

COSEWIC Assessment and Status Report

on the

Horned Grebe *Podiceps auritus*

Western population
Magdalen Islands population

in Canada



Western population – SPECIAL CONCERN
Magdalen Islands population – ENDANGERED
2009

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada



COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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COSEWIC Assessment Summary

Assessment Summary – April 2009

Common name

Horned Grebe - Western population

Scientific name

Podiceps auritus

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.

Occurrence

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

Status history

Designated Special Concern in April 2009. Assessment based on a new status report.

Assessment Summary – April 2009

Common name

Horned Grebe - Magdalen Islands population

Scientific name

Podiceps auritus

Status

Endangered

Reason for designation

The small breeding population of this species has persisted on the Magdalen Islands for at least a century. It has recently shown declines in both population size and area of occupancy. The small size of the population (average of 15 adults) makes it particularly vulnerable to stochastic events.

Occurrence

Quebec

Status history

Designated Endangered in April 2009. Assessment based on a new status report.



COSEWIC
Executive Summary

Horned Grebe
Podiceps auritus

Western population
Magdalen Islands population

Species information

The Horned Grebe (*Podiceps auritus*) is a member of the *Podiceps* genus. There are two known subspecies of the Horned Grebe: (*P. a. auritus*), which breeds in Eurasia, and (*P. a. cornutus*), which breeds in North America. The Horned Grebe is a relatively small waterbird with breeding plumage characterized by a patch of bright buff feathers behind the eye, which extends into tufts that contrast with its black head.

The present status report covers two designatable units of *P. auritus* that breed in Canada, the Western Population, which includes birds breeding from British Columbia to northwestern Ontario, and the Magdalen Islands Population, which includes a long-standing breeding population found on the Magdalen Islands in Quebec. The birds of these two populations show some genetic differences and their breeding ranges are separated by more than 2,000 km. Birds from both populations may, however, overlap on the wintering grounds on the east coast of Canada.

Distribution

Approximately 92% of the North American breeding range of the Horned Grebe is in Canada. It breeds in British Columbia, Yukon, the Mackenzie River Valley in the Northwest Territories, the extreme southern part of Nunavut, all of the Prairies, northwestern Ontario and the Magdalen Islands (Quebec), where a small isolated population has been breeding for at least a century. In the United States, it breeds in central and southern Alaska, as well as locally in some northwestern states. Most of the North American population winters along the coasts of the continent.

Habitat

The Horned Grebe breeds primarily in temperate zones such as the Prairies and Parkland Canada, but can also be found in more boreal and subarctic zones. It generally breeds in freshwater and occasionally in brackish water on small semi-permanent or permanent ponds, but it also uses marshes and shallow bays on lake borders. Breeding areas require open water rich in emerging vegetation, which provides nest materials, concealment and anchorage, and protection for the young.

Biology

The Horned Grebe is generally a solitary nester, although it can nest in loose colonies if the breeding pond is sufficiently large and there are abundant food resources. The Horned Grebe is aggressive when defending its territory, rarely leaving its nest unguarded. Its diet consists primarily of aquatic insects and fish in the summer, and fish, crustaceans and polychaetes in the winter.

Population sizes and trends

The Western Population of the Horned Grebe is estimated at between 200,000 and 500,000 individuals, with most of the birds found in Saskatchewan and Alberta. Long-term trend analyses based on Christmas Bird Counts show a significant decline of 1.5%/year between 1966 and 2005. At this rate of decline, the population will have decreased by approximately 45% since the mid-1960s. Short-term trend analyses based on the same survey methods show a significant annual rate of decline of 1.25%/year between 1993 and 2005 (three generations). At this rate, the population will have decreased by 14% over the last three generations.

The Magdalen Islands Population in Quebec is estimated at an average of 15 adults. Since 1993, no more than 25 adults have been seen during the same breeding season and only five adults were observed in 2005. Analyses based on annual surveys on the Magdalen Islands suggest that the population has declined by approximately 22% over the last three generations.

