HORNED GREBE, WESTERN POPULATION

Summary of the draft Management plan

Horned Grebe pair © iStock.com/pum_eva

Environnement et Changement climatique Canada
Environment and Climate Change Canada
Canada

INTRODUCTION

- Under the Species at Risk Act (SARA), a management plan must be developed for each species listed as Special Concern in order to identify measures for the conservation of the species. This document highlights the key sections of the draft management plan.

Species Conservation Status

- The Horned Grebe, Western population (*Podiceps auritus*) is listed as Special Concern under SARA (since 2017).
- Add other status relevant to your region

Description and Distribution

Description

- Small waterbird weighting between 300 to 570 grams;
- Breeding plumage: adults similar with white belly, black back and chestnut-red neck and flanks with bright yellow tufts behind the eyes.

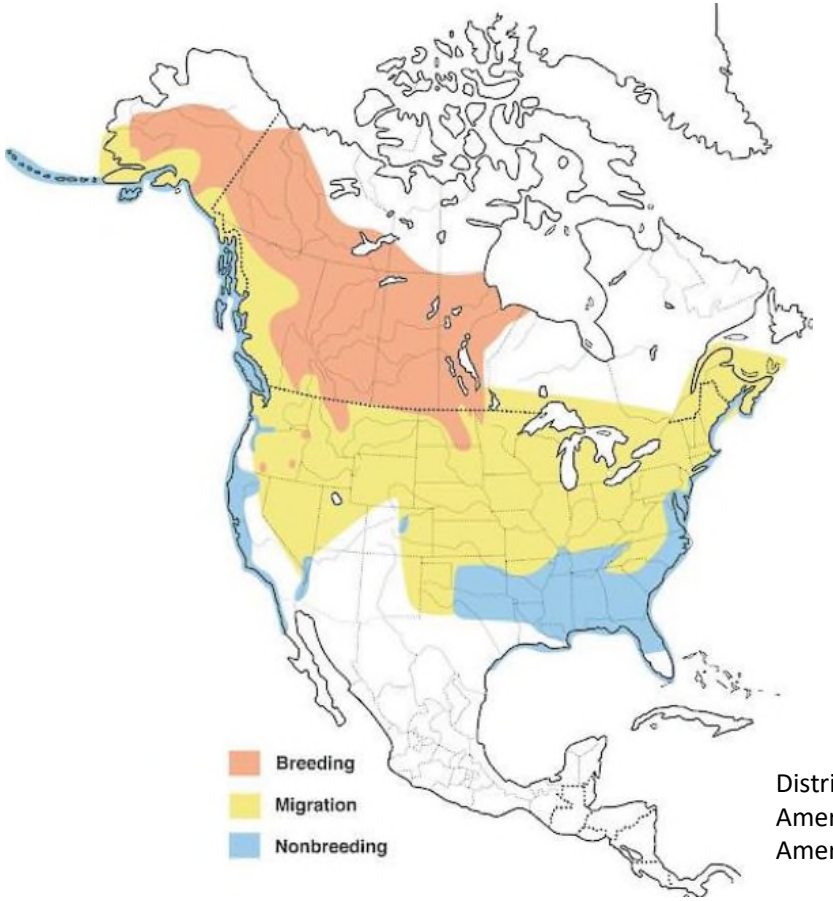
Description and Distribution

Distribution

- Widespread: Yukon and western Northwest Territories, east of the Coast Mountains in BC through Alberta, Saskatchewan and Manitoba;
- Limited in southern Nunavut and northwestern Ontario;
- Highest densities in the Prairie Potholes Region (southern AB, SK and MB).

Description and Distribution

Distribution



Distribution of the Horned Grebe in North America (from Cornell Lab – Birds of North America's Website, Stedman, 2018)

Habitat Needs

- Small, shallow, and usually fishless ponds;
- Ponds with areas of open water surrounded by emergent vegetation (e.g. sedges, rushes and cattails);
- Builds nest of emergent vegetation;
- Feeds on arthropods during the breeding season and small fish on the wintering grounds;
- Solitary nesters; will nest in human-created habitat (e.g. farm dugouts, borrow pits).

Population trends

- Has been declining since the 1970s (BBS data*)
  - Long-term decline (1970-2017): -57.4%
  - Short-term decline (2007-2017): -27.9%
- Steepest declines in the Prairie Potholes Region (BBS data*), but lack of data in the Boreal;
- This decline is not observed on the wintering grounds (CBC data**)

*BBS: Breeding Bird Survey
**CBC: Christmas Bird Counts

Population trends

- The decline appears to have slowed down in recent years;
- Abundance in the high density areas of the Prairie Potholes Region correlated with wet/dry cycles in the Prairies (i.e. abundance of shallow ponds for breeding).

Threats to the Species's Survival (1/6)

Habitat loss

- Conversion of wetlands to agricultural lands;
- Climate change (dry climate reduces ponds availibility);
- Also other development projects such as residential developments and transportation corridors.

Threats to the Species's Survival (2/6)

Pesticides

- Decrease in prey availability or quality due to pesticide runoffs;
- Could lead to decrease in productivity (youngs fledged and their survival).

Threats to the Species's Survival (3/6)

Industrial effluents

- Mortality due to oil spills on migrating and wintering grounds (e.g. as high as 4,000 in 1976 in Chesapeake Bay);
- Contaminants such as DDE and PCB detected in egg shells;
- Furans detected adult birds.

Threats to the Species's Survival (4/6)

Fisheries bycatch

- Mortality due to fisheries bycatch on migration and wintering grounds.

Pathogens

- Mortality due to avian botulism

Threats to the Species's Survival (5/6)

Habitat disturbance and ecosystem modifications

- Increased nutrient and sediment loading can particularly affect small, shallow ponds;
- Cumulative impacts from different sources: livestock and ranching, agriculture, fire and fire suppression, oil and gas, mining and quarrying, logging and wood harvesting, and related infrastructure.

Threats to the Species's Survival (6/6)

Competition

- Loss of breeding habitat due to competition with other grebe species (e.g. Red-necked Grebe and Pied-billed Grebe)

Predation

- Increased predator abundance (e.g. raccoons, ravens)

Management Objective

- Over the next 30 years, maintain the Horned Grebe population level throughout its Canadian range at, or above, the average population levels of the last 30 years.

Conservation Measures (1/3)

Habitat conservation and stewardship

- Empower private landowners, through stewardship programs, to conserve and restore seasonal and semi-permanent wetlands;
- Support the adoption, implementation and enforcement of wetland conservation policies.
- Develop environmentally-responsible best practice guidelines for crop and livestock management that integrate conservation of seasonal and semi-permanent wetlands.
- Develop breeding habitat restoration guidelines (e.g. borrow pits, farm dugouts and stock ponds), particularly drought resilient habitat.

Conservation Measures (2/3)

Population monitoring and surveys

- Establish a long-term monitoring program of wetland bird species to track abundance and habitat use throughout the Horned Grebe's range, particularly in the boreal forest;
- Establish a monitoring program that compiles incidents, species and number of individuals affected by oil spills, fisheries bycatch, diseases and dry landing.

Conservation Measures (3/3)

Research

- Conduct research to understand connectivity between breeding, molting, staging and wintering grounds;
- Conduct research to understand dynamic between HOGR and competitive and predatory species;
- Conduct research to understand impacts of pesticides on wetland bird species.

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Summary of the draft Management Plan for the

HORNED GREBE
(WESTERN POPULATION)

Under the Species at Risk Act (SARA), a management plan must be developed for each species listed as Special Concern in order to identify measures for the conservation of the species. This document highlights the key sections of the draft management plan.

Horned Grebe pair © iStock.com/pum_eva

Species Conservation Status

The Horned Grebe, Western population (*Podiceps auritus*) is listed as Special Concern under SARA (since 2017).

Description and Distribution

The Horned Grebe is a relatively small waterbird weighting between 300 to 570 grams. Its breeding plumage is characterized by a distinctive patch of bright yellow feathers, which extends into tufts behind the eye. Its eyes are red and its neck and flanks are chestnut-red. In winter, the plumage is black (back) and white (belly), while the white cheeks contrast with a black crown.

In Canada, the highest known densities occur in the Prairie Potholes Region in southern Alberta, Saskatchewan and Manitoba. This species is also found in Yukon, the Northwest Territories, southern parts of Nunavut, east of the Coast Mountains in British Columbia and in northwestern parts of Ontario.

Habitat Needs

The Horned Grebe breeds in small, shallow, and usually fishless, perennial ponds with areas of open water surrounded by emergent vegetation, such as sedges, rushes, and cattails. Horned Grebes are usually solitary nesters, as well as opportunistic in their selection of a breeding site, as they will readily nest in human-created habitat.

Threats to the Species' Survival

- Habitat loss due to conversion of wetlands to agricultural land, climate change and the development of transportation corridors.
- Decreased productivity due to increase pesticide runoffs, which contaminate wetlands and limit invertebrate prey.
- Mortality from spills associated with natural resource extraction activities, fisheries bycatch during migration and on wintering grounds, and from pathogens, specifically avian botulism.
- Habitat disturbance due to increased nutrient and sediment loading from livestock and ranching; agriculture; fire and fire suppression; oil and gas; mining and quarrying; logging and wood harvesting; and the construction of related infrastructure.
- Breeding habitat loss due to other competitive grebe species and an increase in predator abundance (e.g. raccoons, ravens).

Canada

Management Objectives

Over the next 30 years, maintain the Horned Grebe population level throughout its Canadian range at, or above, the average population levels of the last 30 years.

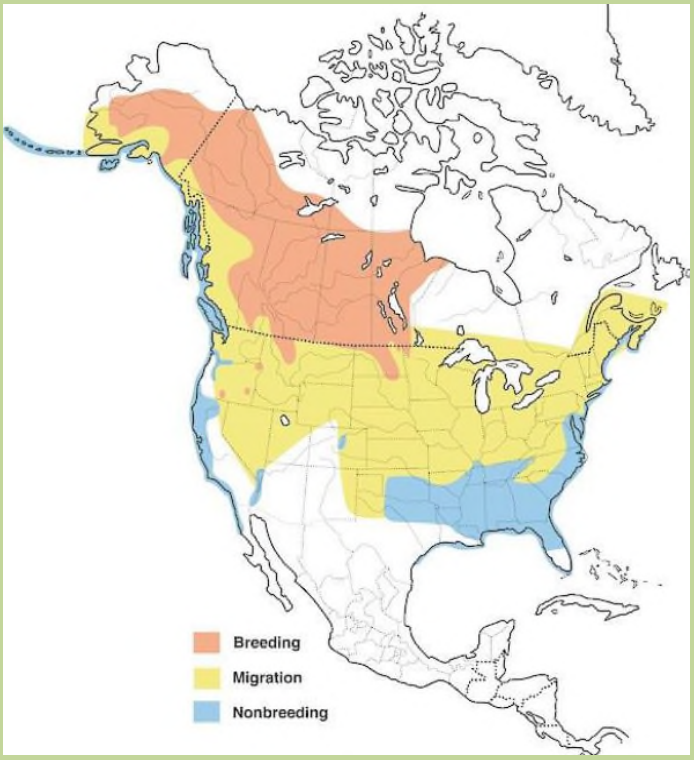
Strategies to Help Meet Objectives

Broad strategies to address the threats to the survival and recovery of the species include:

- Empowering private landowners, through stewardship programs, to conserve and restore seasonal and semi-permanent wetlands;
- Supporting the adoption, implementation and enforcement of wetland conservation policies;
- Developing environmentally-responsible best practice guidelines for crop and livestock management that integrate conservation of seasonal and semi-permanent wetlands;
- Developing breeding habitat restoration guidelines (e.g. borrow pits, farm dugouts and stock ponds), particularly drought resilient habitat;
- Establishing a long-term monitoring program of wetland bird species to track abundance and habitat use throughout the Horned Grebe's range;
- Establishing a monitoring program that compiles incidents, species and number of individuals affected by oil spills, fisheries bycatch, diseases and dry landing;
- Conducting research to understand connectivity between breeding, molting, staging and wintering grounds;
- Conducting research to understand dynamic between HOGR and competitive and predatory species; and
- Conducting research to understand impacts of pesticides on wetland bird species.

