms of ecological functions (Miller *et al.* 2012).

An over-abundance of White-tailed Deer not only impacts the predation of eggs and nestlings, but poses a significant threat to forest structure by inhibiting regeneration and substantially reducing understory vegetation through browsing. Sustained browsing pressure from White-tailed Deer hinders the regeneration of palatable woody vegetation and can completely obliterate herbaceous plants preferred by deer for consumption (Rooney and Waller 2003). In the northern United States, including areas adjacent to Canadian forests, sites with high deer density showed an increased prevalence of introduced and invasive plant species (Russell *et al.* 2017). The effects of White-tailed Deer on the structure of forests used by the Eastern Whip-poor-will to breed warrants more research, particularly because intense browsing pressure likely degrades or eliminates understory vegetation necessary for nesting.

IUCN 9, Pollution (unknown threat impact):

Industrial and military effluents (IUCN 9.2), Agricultural and forestry effluents (IUCN 9.3), Airborne pollutants (IUCN 9.5), Excess energy (IUCN 9.6).

Pollutants from mining may affect the Eastern Whip-poor-will's fitness, based on recently published work on the Red-necked Nightjar, a similar species breeding in southeastern Spain. Birds breeding near mines had higher blood concentrations of toxins, including arsenic, lead, and cadmium, although more research is needed on the implications of this exposure (Espín *et al.* 2020a, 2020b). Industrial and military effluents may also have a negative effect on invertebrates and aerial insectivores (considered under category 7.3).

A recent study on White-crowned Sparrows (*Zonotrichia leucophrys*) at Long Point, Ontario, found reduced food consumption and delays in refueling and departing for migration in individuals that had ingested neonicotinoids (Eng *et al.* 2019). Substantial delays in fall migration could prove fatal for the Eastern Whip-poor-will as flying insects become scarcer with colder weather.

Evidence from feather samples from a riparian songbird breeding in West Virginia and Pennsylvania showed that levels of barium and strontium were significantly higher in birds nesting in fracked sites compared to those nesting in nearby unfracked areas (Latta *et al.* 2015). Although the pathway for metal contamination was not resolved in this study and the effects of metal contamination on breeding birds require further investigation, it should be noted that fracking operations are underway in parts of southern Ontario and Quebec where Eastern Whip-poor-wills breed.

Airborne pollution is pervasive in areas used by the Eastern Whip-poor-will throughout its annual cycle, and may affect the species in similar ways to other pollutants, but no specific research on this is available.

Excess energy in the form of light pollution is a potential concern for the Eastern Whip-poor-will. Virtually all individuals are exposed to this during migration, and some individuals also experience it during other parts of their life cycle. There is some evidence that individuals make an effort to avoid light pollution during migration (Korpach pers. comm. 2020), but the impact of this remains unclear.

Habitat Trends

Loss of habitat throughout the annual cycle is particularly problematic for the Eastern Whip-poor-will. Agricultural expansion is one of the primary causes of deforestation in North America and, combined with residential and industrial development, poses the greatest threat to habitat throughout the species' annual cycle. In Canada, the total farm area has decreased slightly (by 1.9% from 2016 to 2021). However, small and mid-sized farms are in decline due to consolidation into larger farms, leading to changes in the rural Canadian landscape (Statistics Canada 2022). The loss of forest patches and hedgerows due to farm consolidation is detrimental to the species during both breeding and migration, particularly given its selection of forest and shrubland habitats on the breeding grounds for roosting and foraging (Grahame *et al.* 2021), as well as its use of branches as foraging perches throughout the annual cycle (Cink *et al.* 2020). Additionally, the suppression of wildfires, coupled with the insufficient use of prescribed burning, limits the availability of early successional habitat on the breeding grounds. More research is needed to assess whether the abundance of breeding Eastern Whip-poor-wills differs in natural open forest, burns, and clear-cut stands, and the lack of data on reproductive success and survival in these habitat types prevents an understanding of whether clear-cuts are a viable alternative to fire in providing open habitat.

Number of Threat-based Locations

The exact number of threat-based locations is unknown, but is far above the threshold of 10 for considering status based on number of locations.

PROTECTION, STATUS, AND RANKS

Legal Protection and Status

In Canada, the Eastern Whip-poor-will has been listed as Threatened in Schedule 1 of the *Species at Risk Act* since February 2011. The species and its nests are also protected in Canada under the *Migratory Birds Convention Act, 1994* (Government of Canada 2017). The Eastern Whip-poor-will is listed as Threatened under provincial species-at-risk legislation in Manitoba, Ontario, New Brunswick, and Nova Scotia. In Quebec, it is on the *List of Plant and Wildlife Species Which Are Likely to be Designated Threatened or Vulnerable*. The Eastern Whip-poor-will is not afforded protection under the *Endangered Species Act* in the United States (USFWS 2020), but is protected under the *Migratory Bird Treaty Act* (USC 1918). In the states bordering Canada, the Eastern Whip-poor-will is listed as a species at risk in Michigan (Special Concern), Ohio (Species of Concern), New York (Special Concern), and Vermont (Threatened).

Non-Legal Status and Ranks

Globally, NatureServe (2022) ranks the Eastern Whip-poor-will as Secure (G5), while the IUCN has assessed the species as Near Threatened (BirdLife International 2018). In Canada, the species' breeding population is considered N3B (Vulnerable); at a provincial level, it is designated S1 (Critically Imperiled) in Saskatchewan, S1? (presumably Critically Imperiled) in Nova Scotia, S2 (Imperiled) in New Brunswick, and S3 (Vulnerable) in Manitoba, Ontario, and Quebec (see Table 3; CESCC 2022; NatureServe 2022). In the United States, it is considered Secure (N5B). In the states bordering Canada in which it occurs, it is ranked from S2 to S3 in seven states, from S5 in one state, and not ranked or unrankable (SNR/SU) in two states (NatureServe 2022). Table 3 provides further details on conservation ranks.

The Eastern Whip-poor-will is on the "D" Yellow Watch List Species compiled by Partners in Flight. Species in this category have declining populations ("D"), with high population trend scores, moderate to high threats, moderate population size, and low vulnerability scores for range (PIF 2016).