Limiting factors and threats

Permanent loss of wetlands to agriculture and development threaten Horned Grebe populations. Temporary loss of wetlands during droughts can also negatively impact Horned Grebe populations, as can eutrophication and degradation of nesting sites from the accumulation of fertilizers used in agriculture. The expansion of predators on the Prairies, Type E Botulism on the Great Lakes and oil spills on the wintering grounds can also threaten Horned Grebe populations.

The very small size of the Magdalen Islands Population makes it vulnerable to demographic, environmental and genetic factors.

Special significance of the species

Horned Grebes occupy the upper trophic level and all of their life stages are tied to water. They may, therefore, be useful indicators of changes in wetland habitat. Furthermore, their striking nuptial plumage, spectacular courtship displays and approachable nature make them popular among bird watchers and ecotourists. On the Magdalen Islands, and by extension in eastern Canada, this small population is unique among the natural heritage.

Existing protection or other status designations

Both the Northern Prairie and Parkland Waterbird Conservation Plan and the North American Waterbird Conservation Plan (NAWCP) have identified the Horned Grebe as a species of high concern. Canada's Waterbird Conservation Plan (*Wings Over Water*) placed the Horned Grebe population in the "Moderate concern" category. NatureServe, considers the Horned Grebe as globally abundant, widespread and secure in the United States and Canada. However, the species is ranked as vulnerable in Alberta and Washington State, imperiled in Oregon, South Dakota and Minnesota and critically imperiled in Idaho, Ontario and Quebec.

The species is protected under the *Migratory Birds Convention Act*, 1994. Given the precariousness of the Magdalen Islands population in Quebec, the Horned Grebe was designated as a threatened species under Quebec's *Act Respecting Threatened or Vulnerable Species* in 2000. However, this designation does not offer any protection to the species' breeding habitat.



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 (2009)

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

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

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

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



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COSEWIC Status Report

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Horned Grebe *Podiceps auritus*

Western population
Magdalen Islands population

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SPECIES INFORMATION

Name and classification

Order: Podicipediformes
Family: Podicipedidae
Genus: *Podiceps*
Species: *auritus*
Subspecies: *cornutus*

English name: Horned Grebe
French name: Grèbe esclavon
Other English names: Slavonian Grebe, Hell-diver
Other French name: Grèbe cornu

The Podicipedidae family contains seven genera and 22 species (Fjeldså, 2004). The *Podiceps* genus consists of eight species, three of which breed in Canada: the Red-necked Grebe (*P. grisegena*), Eared Grebe (*P. nigricollis*) and the Horned Grebe (*P. auritus*) (Vlug and Fjeldså, 1990; American Ornithologists' Union, 1998). There are two known subspecies of the Horned Grebe: *P. a. auritus*, which breeds in Eurasia, and *P. a. cornutus*, which breeds in North America (Vlug and Fjeldså, 1990).

Morphological description

The Horned Grebe is a relatively small waterbird (length: 31-38 cm; weight: 300-570 g) (Stedman, 2000), with a short, straight bill with a pale tip. Its breeding plumage includes a distinctive patch of bright buff feathers behind the eye, extending back to the nape of the neck and contrasting sharply with its black head. Its foreneck, flanks and upper breast are chestnut-red, while its back is black and its belly white. Males and females are similar in colouration, although the plumage of the male tends to be brighter (Godfrey, 1986; Stedman, 2000). Its eclipse plumage is black and white and characterized by a black crown and white cheeks, which extend almost around the nape (Stedman, 2000). The juvenile plumage is similar to that of adults in winter, but the upper parts are tinged brown. The demarcation between the black crown and white cheeks is also less defined and the bill is paler (Cramp and Simmons, 1977; del Hoyo *et al.*, 1992). Chicks have dark stripes, which are particularly visible on the head and neck (Storer, 1967). *P. a. auritus* is generally darker than *P. a. cornutus*, which has light grey feather edges on the back that are inconspicuous or even absent in *P. a. auritus* (Parkes, 1952).

Genetic description

Based on juvenile plumage and courtship displays, the Horned Grebe is believed to be most closely related to the Red-necked Grebe and Great Crested Grebe (*P. cristatus*) (Stedman, 2000). Other phylogenetic analyses suggest that the Horned Grebe is most closely related to the Red-necked Grebe followed by the Great Crested Grebe (Fjeldså, 2004).