How You Can Help

- Learn more about the Horned Grebe, the threats to its survival and its habitat needs at *//www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html;*
- Practice voluntary stewardship activities and best management practices, for example:
  - Work in cooperation with Environment and Climate Change Canada and/or local conservation groups to conserve essential habitat; and
  - Avoid activities that could harm the species or its habitat.
- Submit observation data to conservation data centres (e.g., eBird).



Distribution of the Horned Grebe in North America (from Cornell Lab – Birds of North America's Website, Stedman, 2018)

Cover photos:
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You can also visit the following website for more information:
Species at Risk Public Registry (www.sararegistry.gc.ca)

DRAFT/PROPOSED

Species at Risk Act
Management Plan Series

Management Plan for the Horned Grebe (*Podiceps auritus*), Western population, in Canada

Horned Grebe, Western population

2020

Government of Canada
Gouvernement du Canada
Canada

Recommended citation:

Environment and Climate Change Canada. 2020. Management Plan for the Horned Grebe Western population (*Podiceps auritus*) in Canada [Draft]. *Species at Risk Act* Management Plan Series. Environment and Climate Change Canada, Ottawa. iv + 37 pp.

For copies of the management plan, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk (SAR) Public Registry[1].

Cover illustration: Horned Grebe pair © iStock.com/pum_eva

Également disponible en français sous le titre
« Plan d'action pour le Grèbe esclavon, population de l'ouest, (*Podiceps auritus*) au Canada » [Proposition] »

ISBN ISBN to be included by SARA Responsible Agency
Catalogue no. Catalogue no. to be included by SARA Responsible Agency

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

Preface

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

The Minister of Environment and Climate Change and Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Horned Grebe, Western population, and has prepared this management plan, as per section 65 of SARA. To the extent possible, it has been prepared in cooperation with the governments of Yukon, Northwest Territories, Nunavut, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, the Gwich'in Renewable Resources Board, the Sahtu Renewable Resources Board, the Wek'eezhii Renewable Resources Board and the Wildlife Management Advisory Council as per section 66(1) of SARA.

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

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

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

Acknowledgments

This management plan was prepared by Benoit Laliberté and Marc-André Cyr (Environment and Climate Change Canada, Canadian Wildlife Service [ECCC-CWS] – National Capital Region). Drafts were reviewed by and helpful insight provided by numerous people:

Christian Artuso (Bird Studies Canada – Manitoba), Stephanie Behrens (Government of Northwest Territories), André Breault (ECCC-CWS – Pacific Region), John Brett (ECCC-CWS – Ontario Region), Suzanne Carrière (Government of Northwest Territories), Kaytlin Cooper (Gwich'in Renewable Resources Board), Katherine Conkin (Government of Saskatchewan), Kiel Drake (Bird Studies Canada – Saskatchewan), Aimee Guile (Wek'eezhii Renewable Resources Board), Annie Larivière Clermont (ECCC-CWS – National Capital Region), Colin McDonald (Sahtu Renewable Resources Board), Ann McKellar (ECCC-CWS – Prairie Region), Rosemin Nathoo (Wildlife Management Advisory Council), Cynthia Pekarik (ECCC-CWS – National Capital Region), Julie Thomas (Government of Yukon), Joanna Wilson (Government of Northwest Territories) and Cindy Wood (ECCC-CWS – Northern Region).

Executive Summary

The Horned Grebe (*Podiceps auritus*) is a waterbird species found in Eurasia and North America. There are two populations in North America: the Western population and a small isolated population in the east (on the Magdalen Islands, Quebec). The Western population, which represents the bulk of the national population of the species, is the subject of this Management Plan.

The Horned Grebe, Western population, was identified as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2009 and has been listed as such in Schedule 1 of the *Species at Risk Act* in 2017. The IUCN (International Union for the Conservation of Nature) Red List increased the rank of the Horned Grebe from Least Concern to Vulnerable in 2015 because of ongoing population declines in North America and Europe (BirdLife International 2018). As a migratory bird, the Horned Grebe is protected in Canada under the Migratory Bird Convention Act and in the U.S., where most of the population winters, under the Migratory Bird Treaty Act.

The size of the North American population of Horned Grebes is estimated at 200,000 to 500,000 individuals, 92% of which breed in Canada (COSEWIC 2009). Although the species has experienced long-term declines, the rate of decline appears to have slowed down in recent years (COSEWIC 2009, Stedman 2018, Kirk 2004). The reasons for this apparent slow down is unclear, but could be due to recent favourable habitat conditions related to climate on the Prairies (i.e. “wet” years). While the Breeding Bird Survey data suggest a long-term decline, a new analysis from the Christmas Bird Count data (this report) shows that the continental population has been stable in the long-term. However, there are regional variations: the number of birds wintering along the West Coast is increasing, while populations wintering along the East Coast experienced a decline until the mid 2000s before increasing in recent years.

The exact causes for the decline of Horned Grebe are unknown, but likely result from a combination of a number of factors, including: i) wetland loss, degradation and modification, ii) climatic conditions affecting the availability of breeding habitat, iii) pollution (e.g. oil spills), iv) fisheries bycatch and v) contamination of wetland food chains by agricultural run-off and pesticides.

The management objective for the Horned Grebe is to stabilize population levels, over the next 30 years (2018-2048), and maintain them above the average population levels of the past 30 years (1987-2017), throughout the species’ Canadian range.

The broad strategies and conservation measures identified to achieve these objectives are: i) conserving and restoring Horned Grebe breeding habitat, ii) addressing key knowledge gaps regarding threats other than habitat loss, iii) understanding the connectivity between breeding and wintering grounds, iv) establishing a monitoring program suited to this wetland species.

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1. COSEWIC* Species Assessment Information

Date of Assessment: April 2009

Common Name (population): Horned Grebe – Western population

Scientific Name: *Podiceps auritus*

COSEWIC Status: Special Concern

Reason for Designation: Approximately 92% of the North American breeding range of this species is in Canada and is occupied by this population. It has experienced both long-term and short-term declines and there is no evidence to suggest that this trend will be reversed in the near future. Threats include degradation of wetland breeding habitat, droughts, increasing populations of nest predators (mostly in the Prairies), and oil spills on their wintering grounds in the Pacific and Atlantic Oceans.

Canadian Occurrence: Yukon Territory, Northwest Territories, Nunavut, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario

COSEWIC Status History: Designated Special Concern in April 2009. Assessment based on a new status report.

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

2. Species Status Information

The North American Horned Grebe population is divided into two distinct populations: the Western population, which comprises the bulk of the individuals across the continent, and a small long-standing breeding population on the Magdalen Islands in Quebec. The Western population is found breeding in Canada from the Yukon to the extreme northwestern part of Ontario, including British Columbia, Alberta, Saskatchewan, Manitoba, the Northwest Territories and the southern part of Nunavut. Approximately 92% of the North American breeding range of this species is in Canada, but the Horned Grebe's breeding ground extends from Alaska, in the north, to Montana and North Dakota, in the south (Stedman 2018).

Globally, the Horned Grebe, Western population's conservation status rank is G5 (Secure); but the status has not been assessed yet (NNR) for Canada or any of the provinces (SNR) where it occurs (NatureServe 2018). The IUCN Red List increased the rank of the global Horned Grebe population from Least Concern to Vulnerable in 2015 because of ongoing population declines in North America and Europe (BirdLife International 2018).

In Canada, the Western population was designated as Special Concern by the COSEWIC and was listed as such under Schedule 1 of the Species at Risk Act (S.C. 2002, c.29) in 2017, while the Magdalen Islands population is listed as Endangered since 2011. The Horned Grebe is also a migratory bird protected under the *Migratory Bird Convention Act,* 1994 and in the U.S. under the *Migratory Bird Treaty Act*. It is designated as a priority species in eleven Bird Conservation subregions[3] across Canada. Finally, at the national level, it is listed as a Tier 2 species in Canada's Waterbird Conservation Plan (Environment Canada 2003).

At the provincial and territory levels, it is considered as Sensitive in Alberta under the *Alberta Wildlife Act*. In Ontario, the Horned Grebe has been listed as Special Concern under the *Endangered Species Act* since 2009. In Quebec, the Magdalen Islands population is listed as Threatened under the *Loi sur les espèces menacées ou vulnérables* (L.R.Q. c. E-12.01), while it is designated as Special Concern in New Brunswick under the Species at Risk Act (O.C. 2013-143). The species is also listed on British Columbia's Yellow List, which means the species is at the least risk of being lost and this designation provides no legal protection.

3. Species Information

3.1. Species Description

The Horned Grebe is a waterbird weighting between 300 to 570 g (Stedman 2018). Its breeding plumage is characterized by a distinctive patch of bright yellow feathers which extends into tufts behind the eye. Its eyes are red and its neck and flanks are chestnut-red. Males and females are similar in colouration. In winter, the plumage is black (back) and white (belly), while the white cheeks contrast with a black crown. The chicks are semi-precocial and semi-nidifugous. They leave the nest hours after hatching and are looked after by the adults, who carry them on their back (Stedman 2018).

This species is known as Surilitchiaq in Inuvialuit, Nǫhta in Dene and Tagwaatsik by the Tetlit Gwich'in First Nation. The European subspecies is known as the Slavonian Grebe.

3.2. Species Population and Distribution

The Horned Grebe has a holartic distribution: it is found both in North America and Eurasia and it is represented by a different subspecies in each hemisphere. While the global population is estimated at 239,000–583,000 individuals (Wetlands International, 2012), the European subspecies, also called Slavonian Grebe (*P. a. auritus*) is estimated

[3] Northwestern Interior Forest, Pacific & Yukon Region (BCR 4), Boreal Taiga Plains, Northern Pacific Rainforest (BCR 5), Prairie & Northern Region (BCR 6), Taiga Shield and Hudson Plain, Prairie & Northern Region (BCR 7), Boreal Softwood Shield, Prairie & Northern Region and Ontario subregions (BCR 8-PNR and BCR 8-ON), Great Basin, Pacific & Yukon Region (BCR 9), Northern Rockies, Pacific & Yukon Region (BCR 10), Prairie Potholes (Prairie & Northern Region (BCR 11), Boreal Hardwood Transition, Ontario and Manitoba Region (BCR 12) and Lower Great Lakes/St. Lawrence Plain (BCR 13).

at 12,800-18,400 mature individuals (BirdLife International 2017), which means that the North American subspecies (*P. a. cornutus*) is by far more abundant.