Table 3. Conservation Status of the Eastern Whip-poor-will in Canada and the United States, from the General Status of Species in Canada (CESCC 2022) and NatureServe (2022)

Jurisdiction	Status[1]	Legal Status[2]
Global	G5	
Canada	N3B	Threatened
Saskatchewan	S1B	
Manitoba	S3B	Threatened
Ontario	S3B	Threatened
Quebec	S3B	
New Brunswick	S2B	Threatened

Jurisdiction	Status[1]	Legal Status[2]
Prince Edward Island	SNA	
Nova Scotia	S1?B	Threatened
United States	N5B, NNRN	
Maine	S3B	
Michigan	S3	Special Concern
Minnesota	SNRB	
New Hampshire	S3B	
New York	S3B	Special Concern
North Dakota	SU	
Ohio	S5	Species of Concern
Pennsylvania	S3B, S3M	
Vermont	S2B	Threatened
Wisconsin	S2B	

[1] G = Global; N (at start of rank) = National; S = Subnational; B = Breeding; M = Migrant; N (at end of rank) = Non-breeding. 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure; NA = Not Applicable; NR = Not Ranked; U = Unrankable (due to lack of information or conflicting information); ? = inexact numeric rank.

[2] Listing as endangered / threatened / special concern (or equivalent designations) at a jurisdictional scale

Land Tenure and Ownership

The quantity of Eastern Whip-poor-will habitat available on public lands and the degree to which this habitat is protected is undetermined. Significant amounts of habitat exist on provincial and federal Crown land, and the species is listed as a regular breeder or migrant in eight national parks and historic sites (Gardiner pers. comm. 2020). The Recovery Strategy for the Eastern Whip-poor-will in Canada (ECCC 2018) identifies 198 units (10 x 10 km standardized UTM squares) within which critical habitat for the species is found, in Manitoba, Ontario, Quebec, and New Brunswick. Of these units, 68 contain federal lands, including seven with federal protected areas. Although Crown land is vulnerable to disturbance—and provincial Crown land is subject to logging in particular—it tends to remain nominally protected from permanent conversion. While logging disturbance can have immediate negative effects on nesting birds, such disturbance could ultimately favour the Eastern Whip-poor-will by creating early and mid-successional woodlands. Controlled burning programs in specific national parks could increase the species' habitat. In managed forests, there are no specific programs for the protection or enhancement of Eastern Whip-poor-will habitat.

Data are lacking on the level of habitat protection for the species on private lands. In rural southwestern Ontario, where most land is privately owned, the few significant remnant pockets of breeding Eastern Whip-poor-wills are found in provincial and federal protected areas: Pinery Provincial Park, Rondeau Provincial Park, the St. Williams Conservation Reserve in the Norfolk Sand Plain, and the Long Point National Wildlife Area (Mills 2007; eBird 2020).

Recovery Activities

The federal recovery strategy for Eastern Whip-poor-will was completed in 2018. One or more action plans for the species will be posted on the Species at Risk Public Registry before the end of 2023 (ECCC 2018).

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INFORMATION SOURCES

Andrén, H., and P. Angelstam. 1988. Elevated predation rates as an edge effect in habitat islands: experimental evidence. Ecology 69:544–547.

Artuso, C., pers. comm. 2021. *Email correspondence to M. Gahbauer.* September 2021. Wildlife Biologist, Environment and Climate Change Canada, Gatineau, Quebec.

Artuso, C., A.R. Couturier, K.D. De Smet, R.F. Koes, D. Lepage, J. McCracken, R.D. Mooi, and P. Taylor (eds.). 2018. *The Atlas of the Breeding Birds of Manitoba, 2010–2014*. Bird Studies Canada. Winnipeg, Manitoba. Website: https://birdatlas.mb.ca/index_en.jsp [accessed October 2020].

Barrow, W., P. Chadwick, B. Couvillion, T. Doyle, S. Faulkner, C. Jeske, T. Michot, L. Randall, C. Wells, and S. Wilson. 2007. Cheniere forest as stopover habitat for migrant landbirds: Immediate effects of Hurricane Rita. US Geological Survey Circular 1306:147-156.

Bejarano, V., and A.E. Jahn. 2018. Relationship between arrival timing and breeding success of intra-tropical migratory Fork-tailed Flycatchers (*Tyrannus savana*). Journal of Field Ornithology 89:109-116.

Bird, J.P., R. Martin, H.R. Akçakaya, J. Gilroy, I.J. Burfield, S.T. Garnett, A. Symes, J. Taylor, Ç.H. Şekercioğlu, and S.H.M. Butchart. 2020. Generation lengths of the world's birds and their implications for extinction risk. Conservation Biology 10.1111/cobi.13486.

Birdlife International. 2018. *Antrostomus vociferus*. The IUCN Red List of Threatened Species 2018: e.T22736393A131617918. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22736393A131617918.en [accessed October 2020].

Birds Canada. 2021. Saskatchewan Breeding Bird Atlas. Website: https://www.birdscanada.org/birdmon/skatlas/main.jsp [accessed September 2021].

Birds Canada. 2021. Christmas Bird Count. Website: https://www.birdscanada.org/bird-science/christmas-bird-count/ [accessed August 2021].

Birds Canada. 2022. Ontario Breeding Bird Atlas. Website: https://www.birdsontario.org/ [accessed March 2022].

Bishop, C.A., and J.M. Brogan. 2013. Estimates of avian mortality attributed to vehicle collisions in Canada. Avian Conservation and Ecology 8(2):2.

Blancher, P. 2013. Estimated number of birds killed by house cats (*Felis catus*) in Canada. Avian Conservation and Ecology 8(2):3.

Böhning-Gaese, K., M.L. Taper, and J.H. Brown. 1993. Are declines in North American insectivorous songbirds due to causes on the breeding range? NCASI Technical Bulletin 7:76–86.

Brown, C.R., and M.B. Brown. 2000. Weather-mediated natural selection on arrival time in cliff swallows (*Petrochelidon pyrrhonota*). Behavioral Ecology and Sociobiology 47:339–345.

Butler, R.W. 2000. Stormy seas for some North American songbirds: Are declines related to severe storms during migration? Auk 117:518–522.

Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage, and A.R. Couturier (eds.). 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. xxii + 706 pp.

CESCC (Canadian Endangered Species Conservation Council). 2022. Wild Species 2020: The General Status of Species in Canada. National General Status Working Group: 172 pp.

Chartier, A.T., J.J. Baldy, and J.M. Brenneman. 2011. The Second Michigan Breeding Bird Atlas, 2002–2008. Kalamazoo Nature Center. Kalamazoo, Michigan. 708 pp.

Chaundy-Smart, R.F.C., S.M. Smith, J.R. Malcolm, and M.I. Bellocq. 2012. Comparison of moth communities following clear-cutting and wildfire disturbance in the southern boreal forest. Forest Ecology and Management 270:273–281.

Chesser, R.T., R.C. Banks, F.K. Barker, C. Cicero, J.L. Dunn, A.W. Kratter, I.J. Lovette, P.C. Rasmussen, J.V. Remsen Jr., J.D. Rising, D.F. Stotz, and K. Winker. 2010. Fifty-First Supplement to the American Ornithologists' Union Check-List of North American Birds. Auk 127:726-744.