3.2.1 Breeding distribution, abundance and trends

Approximately 92% of the North American breeding range of the Horned Grebe is in Canada (Figure 1). Horned Grebes are solitary nesters and they breed at relatively low densities, although their density depends on the availability of suitable nesting ponds. Based on the available Breeding Bird Survey (BBS) data, the known core breeding range (area of higher nesting densities) is located in the Prairie Potholes in southern Alberta, Saskatchewan and Manitoba, but the species is also found at unknown densities in boreal and subarctic zones, including in Yukon, the Northwest Territories and southern parts of Nunavut (Figure 2).

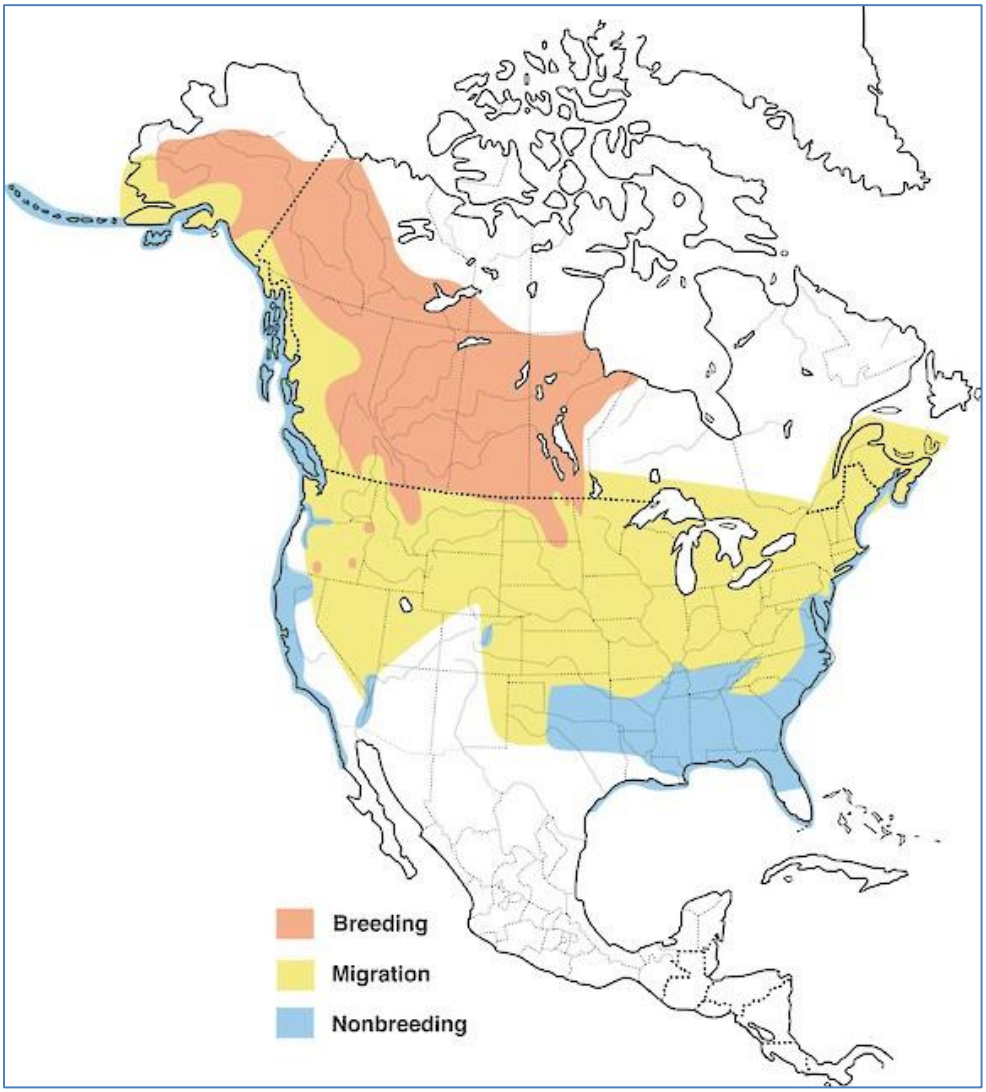

Figure 1. Distribution of the Horned Grebe in North America (from Cornell Lab - Birds of North America's Website, Stedman 2018)

In British Columbia, the species is distributed in sparse clusters east of the Coast Mountains, with the largest clusters located in the Peace River lowlands, the Cariboo plateau, and the Thompson-Nicola plateau (Howie, 2015).

In Ontario, the Horned Grebe is an irregular, even rare breeder in the extreme northwestern parts of the province, near the border with Manitoba. During the second Atlas of the Breeding Birds of Ontario, breeding evidence was reported in three locations (Opasquia Provincial Park, Pikangikum Lake and the Rainy River sewage lagoons) (Hoar, 2007).

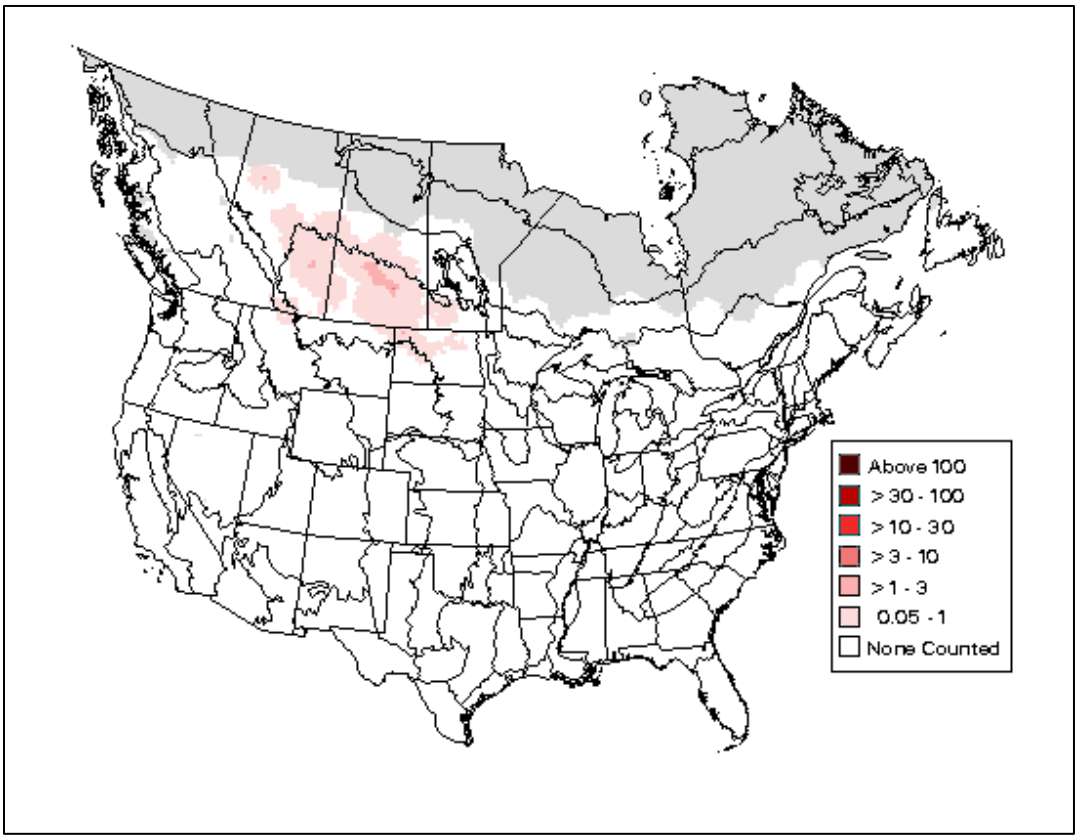

Figure 2. Relative abundance of the Horned Grebe in North America based on the Breeding Bird Survey from 2011 to 2015 (limited to southern parts of the range; areas in grey are areas where not enough data was available; Sauer et al. 2017)

3.2.1.1 Breeding Bird Survey (BBS)

The BBS provides long-term trends of breeding bird populations in Canada, and although its coverage is limited in the northern parts of the Horned Grebe's distribution (i.e. the boreal forest and interior British Columbia), this survey does inform about the status of the Horned Grebes in the southern parts of its range.

According to the BBS data, the Horned Grebe has been declining since 1970 (Table 1). In Canada, the probability that there has been a Canada-wide long-term (1970–2017) decrease is 98.3%. The rate of this decrease is estimated at -1.8%/year or -57.4% since

1970. In the most recent 10-year period (2007-2017), the probability that there has been a Canada-wide decrease is 92.3% and the rate of decrease is estimated at -3.2%/year or -27.9% since 2007 (Environment and Climate Change Canada 2017).

Table 1. National and regional annual percent population change (including 95% Confidence Intervals [CI]) for the Horned Grebe (Western Population) in Canada over the long and most recent 10 years, based on Breeding Bird Survey results.

Geographic area	Long-term trend (1970-2017)[a]				Most recent 10-years trend (2007–2017)			
	%/year	Lower CI	Upper CI	Overall reliability	**%/year**	Lower CI	Upper CI	Overall reliability
Canada	**-1.8***	-3.34	-0.495	Medium	**-3.22**	-8.46	2.02	Low
BCR-4 (Northwestern Interior Forest)	**-1.27**	-3.9	1.87	Low	**-1.17**	-8.25	7.62	Low
BCR-6 (Boreal Taiga Plains)	**-1.31**	-3.09	0.58	Low	**-1.27**	-7.99	3.62	Low
BCR-7 (Taiga Shield and Hudson Plains)	**-2.21**	-7.63	1.51	Low	**-2.04**	-12.3	8.58	Low
BCR-10 (Northern Rockies)	**-4.92***	-13.6	-0.411	Low	**-2.49**	-26.7	33.1	Low
BCR-11 (Prairie Potholes)	**-1.74**	-3.56	0.015	Medium	**-7.36***	-14.5	-0.807	Low

[a] Long-term trends range from 1970 to 2017, except for the Northwest Territories (1989–2017) and Yukon (1973–2017); *Significant trends
Source: Environment and Climate Change Canada (2017)

At the Bird Conservation Region (BCR) level, the most important declines in the “most recent 10-years” period are observed in BCR-11 (the Prairie Pothole Region or PPR). There, the rate of decrease appears to have accelerated with a significant trend of -7.36%/year (Table 1). However, there is high interannual variability in the PPR with years of high indices followed 2-3 years later by years of low indices (Figure 3) and this particularly affects the short-term trend (i.e. 2007 being a “peak” year and 2017 a “low” year).

The cycles observed in BCR-11 are related to wet/dry cycles and Figure 3 shows that the Horned Grebe BBS Annual Index is positively correlated with the number of May ponds (Pond Index). This suggests that on dry years, and hence when small ponds dry out, Horned Grebes may not be as abundant in the the PPR and may “flyover” the less suitable PPR region to nest in other areas, presumably further north. Such a strategy in adopted by some waterfowl species in the PPR (Roy et al. unpublished). However, there is insufficient data from the northern parts of the Horned Grebe’s breeding range to capture the extent of this potential flyover.

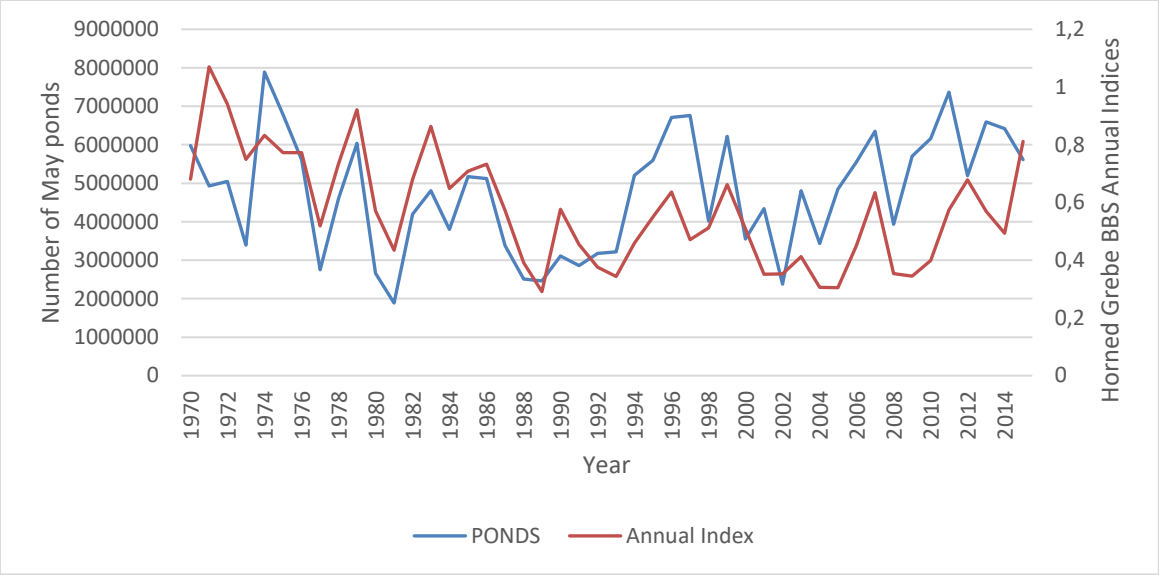

Figure 3. Correlation between the number of May Ponds (Waterfowl Habitat Population and Breeding Survey) and Horned Grebe annual indices (Breeding Bird Survey) in BCR-11 (Prairie Potholes).

Hence, taking into account that these cycles exist, the BBS data suggests that although a long-term decline has occurred in BCR-11 between 1970 and 1990, this decline appears to have slowed down since the early 1990s (Scott Flemming, CWS, unpublished data). This is also supported by the Canada-wide BBS 10 years rolling trends (Figure 4). The 10-year period trends are negative for most 10-year periods until the mid 2000s, with notable exceptions in 1983, 1998 and 1999. However, after 2005, there are a number of positive 10-year period trends, for example in 2007 and between 2011 and 2015.

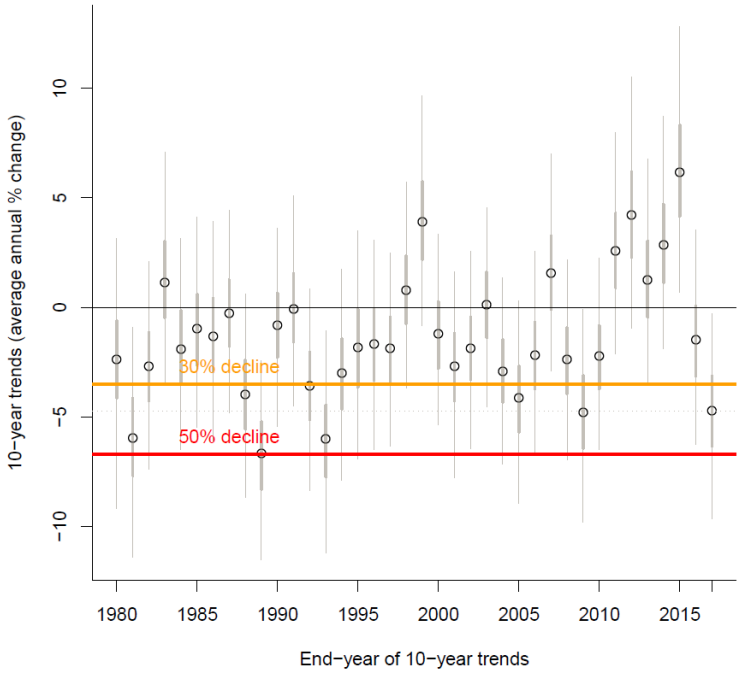

Figure 4. Rolling 10-years period trends for the Horned Grebe in Canada according to Breeding Bird Survey data (Environment and Climate Change Canada 2017).

The smoothed long-term BBS Annual Indices are presented in Figure 5, where the dips represent the drought cycles in the Prairies. The long-term trends are negative for BCR-10 and BCR-11, but it appears to have slowed down in BCR-11 since the early 1990s (but the effect of wet/dry cycles is still observed).

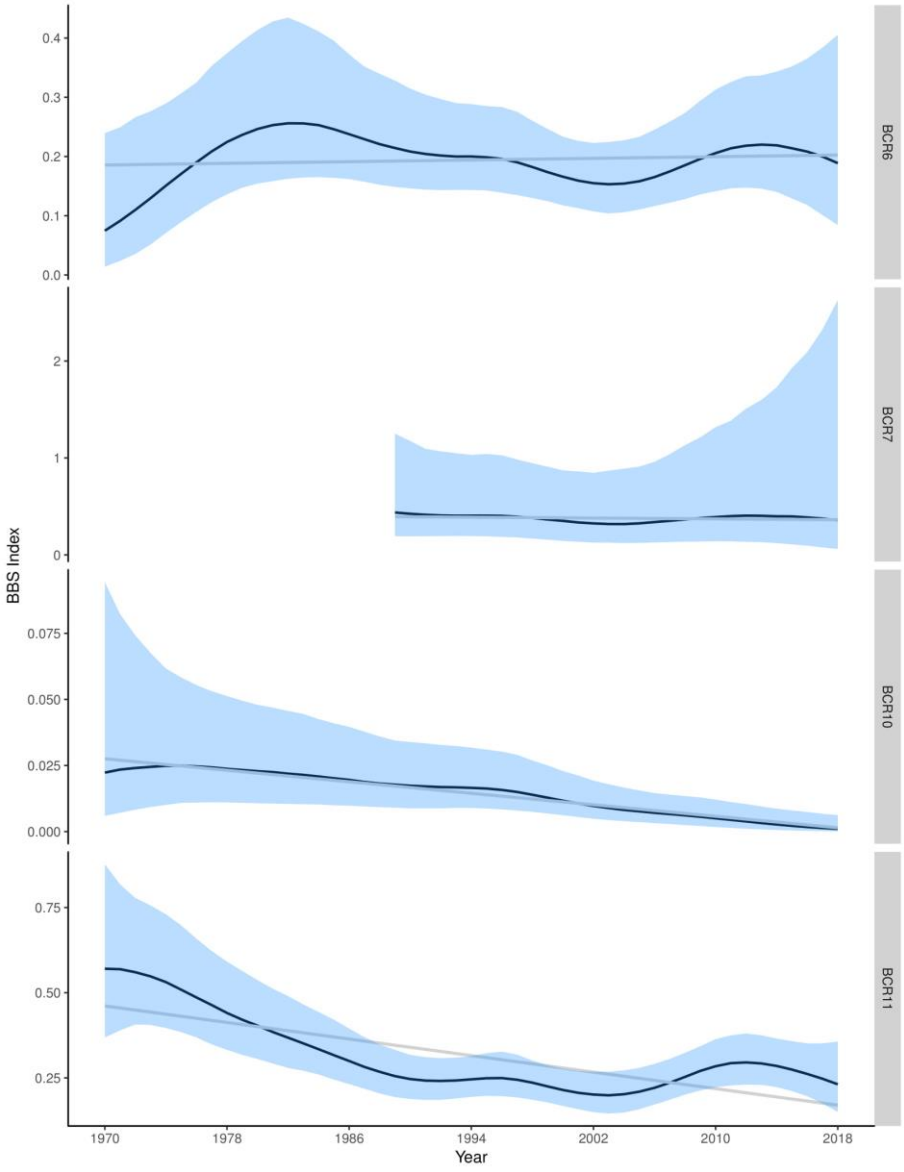

Figure 5. Breeding Bird Survey population indices for the Horned Grebe in four Bird Conservation Regions. Black lines represent population indices from generalized additive models using R package bbsBayes with confidence intervals in blue. Dips in BCRs 6 and 11 correspond to drought cycles in the Canadian Prairies. Grey lines represent population trajectory trend lines.

Additional caveats are that BBS routes may in general under-sample wetlands, and that BBS counts are conducted in June, a time of the year when Horned Grebes are less visible and less active vocally (e.g. during incubation). However, the BBS is the only data set available to estimate population trends across the breeding range.

3.2.1.1 Waterfowl Breeding Habitat and Population Survey (WHBPS)

The Canadian Wildlife Service added grebe counts in the ground survey component of the Waterfowl Breeding Habitat and Population Survey (WBHPS) and preliminary analysis were conducted for the period 2002-2012 (McKellar, unpublished). The WBHPS trend for that period was 20.2 [CI: 13.6 to 27.0], while the BBS trend was 2.1 [CI: -4.6 to 11.1]. Although Horned Grebe counts were higher in the WBHPS (3 972 individuals vs 347 for BBS during that time period) and this survey is conducted in May (a more appropriate seasonal timing for Horned Grebe), similar levels of precision with the BBS were observed (McKellar, unpublished). Thus, it would be necessary to add a grebe-specific protocol using active call broadcasts (Routhier et al. 2014) to obtain reliable abundance data.

3.2.2 Wintering distribution, densities and trends

Based on the last ten years (2008–2017) of the Audubon's Christmas Bird Counts (CBC), an average of 48% of Horned Grebes winter on the west coast of the continent, while 35% winter on the east coast (including Florida). Twelve percent (12%) of birds counted were reported in states located on the Gulf of Mexico, and 5% on inland waterbodies of south and southeastern states (e.g. northeastern Texas through as far north as central Maryland, including: Arkansas, Tennessee, Virginia, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana and Florida; National Audubon Society, 2019). In Texas, more Horned Grebes are found inland than on the coast (A. Wormington, pers. comm. 2014 *in* Kirk, 2014).

In Canada, the Horned Grebe winters on the coast and in the southern interior of British Columbia, on the coasts of Prince Edward Island, Nova Scotia and New Brunswick and occasionally on the lower Great Lakes (Godfrey, 1986).

3.2.2.1 Christmas Bird Count

In Canada, CBC data indicate that the numbers of Horned Grebes wintering in British Columbia (-1.49%/year) and Nova Scotia (-2.38%/year) have been declining since 1966 (National Audubon Society, 2019). It is not clear if this is due to an actual decline or a shift in wintering distribution.

At the continental scale (results from Canada and the USA combined; Figure 6), the population trend based on the CBC has been relatively stable since 1966 (+0.54%/year [CI: -0.43 to 1.92]), but there has been a slight increase in the past 10 years (2007–2017; +1.49%/year [CI: -1.69 to 5.79]).