Chesser, R.T., R.C. Banks, F.K. Barker, C. Cicero, J.L. Dunn, A.W. Kratter, I.J. Lovette, P.C. Rasmussen, J.V. Remsen Jr., J.D. Rising, D.F. Stotz, and K. Winker. 2012. Fifty-Third Supplement to the American Ornithologists' Union Check-List of North American Birds. Auk 129:573-588.

Cink, C.L., P. Pyle, and M.A. Patten. 2020. Eastern Whip-poor-will (*Antrostomus vociferus*), version 1.0. *In* Birds of the World (P.G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bow.whip-p1.01 [accessed July 2020].

Coffin, A.W. 2007. From roadkill to road ecology: A review of the ecological effects of roads. Journal of Transport Geography 15:396–406.

COSEWIC. 2009. COSEWIC assessment and status report on the Whip-poor-will *Caprimulgus vociferus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 28 pp.

COSEWIC. 2020. COSEWIC guidelines for recognizing designatable units. https://cosewic.ca/index.php/en-ca/reports/preparing-status-reports/guidelines-recognizing-designatable-units.html

DeGraaf, R.M., and D.D. Rudis. 1986. New England wildlife: habitat, natural history, and distribution. United States Department of Agriculture, Forest Service, Northeastern Forest Experiment Station, Broomall, Pennsylvania. General Technical Report NE-108, 491 pp.

Diehl, R.H., J.M. Bates, D.E. Willard, and T. P. Gnoske. 2013. Bird mortality during nocturnal migration over Lake Michigan: a case study. The Wilson Journal of Ornithology 126:19–29.

Dobbs, R.C., W.C. Barrow, C.W. Jeske, J. Dimiceli, T.C. Michot, and J.W. Beck. 2009. Short-term effects of hurricane disturbance on food availability for migrant songbirds during autumn stopover. Wetlands 29:123–134.

Donald, P.F., B. Arendarczyk, F. Spooner, and G.M. Buchanan. 2019. Loss of forest intactness elevates global extinction risk in birds. Animal Conservation 22:341–347.

Drake, A., C.A. Rock, S.P. Quinlan, M. Martin, and D.J. Green. 2014. Wind speed during migration influences the survival, timing of breeding, and productivity of a neotropical migrant, *Setophaga petechia*. PloS ONE 9.

Dunn, E.H. 2002. Using decline in bird populations to identify needs for conservation action. Conservation Biology 16:1632-1637.

Eastman, J. 1991. Whip-poor-will, pp. 252-253, in Brewer, R., G.A. McPeek, and R.J. Adams Jr., (eds). The Atlas of Breeding Birds of Michigan. Michigan State University Press, East Lansing, Michigan. 594 pp.

eBird. 2020. eBird: An online database of bird distribution and abundance [web application]. eBird, Ithaca, New York. Website: http://www.ebird.org [accessed October 2020].

ECCC (Environment and Climate Change Canada). 2018. Recovery Strategy for the Eastern Whip-poor-will (*Antrostomus vociferus*) in Canada. Species at Risk Act Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. vi + 107 pp.

Eng, M.L., B.J.M. Stutchbury, and C.A. Morrissey. 2019. A neonicotinoid insecticide reduces fueling and delays migration in songbirds. Science 365:1177–1180.

English, P.A., A.M. Mills, M.D. Cadman, A.E. Heagy, G.J. Rand, D.J. Green and J.J. Nocera. 2017a. Tracking the migration of a nocturnal aerial insectivore in the Americas. BMC Zoology 2:5.

English, P.A., J.J. Nocera, B.A. Pond, and D.J. Green. 2017b. Habitat and food supply across multiple spatial scales influence the distribution and abundance of a nocturnal aerial insectivore. Landscape Ecology 32:343–359.

English, P.A., D.J. Green, and J.J. Nocera. 2018a. Stable isotopes from museum specimens may provide evidence of long-term change in the trophic ecology of a migratory aerial insectivore. Frontiers in Ecology and Evolution 6:14.

English, P.A., J.J. Nocera, and D.J. Green. 2018b. Nightjars may adjust breeding phenology to compensate for mismatches between moths and moonlight. Ecology and Evolution 8:5515-5529.

Espín, S., P. Sánchez-Virosta, J. M. Zamora-Marín, M. León-Ortega, P. Jiménez, M. Zumbado, O. P. Luzardo, T. Eeva, and A. J. García-Fernández. 2020. Toxic elements in blood of red-necked nightjars (*Caprimulgus ruficollis*) inhabiting differently polluted environments. Environmental Pollution 262.

Espín, S., P. Sánchez-Virosta, J. M. Zamora-Marín, M. León-Ortega, P. Jiménez, A. Zamora-López, P. R. Camarero, R. Mateo, T. Eeva, and A. J. García-Fernández. 2020. Physiological effects of toxic elements on a wild nightjar species. Environmental Pollution 263.

Farrell, C.E., S. Wilson, and G. Mitchell. 2016. Assessing the relative use of clearcuts, burned stands, and wetlands as breeding habitat for two declining aerial insectivores in the boreal forest. Forest Ecology and Management 386:62-70.

Farrell, C.E., L. Fahrig, G. Mitchell, and S. Wilson. 2019. Local habitat association does not inform landscape management of threatened birds. Landscape Ecology 34:1313-1327.

Fink, D., T. Auer, A. Johnson, M. Strimas-Mackey, O. Robinson, S. Ligocki, W. Hochachka, C. Wood, I. Davies, M. Iliff, L. Seitz. 2020. eBird Status and Trends, Data Version: 2019; Released: 2020. Cornell Lab or Ornithology, Ithaca, New York.

Fransson, T., T. Kolehmainen, C. Kroon, L. Jansson, and T. Wenninger. 2010. EURING list of longevity records for European birds. Website: https://euring.org/data-and-codes/longevity-list [accessed October 2020].

Gardiner, L., pers. comm. 2020. *Email correspondence to K. Hoo.* June 2020. Ecosystem Scientist, Parks Canada, Government of Canada, Val Marie, Saskatchewan.

Garlapow, R.M. 2007. Whip-poor-will prey availability and foraging habitat: implications for management in pitch pine/scrub oak barrens habitats. MSc thesis, University of Massachusetts Amherst, Amherst, Massachusetts.

Godfrey, W.E. 1986. Birds of Canada. National Museum of Natural Sciences, Ottawa, Ontario. 595 pp.

Government of Canada. 2017. Migratory Birds Convention Act, 1994. Website: https://laws-lois.justice.gc.ca/eng/acts/m-7.01/ [accessed July 2020].

Government of Canada. 2018. Breeding Bird Survey Overview. Website: https://www.canada.ca/en/environment-climate-change/services/bird-surveys/landbird/north-american-breeding/overview.html [accessed July 2020].