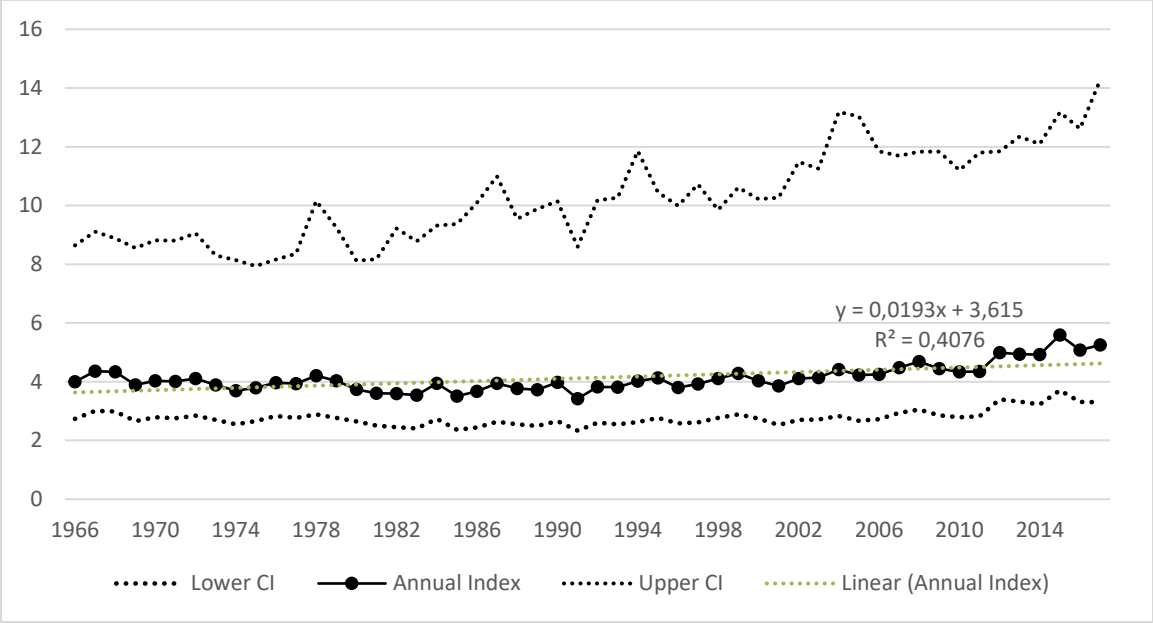

Figure 6. Long-term continental annual index of Horned Grebes from the Christmas Bird Count (1966–2017).

The relatively stable population trend suggested by the CBC data is somewhat contradictory to the results on the breeding grounds obtained from the BBS. However, a closer look at the different wintering areas (East Coast, West Coast, Gulf of Mexico and Interior) indicates important regional variations (Figure 7).

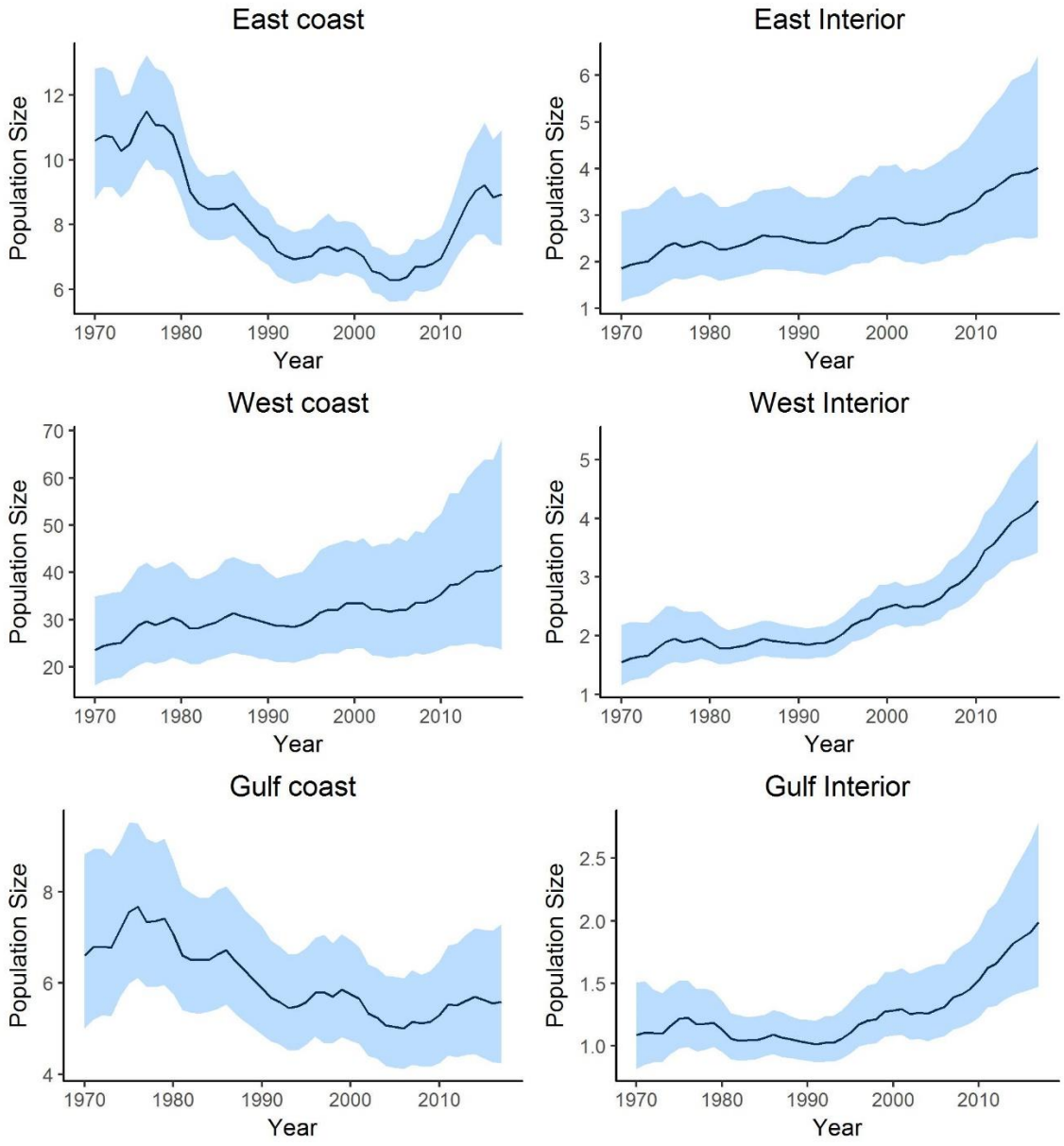

Figure 7. Predicted trends in the Horned Grebe Christmas Bird Count population index between 1970 and 2018 by regions. The original data (Soykan et al. 2018) have been smoothed with a state-space autoregressive population model that includes the effects major climatic drivers (SOI, AMO, Multivariate ENSO index) and the numbers of ponds in the Prairies potholes (C. Roy, CWS, unpublished data).

Based on the CBC, the number of birds wintering along the West Coast and in the Interior (which captures birds *not* wintering along the coast) are increasing, while the number of individuals wintering in the Gulf of Mexico and the East Coast are declining. Also, the number of Horned Grebes wintering along the East Coast declined until the late 2000s, but this trend has reversed in recent years. The number of Horned Grebes wintering there now reaches levels similar to what they were in the 1980s (Figure 7). Hence, populations wintering in different areas are fluctuating at different rates and directions, but although Horned Grebes winter in geographically distinct areas, these sub-populations appear to overlap on their breeding grounds.

3.2.3 Migration

After breeding, Horned Grebes move to larger lakes to undergo molt (Stout and Cooke 2003). Adult Horned Grebes molt wing-feathers simultaneously, which results in a flightless period of a few weeks, usually between July and October (Stedman 2018). Molting locations are largely unknown, but most birds molt away from breeding areas (Stout and Cooke 2003), although a few adults will molt on the breeding grounds (A. Breault, CWS unpubl. data).

During migration, Horned Grebe will stop on large lakes, rivers and wetlands. In Ontario, the average number of birds observed during migration peaks around mid-October in the Fall (highest count: 314) and mid-April in the Spring (highest count: 3,000) (Kirk 2014).

More research connecting breeding and wintering grounds is required, but the few Horned Grebe band recoveries that exist indicate that at least some birds breeding in the Prairies will winter along the East Coast (Figure 8).

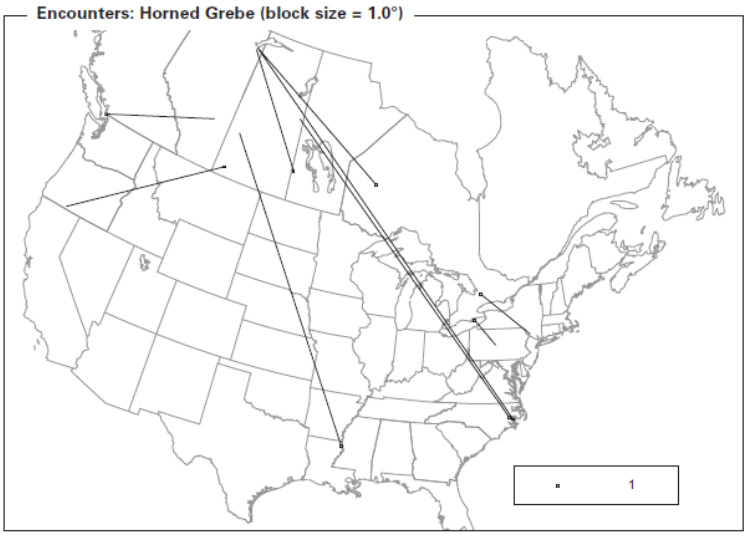

Figure 8. Recovery of banded Horned Grebes (from Dunn et al. 2009)

3.3. Needs of the Horned Grebe

3.3.1 Breeding season

The Horned Grebe breeds in small (generally 0.5 to 2 hectares, but ranging from 0.24 to 18.2 hectares), shallow (at least 20 cm deep, but on average 40 cm), and usually fishless, perennial ponds with areas of open water surrounded by emergent vegetation, such as sedges (*Carex* spp.), rushes (*Equisetum* spp.) and cattails (*Typha* spp.) (Faaborg 1976; Kuczynski et al. 2012; Routhier 2012; Stedman 2018). Ponds must contain at least 40% of open water and beds of emergent vegetation (COSEWIC 2009).

Horned Grebes are territorial and usually solitary nesters (Palmer 1962), but occasionally, more than one pair and even loose colonies will occur on larger ponds in highly productive habitats (Stedman 2018; Fjeldså 1973; Sugden 1977). Horned Grebes are also opportunistic in their selection of a breeding site and will readily nest in human-created habitat (Kuczynski et al. 2012; Hoar 2007; Fournier and Hines 1999).

Horned Grebes generally breed in their first year (COSEWIC 2009). During the breeding season, Horned Grebes will feed mainly on aquatic and some airborne arthropods (Stedman 2018). The reproductive success has been reported as 1.4 young/pair (range 0.6-2.0) in the Northwest Territories (Fournier and Hines 1999) and 2.75 young/pair in Manitoba (Ferguson and Sealy 1983). Youngs are semi-precocial and are fed by adults for the first few days after hatching (9–14 days), a period during which adults will carry youngs on their backs (Stedman 2018).

3.3.2 Migration and wintering periods

Horned Grebes migrate mostly at night (Stedman 2018) and will stop on large lakes, rivers and wetlands. During severe winters or storms, Horned Grebes might become stranded and be forced to dry land. They can also land in areas they mistakenly believe to be water bodies (e.g. mining tailing ponds, solar farms).

In winter, they are mostly found at sea, near coastlines and in bays along the Atlantic, Pacific and Gulf of Mexico coasts (del Hoyo et al. 1992; Stedman 2018), generally south of 38° N, where average January temperature is warmer than -1° C (Kirk, 2014). They will sometimes winter on lakes (Godfrey 1986) and more birds appear to be doing so recently which may be due to the creation of large freshwater reservoirs. On their wintering grounds, diet shifts to fish, crustaceans (especially amphipods and crayfish – at least in North America) and polychaetes (Stedman 2018).