Grahame, E.R.M., K.D. Martin, E.A. Gow, and D.R. Norris. 2021. Diurnal and nocturnal habitat preference of Eastern Whip-poor-wills (*Antrostomus vociferus*) in the northern portion of their breeding range. Avian Conservation and Ecology 16(2):14.

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.

Hamel, P.B. 1992. Land manager's guide to the birds of the South. General Technical Report. SE-22. U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. Asheville, North Carolina. 437 pp.

Harrison, X.A., J.D. Blount, R. Inger, D.R. Norris, and S. Bearhop. 2011. Carry-over effects as drivers of fitness differences in animals. Journal of Animal Ecology 80:4–18.

Hickey, M.B. 1993. Thermoregulation in free-ranging whip-poor-wills. The Condor 95:744-747.

Horn, A. 2015. Eastern Whip-poor-will. pp. 278-279, *in* R.L.M. Stewart, K.A. Bredin, A.R. Couturier, A.G. Horn, D. Lepage, S. Makepeace, P.D. Taylor, M.-A.Villard, and R.M. Whittam (eds.). Second Atlas of Breeding Birds of the Maritime Provinces. Bird Studies Canada, Environment Canada, Natural History Society of Prince Edward Island, Nature New Brunswick, New Brunswick Department of Natural Resources, Nova Scotia Bird Society, Nova Scotia Department of Natural Resources, and Prince Edward Island Department of Agriculture and Forestry, Sackville, New Brunswick.

Howell, S.N.G., and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press, New York.

Huang, A.C., C.A. Bishop, R. McKibbin, A. Drake, and D.J. Green. 2017. Wind conditions on migration influence the annual survival of a neotropical migrant, the western yellow-breasted chat (*Icteria virens auricollis*). BMC Ecology 17:29.

Hunt, P. 2013. Habitat use by Eastern Whip-poor-will (*Antrostomus vociferus*) in New Hampshire with recommendations for management. The New Hampshire Fish and Game Department Nongame and Endangered Wildlife Program, New Hampshire Audubon, Concord, New Hampshire.

Jackson, H.D., and R. Slotow. 2002. A review of Afrotropical nightjar mortality, mainly road kills. Ostrich 73:147-161.

Jackson, H.D. 2003a. A field survey to investigate why nightjars frequent roads at night. Ostrich 74:97-101.

Jackson, H.D. 2003b. Another reason for nightjars being attracted to roads at night. Ostrich 74:228-230.

James, D.A., and J.C. Neal. 1986. Arkansas birds: their distribution and abundance. University of Arkansas Press, Fayetteville.

Klaassen, R.H.G., M. Hake, R. Strandberg, B.J. Koks, C. Trierweiler, K.M. Exo, F. Bairlein, and T. Alerstam. 2014. When and where does mortality occur in migratory birds? Direct evidence from long-term satellite tracking of raptors. Journal of Animal Ecology 83:176–184.

Klimkiewicz, M.K. 2008. Longevity Records of North American Birds. Version 2008.1. Patuxent Wildlife Research Center. Bird Banding Laboratory. Laurel, Maryland.

Knight, E.C., A.C. Smith, R.M. Brigham, and E.M. Bayne. 2021. Combination of targeted monitoring and Breeding Bird Survey data improves population trend estimation and species distribution modeling for the Common Nighthawk. Ornithological Applications 123(2):5.

Kolb, M., and L. Galicia. 2012. Challenging the linear forestation narrative in the Neotropic: Regional patterns and processes of deforestation and regeneration in southern Mexico. Geographical Journal 178:147–161.

Korpach, A., pers. comm. 2020. *Email correspondence to K. Hoo.* July 2020. PhD Student, Avian Behaviour and Conservation Lab, University of Manitoba, Winnipeg, Manitoba.

Korpach, A.M., A. Mills, C. Heidenreich, C.M. Davy, and K.C. Fraser. 2019. Blinded by the light? Circadian partitioning of migratory flights in a nightjar species. Journal of Ornithology 160:835-840.

Korpach, A.M, C.J. Garroway, A.M. Mills, V. von Zuben, C.M. Davy, and K.C Fraser. 2022. Urbanization and artificial light at night reduce the functional connectivity of migratory aerial habitat. Ecography 2022:e05581.

Latta, S.C., L.C. Marshall, M.W. Frantz, and J.D. Toms. 2015. Evidence from two shale regions that a riparian songbird accumulates metals associated with hydraulic fracturing. Ecosphere 6:1-10.

Létourneau, V. 2019. Eastern Whip-poor-will. pp. 178-179, *in* M. Robert, M.-H. Hachey, D. Lepage, and A.R. Couturier (eds.). Second Atlas of the Breeding Birds of Southern Québec. Regroupement Québec Oiseaux, Environment and Climate Change Canada, Bird Studies Canada, Québec, Québec.

Liley, D., and R.T. Clarke. 2003. The impact of urban development and human disturbance on the numbers of nightjar *Caprimulgus europaeus* on heathlands in Dorset, England. Biological Conservation 114:219–230.

Loss, S.R., and P.P. Marra. 2017. Population impacts of free-ranging domestic cats on mainland vertebrates. Frontiers in Ecology and the Environment 15:502-509.

Martin, T.E., and G.R. Geupel. 1993. Nest-monitoring plots: Methods for locating nests and monitoring success. Journal of Field Ornithology 64:507–519.

Masek, J.G., W.B. Cohen, D. Leckie, M.A. Wulder, R. Vargas, B. De Jong, S. Healey, B. Law, R. Birdsey, R.A. Houghton, and D. Mildrexler. 2011. Recent rates of forest harvest and conversion in North America. Journal of Geophysical Research: Biogeosciences 116:1–22.

McGowan, K.J., and K. Corwin. 2008. The Second Atlas of Breeding Birds in New York State. Cornell University Press. Ithaca, New York. 712 pp.

Mendoza-González, G., M.L. Martínez, D. Lithgow, O. Pérez-Maqueo, and P. Simonin. 2012. Land use change and its effects on the value of ecosystem services along the coast of the Gulf of Mexico. Ecological Economics 82:23–32.

Miller, B.J., H.J. Harlow, T.S. Harlow, D. Biggins, and W.J. Ripple. 2012. Trophic cascades linking wolves (*Canis lupus*), coyotes (*Canis latrans*), and small mammals. Canadian Journal of Zoology 90:70–78.

Mills, A.M. 1986. The influence of moonlight on the behaviour of goatsuckers (Caprimulgidae). Auk 103:370-378.

Mills, A.M. 2007. Whip-poor-will. pp. 312-313, *in* M.D. Cadman, D.A. Sutherland, G.G. Beck, D. LePage, and A.R. Couturier (eds.). 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.

Mills, A.M. 2018. Eastern Whip-poor-will. *In* C. Artuso, A.R. Couturier, K.D. De Smet, R.F. Koes, D. Lepage, J. McCracken, R.D. Mooi, and P. Taylor (eds.). 2018. The Atlas of the Breeding Birds of Manitoba, 2010–2014. Bird Studies Canada. Winnipeg, Manitoba. Website: https://birdatlas.mb.ca/index_en.jsp [accessed October 2020].

NatureServe. 2022. NatureServe Explorer [web application]. NatureServe, Arlington, Virginia. Website: https://explorer.natureserve.org/ [accessed March 2022].

Nebel, S., A. Mills, J.D. McCracken, and P.D. Taylor. 2010. Declines of aerial insectivores in North America follow a geographic gradient. Avian Conservation and Ecology 5:1.

Newton, I. 1998. Population Limitation in Birds. Academic Press, London, United Kingdom. 597 pp.

Newton, I. 2006. Can conditions experienced during migration limit the population levels of birds? Journal of Ornithology 147:146–166.

Newton, I. 2007. Weather-related mass-mortality events in migrants. Ibis 149:453–467.

Nocera, J.J., J.M. Blais, D.V. Beresford, L.K. Finity, C. Grooms, L.E. Kimpe, K. Kyser, N. Michelutti, M.W. Reudink, and J.P. Smol. 2012. Historical pesticide applications coincided with an altered diet of aerially foraging insectivorous chimney swifts. Proceedings of the Royal Society B 279:3114-3120.

Palmer-Ball, B.L. Jr. 1996. The Kentucky Breeding Bird Atlas. University Press of Kentucky, Lexington, Kentucky. 372 pp.

Peck, G.K., and R.D. James. 1983. Breeding birds of Ontario, nidiology and distribution, Vol. 1: nonpasserines. Royal Ontario Museum, Toronto, Ontario. 321 pp.

PIF (Partners in Flight). 2016. Watch List Species Table (and Definitions). Continental Landbird Conservation Plan. Website: https://partnersinflight.org/resources/pif-watch-list-table-2016/ [accessed July 2020].

PIF. 2020. Population Estimates Database, version 3.1. Website: https://pif.birdconservancy.org/population-estimates-database/ [accessed July 2020].

Pomfret, J.K., J.J. Nocera, T.K. Kyser and M.W. Reudink. 2014. Linking population declines with diet quality in Vaux's Swifts. Northwest Science 88:305-313.

Purves, E.F. 2015. The role of breeding habitat loss in the decline of Eastern Whip-Poor-Will (*Antrostomus vociferus*) populations in Canada. Queen's University, Kingston, Ontario.

Rand, G.J. 2014. Home range use, habitat selection, and stress physiology of Eastern Whip-poor-wills (*Antrostomus vociferus*) at the northern edge of their range. MSc Thesis, Trent University, Peterborough, Ontario.

Reese, J.G. 1996. Whip-poor-will. pp. 194-195, *in* C.S. Robbins, ed. Atlas of the Breeding Birds of Maryland and the District of Columbia, University of Pittsburgh Press, Pittsburgh, Pennsylvania. 479 pp.

Renfrew, R. 2013. The Second Atlas of Breeding Birds of Vermont. University Press of New England, Lebanon, New Hampshire. 572 pp.

Ridgely, R.S., and J. Gwynne. 1989. A Guide to the Birds of Panama, with Costa Rica, Nicaragua, and Honduras. 2nd edition. Princeton University Press. Princeton, New Jersey.

Robert, M., M.-H. Hachey, D. Lepage, and A.R. Couturier. 2019. Second Atlas of the Breeding Birds of Southern Québec. Regroupement Québec Oiseaux, Environment and Climate Change Canada, Bird Studies Canada. 720 pp.

Rockwell, S.M., C.I. Bocetti, and P.P. Marra. 2012. Carry-over effects of winter climate on spring arrival date and reproductive success in an endangered migratory bird, Kirtland's Warbler (*Setophaga kirtlandii*). The Auk 129:744–752.

Rodewald, P.G., M.B. Shumar, A.T. Boone, D.L. Slager, and J. McCormac. 2016. The Second Atlas of Breeding Birds of Ohio. The Pennsylvania State University Press. University Park, Pennsylvania. 600 pp.

Rooney, T.P., and D.M. Waller. 2003. Direct and indirect effects of White-tailed Deer in forest ecosystems. Forest Ecology and Management 181:165–76.

Rousseu, F., and B. Drolet. 2017. The nesting phenology of birds in Canada. Canadian Wildlife Service, Technical Report Series No. 533, Environment and Climate Change Canada, Quebec Region, Quebec. xxii + 314 pp.

Russell, M.B., C.W. Woodall, K.M. Potter, B.F. Walters, G.M. Domke, and C.M. Oswalt. 2017. Interactions between white-tailed deer density and the composition of forest understories in the northern United States. Forest Ecology and Management 384:26–33.

Ryan, K.C., E.E. Knapp, and J.M. Varner. 2013. Prescribed fire in North American forests and woodlands: History, current practice, and challenges. Frontiers in Ecology and the Environment 11:15–24.

Saino, N., R. Ambrosini, M. Caprioli, A. Romano, M. Romano, D. Rubolini, C. Scandolara, and F. Liechti. 2017. Sex-dependent carry-over effects on timing of reproduction and fecundity of a migratory bird. Journal of Animal Ecology 86:239–249.

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

Sánchez-Bayo, F., and K.A.G. Wyckhuys. 2019. Worldwide decline of the entomofauna: A review of its drivers. Biological Conservation 232:8–27.

Sauer, J.R., D.K. Niven, J.E. Hines, D.J. Ziolkowski, Jr., K.L. Pardieck, J.E. Fallon, and W.A. Link. 2017. The North American Breeding Bird Survey, Results and Analysis 1966–2015. Version 2.07.2017. USGS Patuxent Wildlife Research Center. Laurel, Maryland.

Sibley, D.A. 2003. Birds of Eastern North America. A&C Publishers Ltd., London, United Kingdom. 431 pp.

Sillett, T.S., and R.T. Holmes. 2002. Variation in Survivorship of a Migratory Songbird throughout Its Annual Cycle. Journal of Animal Ecology 71:296–308.

Skinner, A. 2021. Using GPS-tracking to fill knowledge gaps in the full annual cycle of an elusive aerial insectivore in steep decline. MSc thesis, Ohio State University, Columbus, Ohio.

Slover, C.L., and T.E. Katzner. 2016. Eastern whip-poor-wills (*Antrostomus vociferus*) are positively associated with low elevation forest in the central Appalachians. Wilson Journal of Ornithology 128:846–856.