4. Threats

4.1. Threat Assessment

The “Horned Grebe, Western population” threat assessment is based on the IUCN-CMP (International Union for the Conservation of Nature –Conservation Measures Partnership) unified threat classification system. Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational). Limiting factors are not considered during this assessment process. Historical threats, indirect or cumulative effects of the threats, or any other relevant information that would help understand the nature of the threats are presented in the Description of Threats section. The detailed Threat Assessment Calculator is also presented in Appendix B.

Table 2. Threat Assessment Calculator Summary

Threat		Impact	Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing
1	**Residential & commercial development**	Negligible	Negligible (<1%)	Slight (1-10%)	High (Continuing)
1.1	Housing & urban areas	Negligible	Negligible (<1%)	Slight (1-10%)	High (Continuing)
2	**Agriculture & aquaculture**	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)
2.1	Annual & perennial non-timber crops	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)
2.3	Livestock farming & ranching	Not a Threat	Negligible (<1%)	Neutral or Potential Benefit	High (Continuing)
4	**Transportation & service corridors**	Not a Threat	Negligible (<1%)	Neutral or Potential Benefit	High (Continuing)
4.1	Roads & railroads	Not a Threat	Negligible (<1%)	Neutral or Potential Benefit	High (Continuing)
5	**Biological resource use**	Low	Small (1-10%)	Extreme (71-100%)	High (Continuing)
5.4	Fishing & harvesting aquatic resources	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)
6	**Human intrusions & disturbance**	Negligible	Negligible (<1%)	Slight (1-10%)	High (Continuing)
6.1	Recreational activities	Negligible	Negligible (<1%)	Slight (1-10%)	High (Continuing)

Threat		Impact	Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing
7	**Natural system modifications**	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)
7.1	Fire & fire suppression	Unknown	Unknown	Unknown	High (Continuing)
7.3	Other ecosystem modifications	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)
8	**Invasive & problematic species, pathogens & genes**	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)
8.2	Problematic native plants and animals	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)
8.4	Pathogens & microbes	Negligible	Small (1-10%)	Negligible (<1%)	Moderate (Possibly in the short term < 10 yrs)
9	**Pollution**	Medium - Low	Large (31-70%)	Moderate - Slight (1-30%)	High (Continuing)
9.2	Industrial & military effluents	Low	Restricted - Small (1-30%)	Moderate - Slight (1-30%)	High (Continuing)
9.3	Agricultural & forestry effluents	Medium - Low	Large (31-70%)	Moderate - Slight (1-30%)	High (Continuing)
11	**Climate change**	Medium - Low	Large (31-70%)	Moderate - Slight (1-30%)	
11.4	Changes in precipitation & hydrological regimes	Medium - Low	Large (31-70%)	Moderate - Slight (1-30%)	Moderate (Possibly in the short term < 10 yrs)
11.5	Severe / Extreme Weather Events	Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)

[a] **Impact** – The degree to which a species is observed, inferred, or suspected of being directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g. if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

4.2. Description of Threats

The causes for the decline of the Horned Grebe, Western population, are unknown, but likely result from a combination of wetland loss and degradation due to agriculture, contamination by pesticides, the impact of climate change on hydrological regimes, pollution (e.g. oil spills), fisheries bycatch, increasing predation and competition from other grebe species and ecosystem modifications which alter water quality and turbidity.

1.1 Housing & urban areas

New residential developments near and around lakes can negatively impact grebes nesting habitat through habitat modification (e.g. removal of vegetation) and disturbance. In the Canadian prairies, new developments (including new roads, farm infrastructures, housing development and extraction activities) represented a small fraction (<6%) of the total area of wetlands lost between 1985 and 2001 (Watmough and Schmoll 2007). However, large parts of the Horned Grebe's breeding distribution is located is areas of relatively low human density, so the scope of this threat was considered negligible. Most ponds where this species breed are not usually the preferred waterbodies for housing development due to their size and depth. However, during dry years, ponds dry up and at risk of encroachment, particularly near settlements.

In Europe, Horned Grebes will abandon lakes with many summer houses and continuous human activity on the water during summer (Summers et al. 2009; J. Fjeldså, pers. communication *in* Stedman 2018). Kuczynski et al. (2012) also observed that Horned Grebes avoided ponds with human structures located inside ponds (e.g. docks, machinery) in Alberta.

2.1 Annual & perennial non-timber crops

The conversion of wetlands to agricultural land is deeply rooted in the landscape of the Prairies: up to 70% of the wetlands have disappeared in some areas since European settlement (Canadian Wetland Inventory 2008). Currently, more than 90% of wetlands show signs of alteration while the number of remaining pristine wetlands in the landscape is decreasing (Bartzen et al. 2010). Kuczynski et al. (2012) suggested that small pothole-type wetlands might have disappeared faster from the Prairie landscape than larger, natural wetlands, which might be too large to support Horned Grebes.

Between 1985 and 2001, wetland area in the Prairie Habitat Joint Venture (PHJV) decreased by 5% (228,500 ha of wetlands lost). 77% of wetlands lost were <0.25 ha in area. Wetland basin of >0.26 ha and <1 ha in size accounted for 19% of all complete losses, whereas basins >1 ha accounted for 4% of losses (Watmough and Schmoll 2007). During this period, the most common cover types replacing lost wetland area were annual cultivation (62%) and perennial grass (21%; Watmough and Schmoll 2007).

Despite ongoing habitat conservation and restoration efforts, it is estimated that approximately 152,000 acres of wetlands will be lost over the next 10 years in the PHJV

area (PHJV 2014a) and temporary and seasonal ponds are the most vulnerable to conversion to agriculture (Bartzen et al. 2010).

Considering the high abundance of Horned Grebes in the PPR and their preference for small (generally <2 ha), shallow wetlands, the threat of habitat loss and modification through agriculture is considered one of the major factors driving the declines of Horned Grebes.

2.3 Livestock farming & ranching

Livestock can impact wetlands in a number of ways. They use wetlands as a source of drinking water, defecating or trampling the surrounding vegetation, which increases nutrient and sediment loading. However, the impact of nutrient and sediment loading is covered in 7.3 Other ecosystem modifications.

Thus, livestock management was considered as an opportunity for potential benefit for the Horned Grebe if environmentally sounds management practices are adopted. These practices include, for example, fencing wetlands and maintaining riparian vegetation (Cox and Cullington 2009). Once these practices are adopted, the small ponds used by Horned Grebes are more likely to be retained and protected. Additionally, dugouts and farm ponds are often created to maintain a steady supply of water. The Horned Grebe will readily adopt human-made ponds, and so these water supply, if properly vegetated and naturalized, can also become potential habitat.

4.1 Roads & railroads

Transportation corridors including roads and railroads are generally considered as sources of habitat loss and fragmentation that can have a large cumulative impact in the boreal region (Webster et al. 2015). Although the impact of transportation corridors on Horned Grebe habitat has not been assessed, the small, shallow ponds and marshes on which they breed are vulnerable to alteration of hydrologic regime, sediment loading and direct wetland removal due to their shallow depth.

However, Horned Grebes are known to colonize and successfully raise broods on borrow pits created from soil removal in road construction (Fournier and Hines 1999; Kuczynski et al. 2012); therefore habitat loss during construction might be partially or completely compensated by the creation of new habitat. In a study conducted in Alberta (Kuczynski et al. 2012), Horned Grebe occupied 36% of constructed ponds and 74.5%-81.3% of these produced chicks. The borrow pits that were occupied were usually 0.6 ha to 2 ha with more emergent (73%) and riparian vegetation (80%) covering the pond periphery and exempt of beavers.

For this reason, roads are considered to have a neutral or potentially beneficial impact if proper borrow pit restoration guidelines are adopted. These guidelines should focus on creating ponds that are large and deep enough for Horned Grebes (even during drought years), and include a revegetation program.

5.4 Fishing & harvesting aquatic resources

Because of their diet specialization during migration and on their wintering grounds (i.e. fish), grebes are vulnerable to getting caught and drowning in fishing nets (Harrison and Robins 1992; Ulfvens 1989; Piersma 1988; Riske 1976). The COSEWIC report (2009) mentions that grebes are killed annually on the Great Lakes during both spring and fall migration and that grebe species are caught in gillnet fisheries in California (Mills et al., 2005). Bartonek (1965) estimated that 3,000 grebes (not identified at the species level) and loons were netted annually on the southern part of Lake Winnipegosis, Manitoba. In Europe, Zydelis et al. (2009) reported the order of magnitude of Slavonian Grebe (the European subspecies of Horned Grebe) reported as bycatch in the Baltic and North Seas as “tens”. This represents the mortality of approximately 1% (total wintering population of approximately 1,850), so the number of birds potentially affected in North America could be much higher than what has been reported in Europe, but evidence is lacking because bycatch mortality is not systematically reported.

On the Pacific coast, it is estimated that gill-net fishing is responsible for an annual bycatch of 12,085 (range 1,129–24,002) seabirds, but Horned Grebes were not reported as being taken (Smith and Morgan 2005; Ellis et al. 2013).

Additionally, fishery regulations and reduced fishing efforts have resulted in an overall decline of bycatch mortality of seabirds on the eastern (Regular et al. 2013) and western coasts of North America (Zydelis et al. 2013), which most likely reduced the impact of this threat on Horned Grebe. Although detailed data on Horned Grebe bycatch is lacking, this impact was scored as “low” because there is evidence that the species is vulnerable and individuals likely get caught on a yearly basis.

6.1 Recreational activities

In Europe, watercraft disturbance on grebes (including Slavonian/Horned Grebes) has been documented to impact reproductive success either by flushing birds from their nest or causing nest destruction through wave action (Ruddock and Whitfield 2007). However, grebes have also shown to adapt to disturbance from passing watercraft. This threat is probably limited on their Canadian breeding grounds due to the nature of their preferred habitat (i.e. fishless, small, shallow wetlands) which do not present a lot of interest to recreational boaters or anglers. Disturbance by watercraft is more likely to occur on their staging and wintering areas, particularly after the breeding season when they are moulting and are flightless (Stedman 2018). Specific information on the intensity of disturbance in North America is lacking, but this threat is generally considered marginal and was scored as “negligible”.

7.1 Fire & fire suppression

Forest fires can have a profound impact on the boreal forest (e.g. habitat destruction, changes in vegetation, run-offs of sediments, changes in nutrient cycles and hydrological

processes). With climate change, frequency and intensity of forest fires is predicted to increase (Amiro et al. 2003). Specific impacts of forest fires on Horned Grebes have not been studied and are likely the result of several indirect and cumulative impacts over the long-term. Additional research should provide insight on forest fire's impact on waterbirds and wetlands (particularly small, shallow wetlands). For this reason, this threat was scored as unknown.

7.3 Other ecosystem modifications

Horned Grebes are exclusively aquatic birds and rely heavily on waterbodies to feed, breed and molt. Any activity that could potentially affect hydrology (i.e. water quality) is likely to impact the Horned Grebe. Such activities include agriculture (e.g. fertilizer run-offs), oil & gas, mining & quarrying, logging & wood harvesting, and the construction of related infrastructure, such as roads, camps, pipelines, well pads, and cut lines. These activities are widespread throughout the Horned Grebe's distribution, and although their cumulative impact is unknown, they can increase nutrient loading (Bayley et al. 2012) by removing riparian vegetation, changing water flows and changing nutrient dynamic.