Smith, A.R. 1996. Atlas of Saskatchewan birds. Canadian Wildlife Service, Natural History Society, Regina, 456 pp.

Smith, A. 2020. Unpublished Data: North American Breeding Bird Survey, Canadian Trends. Environment and Climate Change Canada, Ottawa, Ontario.

Smith, R.J., and F.R. Moore. 2003. Arrival fat and reproductive performance in a long-distance passerine migrant. Oecologia 134:325–331.

Smith, R.J., and F.R. Moore. 2005. Arrival timing and seasonal reproductive performance in a long-distance migratory landbird. Behavioral Ecology and Sociobiology 57:231–239.

Speirs, J.M. 1985. Birds of Ontario. Natural History/Natural Heritage Inc. Toronto, Ontario.

Spiller, K.J., and R. Dettmers. 2019. Evidence for multiple drivers of aerial insectivore declines in North America. Condor 121:1–13.

Stanton, J.C., P. Blancher, K.V. Rosenberg, A.O. Panjabi, and W.E. Thogmartin. 2019. Estimating uncertainty of North American landbird population sizes. Avian Conservation and Ecology 14(1):4.

Statistics Canada. 2022. Canada's 2021 Census of Agriculture: A story about the transformation of the agriculture industry and adaptiveness of Canadian farmers. Website: https://www150.statcan.gc.ca/n1/daily-quotidien/220511/dq220511a-eng.htm [accessed June 2022].

Stewart, R.L.M., K.A. Bredin, A.R. Couturier, A.G. Horn, D. Lepage, S. Makepeace, P.D. Taylor, M.-A. Villard, and R.M. Whittam. 2015. Second Atlas of Breeding Birds of the Maritime Provinces. Bird Studies Canada, Environment Canada, Natural History Society of Prince Edward Island, Nature New Brunswick, New Brunswick Department of Natural Resources, Nova Scotia Bird Society, Nova Scotia Department of Natural Resources, and Prince Edward Island Department of Agriculture and Forestry, Sackville, New Brunswick. 528 + 28 pp.

Stiles, F.G., and A.F. Skutch. 1989. A Guide to the Birds of Costa Rica. Cornell University Press, Ithaca, New York. 656 pp.

Tonra, C.M., J.R. Wright, and S.N. Matthews. 2019. Remote estimation of overwintering home ranges in an elusive, migratory nocturnal bird. Ecology and Evolution 9:12586-12599.

Tozer, D.C., J.C. Hoare, J.E. Inglis, J. Yaraskavitch, H. Kitching, and S. Dobbyn. 2014. Clearcut with seed trees in red pine forests associated with increased occupancy by Eastern Whip-poor-wills. Forest Ecology and Management 330:1-7.

Tufts, R.W. 1986. Birds of Nova Scotia. Third Edition. Nimbus Publishing and the Nova Scotia Museum. Halifax, Nova Scotia. 478 pp.

USC (United States Code Annotated). 1918. Migratory Bird Treaty Act of 1918. Title 16: Conservation of the United States Code: 703-712. Amended April 16, 2020.

USFWS (United States Fish and Wildlife Service). 2020. Environment Conservation Online System

Vala, M.A., G.W. Mitchell, K.C. Hannah, J. Put, and S. Wilson. 2020. The effects of landscape composition and configuration on Eastern Whip-poor-will (*Caprimulgus vociferus*) and Common Nighthawk (*Chordeiles minor*) occupancy in an agroecosystem. Avian Conservation and Ecology 15(1):24.

Van Wilgenburg, S.L., K.A. Hobson, E.M. Bayne, and N. Koper. 2013. Estimated avian nest loss associated with oil and gas exploration and extraction in the western Canadian sedimentary basin. Avian Conservation and Ecology 8:9.

Vilella, F.J. 1995. Reproductive ecology and behaviour of the Puerto Rican Nightjar *Caprimulgus noctitherus.* Bird Conservation International 5:349-366.

Walker, J., and P.D. Taylor. 2017. Using eBird to model population change of migratory bird species. Avian Conservation and Ecology 12:4.

Will, T., J.C. Stanton, K.V. Rosenberg, A.O. Panjabi, A.F. Camfield, A.E. Shaw, W.E. Thogmartin, and P.J. Blancher. 2020. Handbook to the Partners in Flight Population Estimates Database, Version 3.1. PIF Technical Series No 7.1. Website: http://pif.birdconservancy.org/popest.handbook.pdf [accessed October 2020].

Wilcove, D.S., C.H. McLellan, and A.P. Dobson. 1986. Habitat fragmentation in the temperate zone. pp. 237-256, *in* Michael E. Soulé (ed.). Conservation Biology: The Science of Scarcity and Diversity. Sinauer Associates, Inc., Sunderland, Massachusetts.

Wilson, A.M., D.W. Brauning, and R.S. Mulvihill. 2012. Second Atlas of Breeding Birds in Pennsylvania. The Pennsylvania State University Press. University Park, Pennsylvania. 612 pp.

Wilson, M.D. 2003. Distribution, abundance, and home range of the Whip-poor-will (*Caprimulgus vociferus*) in a managed forest landscape. MA thesis, The College of William and Mary, Williamsburg, Virginia.

Wilson, M.D., and B.D. Watts. 2008. Landscape configuration effects on distribution and abundance of Whip-poor-wills. The Wilson Journal of Ornithology 120:778-783.

Wilson, S.G. 1985. Summer Distribution of Whip-poor-wills in Minnesota. The Loon 57: 6-8.

Woodcock, B.A., N.J.B. Isaac, J.M. Bullock, D.B. Roy, D.G. Garthwaite, A. Crowe, and R.F. Pywell. 2016. Impacts of neonicotinoid use on long-term population changes in wild bees in England. Nature Communication 7(12459).

BIOGRAPHICAL SUMMARY OF REPORT WRITERS

Kathryn Hoo is a Terrestrial and Wetland Biologist with Natural Resource Solutions Incorporated (NRSI), an environmental consulting firm located in Waterloo, Ontario. At NRSI, Kathryn is a bird specialist; she leads natural resource inventories and evaluations, species at risk monitoring, and post-construction monitoring studies at renewable energy projects. Since graduating with a Bachelor of Science degree from the University of Guelph, Kathryn has participated in a number of avian field studies throughout Canada, using a wide range of monitoring and research techniques. Kathryn is active in the Ontario birding community and regularly contributes data to eBird and other databases.

Elora Grahame is a PhD student in the Norris Lab at the University of Guelph. She studies reproductive success and habitat use in the Common Nighthawk and Eastern Whip-poor-will on the breeding grounds in Ontario. Additionally, her research uses the Motus Wildlife Tracking System to study the effects of factors such as individual characteristics and environmental variables on migration rate and stopover duration for both species.

Kenneth Burrell is a terrestrial biologist specializing in ornithology. Kenneth has been studying birds for over 20 years and has conducted countless field studies throughout Canada. He is actively involved in the Ontario birding community and publishes widely on topics in field ornithology, ranging from species at risk to meteorological impacts on bird migration, and has recently published a book on the *Best Places to Bird in Ontario*. Kenneth volunteers widely for bird conservation programs, including the CBC, BBS, and various species at risk recovery projects.

COLLECTIONS EXAMINED

No collections were examined for the preparation of this report.

Appendix I. Threats Calculator results for the Eastern Whip-poor-will

THREATS ASSESSMENT WORKSHEET				
Species or Ecosystem Scientific Name	Eastern Whip-poor-will *Antrostomus vociferus*			
Element ID		**Elcode**		
Date (Ctrl + ";" for today's date):	19 March 2022			
Assessor(s):	Dwayne Lepitzki (facilitator), Kathryn Hoo (writer), Elora Grahame (writer), Marcel Gahbauer (Birds SSC co-chair), Amit Saini (COSEWIC Secretariat), Christian Artuso, Courtney Baldo, Louise Blight, Leah de Forest, Richard Elliot, Kim Gamble, Adam Hadley, Tara Imlay, Colin Jones, Shannon Landels, Mark McGarrigle, Mary Sabine, Gina Schalk, Paul Smith, Marc-André Valiquette, Erin Whidden			
References:	Draft status report and draft threats calculator for Eastern Whip-poor-will			
Overall Threat Impact Calculation Help:		**Level 1 Threat Impact Counts**		
	Threat Impact		**high range**	**low range**
	A	Very High	0	0
	B	High	1	0
	C	Medium	0	1
	D	Low	4	4
Calculated Overall Threat Impact:			High	High
Assigned Overall Threat Impact:	**B = High**			
Impact Adjustment Reasons:	**n/a**			
Overall Threat Comments:	Generation time for Eastern Whip-poor-will is approximately 3.7 years (bird et al. 2020), so the time-frame for considering severity and timing is 11 years. Threats to the Canadian population of Eastern Whip-poor-will are considered breeding grounds in southern Canada, on migration, and on wintering grounds in the southeastern United States, eastern Mexico, and Central America.			

Threat		**Impact (calculated)**		**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
1	Residential & commercial development	D	Low	Restricted (11-30%)	Moderate (11-30%)	High (Continuing)	**Roll-up adjusted to correct the impact calculation glitch for 1.1**