Horned Grebes use primarily eutrophic environments, so nutrient loading can be beneficial to a certain point by making small ponds more productive and increasing the abundance of macroinvertebrates which grebes eat. However, excessive eutrophication can be detrimental by decreasing water quality (Scheffer et al. 2001; Sánchez-Carrillo et al. 1999). For the Horned Grebe, an increase of water turbidity and aquatic plant growth reduces its ability to forage and a decrease in the amount of open water can make small ponds unsuitable for breeding.

Because Horned Grebes use small ponds and marshes for breeding, these are generally considered vulnerable to alteration of hydrologic regime and sediment loading due to their shallow depth (Scheffer et al. 2001; Bayley et al. 2012). The scope of this threat was estimated to be large because many activities might impact breeding ponds throughout the species' range, but the panel of experts also identified it as having a small severity over the next 3 generations.

8.2 Problematic native plants & animals

Native species that can cause issues for the Horned Grebe include competitive grebe species (Hammell 2017; Routhier 2012; Osnas, 2003; Shaffer and Laporte, 2003), such as the Red-necked Grebe (*Podiceps grisegena*) and the Pied-billed Grebe (*Podilymbus podicep*) and predators.

Smaller ponds are seldom occupied by more than one pair of breeding Horned Grebes and they rarely co-occur with another grebe species, so it is possible that competition limits the amount of suitable breeding habitat for the species. In Manitoba, both the Red-necked and Pied-billed Grebes can displace and even exclude Horned Grebes from the most productive breeding habitats (Hammell 2017; Osnas; 2003, Faaborg, 1976). Reasons underlying this apparent change are unknown, but according the BBS data, the

Red-necked Grebe population is increasing, while the Pied-billed Grebe population is stable or slightly declining.

Potential nest predators include mammals such as the raccoon (*Procyon lotor*), the American mink (*Neovison vison*) and the North American river otter (*Lontra canadensis*) and birds such as Common Raven (*Corvus corax*), American Crow (*C. brachyrhynchos*), Black-billed Magpie (*Pica hudsonia*), American Coot (*Fulica americana*) and various species of gulls (Stedman 2018; Perkins et al. 2005).

Raccoons have greatly expanded their range northwards over the course of the last century and are now widespread in the Canadian Prairies and even in the boreal forest (Larivière 2004; Latham 2008). Changes to habitat, such as conversion to cropland, is a contributing factor to a reduced nest success due to predation (Watmough and Schmoll, 2007; Sovada et al. 2001), so it is possible that Horned Grebes are facing an increased predation rate from raccoons.

For the 1970–2017 period, BBS trends show a substantial increase in Common Raven population in Canada (+2.47%/year [1.94–2.99]) with the greatest increases occurring in BCR-11 (+13.9%/year [12.6–15.1]), whereas American Crow and Black-billed Magpie actually show a stable or decreasing trend (Environment and Climate Change Canada, 2017).

The overall impact of competitive grebe species and the increase in predator abundance is considered low, but further studies are required to understand effects on Horned Grebe populations.

8.4 Pathogens & Microbes

Avian botulism is the most significant threat in terms of pathogens to waterfowl and shorebirds (Rocke and Bollinger, 2007). Horned Grebes are particularly vulnerable to Type E, which mostly affects fish-eating birds in the Great Lakes in Canada. Type E outbreaks in the Great Lakes were documented for the first time in the U.S.A. in 1963 (Rocke and Bollinger, 2007) and in Ontario in 1998 (Campbell and Barker, 1999; CWCH 2000). During some outbreaks, more than 10,000 fatalities have been reported, with Horned Grebe sometimes in the top 5 species affected (Chipault et al. 2015). Kirk (2014) also reports that “between 2004 and 2013, the USGS National Wildlife Health Center received reports of 660 known (2,304 estimated) dead Horned Grebes recovered on Great Lakes shores and associated with confirmed or suspect botulism type E mortality events in Wisconsin, Michigan, Pennsylvania, New York, and Ontario (J. Chipault, pers. comm. 2014)”.

The species could also be vulnerable to Type C (Smith 1977 *cited in* Rocke and Bollinger 2007), but to a lesser extent than Type E and than other species. In Canada, Type C mostly affects waterfowl in the Prairies (CWHC 2000). In the database maintained by the Canadian Wildlife Health Cooperative (2019), there are 9 records of botulism Type E in

Horned Grebe and 4 records of “unknown” botulism strain, which could be either Type C or E.

Invasive non-native species which could be intermediate hosts are a contributing factor to mortality associated with avian botulism. Zebra mussels (*Dreissena polymorpha*) and round gobies (*Gobius sp.*) are contributing factors to outbreaks of Type E botulism in Great Lakes fish-eating and mussel-eating birds (CWHC 2000).

Overall, the impact of pathogens & microbes on Horned Grebe is considered negligible, mostly because Type E outbreaks that can affect a large number of birds are unpredictable.

9.2 Industrial & military effluents

The increase of natural resources extraction activities leads to a higher risk of spills occurring in the environment, which could impact Horned Grebe. However, such incidents are likely to affect a small number of birds, since they are usually solitary nesters.

Tailing ponds are located across internationally important migratory corridors and pose a significant mortality risk for birds, including mass mortality events (Timoney and Ronconi, 2010). In 2008, approximately 1,600 ducks were found dead after landing on tailing ponds located on Syncrude Canada’s Aurora North tar sands mine (R. v. Syncrude Canada Ltd. 2010). A standardized monitoring program of tailing ponds produced by the oil sands mining industry was introduced in 2011 in the oil sands region of Alberta (St. Clair et al. 2013). Horned Grebes were reported as one of the species affected by tailing ponds and the number of Horned Grebes that landed on tailing ponds varied between year (2011-2016) from one to 263 (125 on average). However, the overall number of Horned Grebes that were oiled and died after landing on these was relatively low. It varied from one individual to a high of nine individuals in 2015 (St. Clair et al. 2012; St. Clair et al., 2013; Owl Moon Environmental Inc, 2014; Owl Moon Environmental Inc, 2015; Owl Moon Environmental Inc, 2016; Owl Moon Environmental Inc, 2017). However, data regarding the non-lethal effects on birds that survive after leaving tailing ponds is lacking.

Because of their higher trophic position in the food chain, grebes are vulnerable to bioaccumulation of contaminants. DDE (dichlorodiphenyldichloroethylene) and PCB (polychlorinated biphenyl) have been reported in Horned Grebe egg shells in Manitoba (Forsyth et al. 1994) and high levels of dioxins and furans were detected in Horned Grebe livers downstream of a pulp and paper plant in British Columbia (Vermeer et al. 1993).

Horned Grebes are also vulnerable to oil pollution on their wintering grounds and have been reported as casualties in many incidents. In the southern USA, 12.3% of 34,717 oiled birds killed in eight oil spills were Horned Grebes (del Hoyo et al. 1992). In 1976, an oil spill in Chesapeake Bay was responsible for the death of more than 4,000 Horned Grebes (Roland et al. 1977). On the Pacific coast, Horned Grebes are also regularly affected by oil spills: 78 oiled Horned Grebes were collected live and dead in California after the Cosco Busan oil spill (California Department of Fish and Game, 2008), 12 were

collected after the Selendang Ayu oil spill in Alaska (Industrial Economics, Inc. 2015) and 16 were collected during an oiling episode in the winter of 1997-98 in central California (Hampton *et al*., 2003). Following the Deepwater Horizon Spill along the Gulf Coast, a total of 4 unidentified grebes (2 oiled and 2 not visibly oiled) died (USFWS, 2011).

Overall, the number of Horned Grebe impacted by the oil spills described above are likely underestimates, as individuals may die offshore and may not be recovered. Even birds that do come ashore can die outside the search areas, are difficult to capture until they are dead, and once dead can easily be missed by searchers (Ford et al. 2009). The above figure only reflects the direct, short-term impact of the oil spills and do not take into account long term and cumulative effects. For example, the Horned Grebe population had not recovered from the Exxon Valdez spills even years after the event (Day et al. 1997; McKnight et al. 2008).

The large wintering area of this species in North America partially protects this population from catastrophic losses due to isolated, localized oil spills (Stedman 2018). For these reasons, the overall impact of Industrial & military effluents was scored as “low”, but mortality from oil spill incidents requires monitoring.

9.3 Agricultural & forestry effluents

There are two major types of run-offs that can impact Horned Grebes: fertilizers and pesticides. The former is covered under 7.3 Other ecosystem modifications. Pesticides have been documented to have a negative impact on invertebrates (Stehle and Schulz 2015) which can eventually impact grebes’ productivity.

In an agricultural landscape, pesticides are likely to contaminate some wetlands (through surface runoffs, leaching, spray-drift and wind erosion). The presence of a suite of pesticides, such as atrazine and glyphosate, has been documented in Prairie Pothole wetlands (Donald et al. 2001; Anderson et al. 2012; McMurry et al. 2016; Evelsier and Skopec, 2018). Although the impact of these pesticides on the Horned Grebe requires further research, they are generally considered as a threat to biodiversity, including birds (Mineau and Palmer 2013). Neonicotinoids are a group of pesticides that have received more attention in recent years.

First introduced in the 1990s, neonicotinoids are now the most widely used insecticide in the world (Douglas and Tooker 2015). Neonicotinoids are persistent insecticides that have the propensity to integrate water systems and can have negative impacts on aquatic invertebrates (Mineau and Palmer 2013; Anderson et al. 2015; Morrissey et al. 2015). This class of pesticide is widely used in the Prairies (Main et al. 2014), and although its impact on Horned Grebe has not been studied yet, it might contribute to a reduction in invertebrate prey availability, as well as contributing to sub-lethal effects on the species, such as a decrease in reproductive output (Main et al. 2014). Since information regarding how Horned Grebe are affected by pesticides is lacking, there is some uncertainty regarding the overall impact of this threat and it was scored as “low to medium”.

11.4 Changes in precipitation & hydrological regimes

Climate change is a complex phenomenon that is generally expected to lead to a warmer climate and changes in precipitation patterns. A climate change scenario where the combined effects of changes in temperature and precipitation lead to higher evapotranspiration would reduce the persistence of small ephemeral wetlands in the PPR (Millett et al. 2005; Werner et al. 2010), thus posing a significant threat to Horned Grebes. In fact, Horned Grebes already respond to wet/dry cycles in the PPR, where the May pond index is positively correlated with the BBS Annual Index (Roy and Laliberté, unpublished).

There is still considerable uncertainty regarding impacts of climate change on wetlands in western Canada, but some cumulative impacts are foreseeable. Warmer and drier climate could increase the frequency and intensity forest fires, cause the melting of the permafrost and the dessication of wetlands (Cheskey et al. 2011). Additionally, droughts are a contributing factor to ephemeral and semi-permanent wetland conversion to cropland (Bartzen et al. 2010). This impact was scored as “low to medium” because of the uncertainty about the climate trend over the next 10 to 15 years, but recognizing that it can have a significant impact on habitat.