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
1.1	Housing & urban areas	CD	Medium - Low	Restricted (11-30%)	Moderate - Slight (1-30%)	High (Continuing)	Loss of stopover habitat in the Gulf of Mexico region due to ongoing residential development is likely the most important factor, but there is also significant ongoing cottage development in Ontario and Manitoba, and substantial urban development just east of Winnipeg over the past decade, which is also likely to continue. The scope is likely to be toward the lower end of restricted. Severity is somewhat uncertain, given that individuals are concentrated in small areas during stopovers and have known site fidelity, but their ability to adjust and find new stopover sites is poorly understood.
1.2	Commercial & industrial areas		Negligible	Negligible (<1%)	Moderate - Slight (1-30%)	High (Continuing)	Scope negligible, probably largely limited to some developments around the Gulf of Mexico and other migratory stopovers. Severity as above.
1.3	Tourism & recreation areas	D	Low	Small (1-10%)	Moderate - Slight (1-30%)	High (Continuing)	Primarily of concern along the Gulf of Mexico in relation to resort development (especially Yucatan Peninsula); scope difficult to identify given uncertainties about stopover/winter habitat use, but most likely small. Severity as above.
2	Agriculture & aquaculture	D	Low	Restricted (11-30%)	Moderate (11-30%)	High (Continuing)	**Roll-up adjusted to correct the impact calculation glitch for 2.1 and 2.3**
2.1	Annual & perennial non-timber crops	CD	Medium - Low	Restricted (11-30%)	Moderate - Slight (1-30%)	High (Continuing)	Primarily related to conversion of neotropical forest to pasture and agriculture on the wintering grounds, although some similar changes also occurring in Manitoba. Abandonment of agricultural lands could provide early successional habitat, but only for 15 years at most. Uncertainty about severity reflects concern over high site fidelity and likelihood of finding alternate habitat, but limited data on this.
2.2	Wood & pulp plantations		Negligible	Negligible (<1%)	Unknown	High (Continuing)	Likely affects a negligible proportion of the population. Effects can be negative if suitable habitat is eliminated, but may also be positive where plantations are suitable for nesting; more research needed.
2.3	Livestock farming & ranching	CD	Medium - Low	Restricted (11-30%)	Moderate - Slight (1-30%)	High (Continuing)	Scope and severity similar to 2.1
2.4	Marine & freshwater aquaculture						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3	Energy production & mining		Unknown	Small (1-10%)	Unknown	High (Continuing)	
3.1	Oil & gas drilling		Negligible	Negligible (<1%)	Unknown	High (Continuing)	Minimal overlap of oil and gas production with Eastern Whip-poor-will distribution. Some displacement is possible where it occurs; however, severity of this threat is largely unknown.
3.2	Mining & quarrying		Unknown	Small (1-10%)	Unknown	High (Continuing)	More prevalent in Manitoba than other parts of Canadian breeding range, but only ~11% of the population there; scope likely small overall and perhaps near low end of range. Development of new mines and quarries could displace Eastern Whip-poor-will, with effects similar to residential and commercial development. However, abandoned gravel pits may be used, so overall severity is unknown.
3.3	Renewable energy						Potential mortality from wind turbines, but no evidence available, and likely not a measurable contributor to population trends.
4	Transportation & service corridors	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	
4.1	Roads & railroads	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	Nearly all Eastern Whip-poor-wills are exposed to roads at some point in their life cycle, with many foraging, singing, and roosting over or adjacent to lightly used roads in particular. Displacement through loss of habitat due to construction of new roads may to some degree be offset by the attraction for foraging, but this is likely to be more than offset by mortality risk from vehicle collisions, with overall severity likely slight.
4.2	Utility & service lines		Unknown	Restricted (11-30%)	Unknown	High (Continuing)	Less extensive overlap than for roads, likely relevant to a restricted portion of the population. Similar to roads, loss of breeding habitat may be offset by suitability of foraging in the resulting open areas, and there is potential (although undocumented) for collision with overhead wires. Severity is therefore considered unknown.
4.3	Shipping lanes						
4.4	Flight paths						
5	Biological resource use		Unknown	Large (31-70%)	Unknown	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
5.1	Hunting & collecting terrestrial animals						
5.2	Gathering terrestrial plants						
5.3	Logging & wood harvesting		Unknown	Large (31-70%)	Unknown	High (Continuing)	Logging is occurring on both the breeding and wintering grounds, with a large proportion of individuals likely to encounter effects at some point in their life cycle. Logging can open up areas for foraging but, given high site fidelity, there is concern about displacement from nest sites and ability to adapt (see Category 1). Clear-cutting has a negative impact but rotational cutting may be beneficial in the breeding range by creating openings for nesting and foraging habitat. Overall, severity is unknown, given potential for negative and positive impact and need for more data on insect availability and reproductive success in logged areas.
5.4	Fishing & harvesting aquatic resources						
6	Human intrusions & disturbance		Unknown	Small (1-10%)	Unknown	High (Continuing)	
6.1	Recreational activities		Unknown	Small (1-10%)	Unknown	High (Continuing)	There is considerable overlap between the Eastern Whip-poor-will's breeding range and popular recreational areas in Manitoba and Ontario in particular, though actual exposure to recreational activities is likely to be in the range of small overall. Hiking, off-leash dogs, off-road vehicles, and firewood collection are among the factors that can reduce habitat suitability or contribute to nest failure or mortality. However, many interactions are likely brief and minor, and more research is needed. The overall severity is therefore unknown.
6.2	War, civil unrest & military exercises		Negligible	Negligible (<1%)	Unknown	Unknown	Eastern Whip-poor-wills breed on some military bases, but they are almost certainly a negligible portion of the population. Research is needed to understand whether there are any effects of significance.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
6.3	Work & other activities		Negligible	Negligible (<1%)	Unknown	High (Continuing)	Very few individuals are targeted in research, or caught incidentally at migration monitoring stations. Eastern Whip-poor-will appears to be tolerant of research on the breeding grounds involving radiotelemetry and mist-netting as well as nest checks at intervals of at least every three days. Increased frequency of nest visits could be detrimental to nest success, as predators could be cued in to nest location. Overall severity is therefore unknown.
7	Natural system modifications	BC	High - Medium	Pervasive (71-100%)	Serious - Moderate (11-70%)	High (Continuing)	
7.1	Fire & fire suppression	D	Low	Restricted (11-30%)	Slight (1-10%)	High (Continuing)	Fire suppression is of concern as Eastern Whip-poor-will requires open forest, and burns can be beneficial by providing an abundance of insect prey. However, over the span of the next 10 years, fire suppression may affect only a restricted portion of the population. Severity is difficult to score as the effects are gradual; in the short term, likely slight, but perhaps higher in the long term if fire suppression is maintained.
7.2	Dams & water management/use						
7.3	Other ecosystem modifications	BC	High - Medium	Pervasive (71-100%)	Serious - Moderate (11-70%)	High (Continuing)	Essentially all individuals are exposed to the loss of insect prey arising from increased use of agricultural and forest pesticides. Severity is difficult to define given the lack of research specific to the Eastern Whip-poor-will, but given the widespread decline among aerial insectivores and the fundamental importance of prey availability, it is believed to be in the range of moderate to serious.
8	Invasive & other problematic species & genes		Unknown	Restricted (11-30%)	Unknown	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
8.1	Invasive non-native/alien species/diseases		Unknown	Small (1-10%)	Unknown	High (Continuing)	Although outdoor and feral cats are a potential threat to any ground-nesting bird, the tendency of Eastern Whip-poor-will to avoid human activity may reduce the scope of exposure to small overall. Vulnerability is likely greatest during nesting. Although cats have an adverse effect on the Eastern Whip-poor-will as predators, they also reduce the population of rodents (e.g. chipmunks, squirrels, mice) and small mustelids (i.e. weasels), which are also documented nest predators. Overall severity of this threat is unknown as more research is needed.
8.2	Problematic native species/diseases		Unknown	Restricted (11-30%)	Unknown	High (Continuing)	White-tailed Deer, Raccoon, and Red Fox are all documented nest predators of Eastern Whip-poor-will that have increased in abundance in response to human activities and lack of predators to limit their populations. This is most apparent in the southern portion of the breeding range of Eastern Whip-poor-will, likely corresponding to a restricted portion of the population. Severity is as above.
8.3	Introduced genetic material						
8.4	Problematic species/diseases of unknown origin						
8.5	Viral/prion-induced diseases						
8.6	Diseases of unknown cause						
9	Pollution		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	
9.1	Domestic & urban waste water						
9.2	Industrial & military effluents		Unknown	Large (31-70%)	Unknown	High (Continuing)	Effluents from mining have been documented to affect some birds, but impact on Eastern Whip-poor-will remains undocumented
9.3	Agricultural & forestry effluents		Unknown	Large (31-70%)	Unknown	High (Continuing)	A large portion of the population is likely exposed to agricultural or forestry effluents at some point. However, the nature and severity of effects on Eastern Whip-poor-will are largely unknown at this time.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
9.4	Garbage & solid waste						
9.5	Air-borne pollutants		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	Similar to 9.3; a large part of the Eastern Whip-poor-will population is likely exposed, but effects are not documented and severity remains unknown.
9.6	Excess energy		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	All individuals are exposed to light pollution during migration at minimum. Current research (A. Korpach pers. comm. 2020) suggests that individuals may avoid light pollution during migration, but implications of this are unknown.
10	Geological events						
10.1	Volcanoes						
10.2	Earthquakes/tsunamis						
10.3	Avalanches/landslides						
11	Climate change & severe weather	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	Climate change is occurring throughout the range of Eastern Whip-poor-will; therefore scope is considered pervasive for all aspects of this category.
11.1	Habitat shifting & alteration		Not Calculated (outside assessment timeframe)	Pervasive (71-100%)	Unknown	Low (Possibly in the long term, >10 yrs/3 gen)	Changes are gradual, and likely to be more evident over the long term, with little measurable change expected within the next 11 years. It is unclear at this point whether the net impact will be negative or positive for Eastern Whip-poor-will.
11.2	Droughts		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	Drought could be problematic if it reduces prey supply, in turn impacting breeding success and survival. However, it could also be beneficial if it leads to fire and an increase in open habitat. More research is required to understand severity.
11.3	Temperature extremes		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	Unseasonably cold weather has potential to cause starvation in early spring, or disrupt foraging prior to and during fall migration, but severity is unknown at present.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
11.4	Storms & flooding	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	Hurricanes and severe storms during migration are the greatest concern, through potential for direct mortality and damage to important stopover habitat, which may constrain the ability of individuals to refuel, and could reduce probability of survival. Some loss of nests to heavy rain/flooding is also possible, and heavy rain during the nestling phase may limit foraging opportunities and reduce reproductive success. Under current conditions, the overall severity of this threat is slight, but it could become higher in the future, and may fluctuate depending on the intensity of storms from year to year.
11.5	Other impacts						