11.5 Severe / Extreme Weather Events

Severe weather conditions can force Horned Grebes to land in areas where they are not able to take off again (e.g. dry landing). Stranded birds are frequently reported during migration and severe winters, but some “mass” dry landing episodes can occur following particularly severe storms, as shown in three documented cases in which 68, 75 and 124 individuals were forced to dry land (Hodgdon, 1979; Bell, 1980; Eaton, 1983). Storms will also create waves that can flood nests or kill adults (i.e. hail). Storm frequency (e.g. episodes of hail and tornadoes) are predicted to increase, although information is lacking to predict if this will have a significant impact on the population. Based on current information, this threat was considered to be negligible.

5. Management Objective

The management objective for the Horned Grebe is to maintain, over the next 30 years (2018-2048), population level throughout its Canadian range, at or above the average population levels of the last 30 years (1987-2017).

The species was designated as Special Concern because of population declines and the many threats it faces, particularly habitat loss and degradation. Although limited data is available in the northern parts of the breeding distribution, the BBS data suggests that the Canada-wide decline in ongoing, but slowing down. On the other hand, the latest analyses from the CBC suggest an overall relatively stable long-term trend, but the abundance of birds wintering along the East Coast has declined until the mid-2000s and subsequently increased, while it has increased along the West Coast.

Although the information from the two datasets (BBS and CBC) are somewhat contradictory, the species remains vulnerable to additional habitat loss, particularly to agriculture and especially in dry years in the Prairies, when semi-permanent wetlands are more vulnerable to conversion to agricultural lands. Hence, in the short-term, maintaining, restoring and creating breeding habitat, particularly in the Prairies, is crucial to maintaining Horned Grebe populations, while additional research is required to assess population trends in the northern parts of the breeding range, and to understand links between breeding and wintering grounds.

6. Broad Strategies and Conservation Measures

6.1. Actions Already Completed or Currently Underway

- A recovery strategy (2013) and an action plan (2015) were developed for the Horned Grebe, Magdalen Islands population. One of the action plan's approach is to support actions targeting the maintenance of the Western population to help ensure it remains abundant and thereby increases the probability of exchanges with the Magdalen Islands population.
- The Horned Grebe, Western population, is surveyed by the major monitoring programs in North America such as the BBS, the CBC and the WBPHS. Although these programs provide long-term trends, they are not specifically designed for secretive marsh birds and could be improved by the addition of marsh bird specific methodology (i.e. use of playbacks in the WBPHS ground survey components; Routhier et al. 2012).
- The Prairie Marsh Monitoring Program, which ran from 2008 to 2012, is a survey dedicated to marsh birds and employs playback call (although the Horned Grebe call is not used; Bird Studies Canada, 2018).
- In 2010, report to Parks Canada on seabirds identified Horned Grebe as a priority species for monitoring (Davidson, 2010).
- In 2014, the Ontario government released a provincial management plan for the Horned Grebe, Western population, that identified threats, population objectives and conservation measures for the species (Kirk, 2014).
- The Horned Grebe, including both Western and Magdalen Island populations, has been identified as a priority species in 18 BCR strategies which established population objectives and conservation measures.
- The Prairie Habitat Joint Venture developed habitat objectives, and conservation programs and partnerships for the Prairies Parklands (PHJV, 2014a) and the Western Boreal Forest (PHJV, 2014b). These plans establish programs and partnerships that address the threat of habitat loss and degradation facing the Horned Grebe, Western population, across its Canadian breeding range.
- The Multi-species Action Plan for Gulf Islands National Park Reserve of Canada and the Multi-species Action Plan for Gwaii Haanas National Park Reserve, National Marine Conservation Area Reserve and Haida Heritage Site identify the

recovery measures for Horned Grebe, Western Population that will be implemented in these protected heritage places.

- The Multi-species Action Plan for Riding Mountain National Park of Canada, currently under development, is also expected to identify recovery measures for the species.
- The Canadian Wildlife Health Cooperative actively monitors avian influenza mortality in a wide range of bird species including the Horned Grebe.
- Research has been conducted at the University of Alberta and data has been gathered in the Aspen Parkland (Moenting et al. unpublished) and the Peace River Parkland (Kuczinski et al. 2009).
- Bird landings and mortality on liquid impoundment facilities in the oil sand region of Alberta are monitored since 2011 through the Oil sands bird contact monitoring program (OSCMP).

6.2. Broad Strategies

The broad strategies of this management plan are as follows:

- Habitat conservation and stewardship
- Population monitoring and surveys
- Research

6.3. Conservation Measures

Table 3. Conservation Measures and Implementation Schedule

Conservation Measure	Priority	Threats or Concerns Addressed	Timeline
Broad Strategy: Habitat conservation and stewardship			
Empower private landowners, through stewardship programs, to conserve and restore seasonal and semi-permanent wetlands, particularly in the PPR.	High	IUCN Threat 2.1	2020-2030
Support the adoption, implementation and enforcement of wetland conservation policies.	High	IUCN Threat 2.1 and 9.3	2020-2050
Develop environmentally-responsible best practice guidelines for crop and livestock management that integrate conservation of seasonal and semi-permanent wetlands.	Medium	IUCN Threat 2.1 and 2.3 and 9.3	2020-2025
Develop breeding habitat restoration guidelines (e.g. borrow pits, farm dugouts and stock ponds), particularly drought resilient habitat.	High	IUCN Threat 3.1 and 4.1	2020-2025
Broad Strategy: Population monitoring and surveys			
Establish a long-term monitoring program of wetland bird species to track abundance and habitat use throughout the Horned Grebe's range, particularly in the boreal forest.	High	All	2020-2025
Establish a monitoring program that compiles incidents, species and number of individuals affected by oil spills, fisheries bycatch, diseases and dry landing.	Low	IUCN Threat 5.4, 8.4, 9.2 and 11.5	2020-2050
Broad Strategy: Research			
Conduct research to understand connectivity between breeding, molting, staging and wintering grounds.	High	All	2020-2030
Conduct research to understand dynamic between HOGR and competitive and predatory species.	Low	IUCN Threat 8.2	2020-2030
Conduct research to understand impacts of pesticides on wetland bird species.	Medium	IUCN Threat 9.3	2020-2030

[e] *"Priority" reflects the degree to which the measure contributes directly to the conservation of the species or is an essential precursor to a measure that contributes to the conservation of the species. High priority measures are considered those most likely to have an immediate and/or direct influence on attaining the management objective for the species. Medium priority measures may have a less immediate or less direct influence on reaching the management objective, but are still important for the management of the population. Low priority conservation measures will likely have an indirect or gradual influence on*

reaching the management objective, but are considered important contributions to the knowledge base and/or public involvement and acceptance of the species.

6.4. Narrative to Support Conservation Measures and Implementation Schedule

The conservation measures for the Horned Grebe, Western population, were developed to address all threats this species is facing, while putting more emphasis on the most important threats and addressing important knowledge gaps, such as breeding population trends in northern parts of its range and connectivity between breeding and wintering grounds.

The PPR has been identified as a focal region for conservation measures because it is an area of relatively high breeding densities where the most important threats occur (i.e. conversion of breeding habitat to agriculture, vulnerability of breeding habitat due to dryer climate and pollution by pesticides).

The most imminent threat to Horned Grebe in the PPR is the degradation and conversion of privately owned agricultural land. Small, shallow wetlands are more vulnerable to conversion to agriculture, particularly during dry years. The involvement of private land owners is thus crucial to implementing this management plan. Outreach and education regarding the importance of seasonal and semi-permanent wetlands as well as stewardship programs will support and empower private landowners to conserve, restore and create wetlands on their property. Farm dugout and water stock ponds can be used as nesting ponds if they are properly managed. Horned Grebes will readily breed in human-created habitats, such as borrow pits, farm dugout and water stock ponds. Restoration guidelines promoting habitat features preferred by the Horned Grebe (and other aquatic animals), such as maintenance of riparian and emergent vegetation, should be developed. Also, best management practices for livestock management will also support the protection of small wetlands by maintaining riparian vegetation and limiting disturbance and destruction by livestock.

Additionally, wetland conservation should be guided by larger frameworks which are typically of provincial jurisdiction. Wetland policies should be implemented in concert with relevant policy makers and include guidelines regarding the conservation of ephemeral wetlands.

Information about connectivity is essential to adopt more targeted conservation measures since populations breeding and wintering in different areas are fluctuating at different rates and directions. For example, the reasons behind the decline and subsequent increase of Horned Grebes wintering along the East Coast remain largely unknown. Understanding where these individuals breed would help reduce threats throughout their life cycle.

The BBS has, however, significant shortcomings as a tool to assess breeding population size and trends in Horned Grebes, particularly in large areas of its breeding range (i.e.

the boreal forest). Although existing programs could be improved to gather information on grebes in the boreal forest (i.e. the Waterfowl Breeding Population and Habitat Survey), a monitoring program targeting Horned Grebes and other mash-bird species is recommended to properly assess population trends. This program should be implemented to cover, as much as possible, the entire breeding range of the species.

A number of secondary threats affecting waterbirds (e.g. oil spills, fisheries bycatch, diseases and dry landing) have been identified, but in all these cases, data is currently collected on a case-by-case basis and seldom compiled at national or continental scales. Hence, the overall understanding of the impact of these threats is incomplete and potentially underestimated. Concerted and integrated monitoring programs are required to monitor these threats in the future.

Finally, the threats of pesticides and predators and competitive species are speculated to have a relatively important impact on Horned Grebes, but their impact on population dynamics remains mostly unknown. These should be the focus of future research effort targeting the Horned Grebe.

7. Measuring Progress

The performance indicators presented below provide a way to measure progress towards achieving the management objective and monitor the implementation of the management plan.

- The indicator of progress for population levels is a stable population over the next 30 years (2018-2048) that equals or exceeds the average population level of the past 30 years (1987-2017).
    - The population trend of Horned Grebes will be inferred using a combination of available data sources, including the Breeding Bird Surveys, the Christmas Bird Counts, the Waterfowl Breeding Population and Habitat Surveys and new survey data targeting wetland species once these are developed.
- The indicator of progress for the species' distribution in Canada is maintenance of the current distribution (based on 2007-2017 records).
    - The distribution of Horned Grebes in Canada will be measured using a combination of available data sources, including the Breeding Bird Surveys, eBird database, provincial breeding bird atlases and other surveys targeting wetland species once they are developed.

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Appendix A: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*[4]. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[5] (FSDS) goals and targets.

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

The Horned Grebe is a waterbird species nesting on small ponds and wetlands of the prairie and boreal ecoregions upon which many other species depend for nesting and feeding. Conservation measures aimed at conserving and restoring ecosystems are expected to alleviate threats for other wetlands species, such as the Olive-sided Flycatcher (*Contopus cooperi*), the Rusty Blackbird (*Euphagus carolinus*) and the Yellow Rail (*Coturnicops noveboracensis*), Western Tiger Salamander (*Ambystoma mavortium*), Western Toad (*Anaxyrus boreas*), Northern Leopard Frog (*Lithobates pipiens*), Great Plains Toad (*Anaxyrus cognatus*), non-inclusively. On wintering grounds, mitigating stresses related to fisheries bycatch and contamination is expected to benefit seabird species such as the Marbled Murrelet (*Brachyramphus marmoratus*), the Pink-footed Shearwater (*Puffinus creatopus*) and the Short-tailed Albatross (*Phoebastria albatrus*).

Although it is possible that this management plan may negatively influence other species, it is concluded that it is unlikely to produce significant negative effects, given the non-intrusive nature of the proposed actions and the abundant populations of potentially affected species.

[4] http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[5] www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1