A genetic study of the Horned Grebe was carried out using samples from 128 individuals in six Canadian provinces or territories (British Columbia, Alberta, Manitoba, Yukon, Northwest Territories and Magdalen Islands (Quebec)) and in Iceland (Boulet *et al.*, 2005). Three types of genetic markers were used: mitochondrial (mt) DNA, the intron of the α -enolase gene and amplified fragment length polymorphism (AFLP).

According to phylogenetic analyses based on mtDNA, the Horned Grebes of Iceland and North America (including the Magdalen Islands) form a single phylogenetic group. The mtDNA haplotypes form a classic “star-shaped” haplotype network (Figure 1), the pattern expected if all populations descended from a single ancestral population that grew fairly rapidly (or alternatively that experienced a selective sweep in mtDNA) (D. Irwin and V. Friesen, pers. comm. 2009).

The Horned Grebe nonetheless demonstrates significant differentiation in its global population at the mtDNA level and in AFLP. Moreover, the moderate but significant genetic differentiation observed in mtDNA is well distributed between the two subspecies (i.e. between Iceland and the other North American sites; 15.7% of variance) and among the three disjunct parts of the range that were analyzed separately (western North America, Quebec, Iceland; 25.6% of variance). Conversely, no significant genetic variation has been observed among sites located in western North America. From the frequency of haplotypes observed (mtDNA), the Quebec population has been identified as being the most divergent after the Iceland population (Table 1 and Figure 2) (Boulet *et al.*, 2005).

Results from the AFLP analysis suggest four distinct groups: Iceland, Quebec, British Columbia and the west central sites (Alberta, Manitoba, Yukon and the Northwest Territories); Iceland shows the highest level of differentiation, followed by Quebec and British Columbia (Boulet *et al.*, 2005). Results from the analysis of the intron of the α -enolase gene, however, show no evidence of genetic differentiation based on subspecies or according to disjunct areas of the range.

Hence, the Magdalen Islands population would not be “demographically connected” to the population that breeds in Iceland, but certain indices suggest that there may be genetic exchanges with western North American populations. Boulet *et al.* (2005) state that they recorded possible demographic connectivity between Quebec and western North America. It is difficult to precisely estimate the point at which Horned Grebes established themselves on the Magdalen Islands and when the last genetic exchanges with the other population took place. The Magdalen Islands population may

be of fairly recent origin (end of the 19th century), like the population in Scotland around 1908 (Fjeldså, 1973a), but they may also be a vestige of the population that bred on the continental shelf during the Pleistocene glaciation and which would have been subject to a relatively recent genetic influx from the other regions (Boulet *et al.*, 2005).

Table 1. Paired values of differentiation indices (Fst) calculated between populations of the Horned Grebe surveyed on the basis of three markers (mtDNA, enolase intron and 25 AFLP loci). Source: Boulet *et al.* (2005).

	Alta. (n=13)	B.C. (n=11)	Man. (n=10)	N.W.T. (n=14)	Y.T. (n=12)	Que (n=15)
B.C. (mt)	-0.02					
(enol)	0.00	-				
(AFLP)	0.03					
Man. (mt)	-0.03	-0.02				
(enol)	-0.03	0.01	-			
(AFLP)	-0.02	0.04*				
N.W.T. (mt)	-0.02	0.00	0.00			
(enol)	-0.03	-0.02	-0.02	-		
(AFLP)	0.02	0.05*	0.03			
Y.T. (mt)	-0.01	0.00	-0.01	-0.02		
(enol)	0.06	-0.02	0.06	0.01	-	
(AFLP)	0.00	0.03	0.01	-0.01		
Que (mt)	0.30*	0.17**	0.22**	0.28*	0.42*	
(enol)	-0.03	0.03	-0.03	-0.01	0.09	-
(AFLP)	0.04*	0.04*	0.02	0.05*	0.01	
IC (mt)	0.22*	0.19*	0.15*	0.21*	0.27*	0.49*
(enol)	0.03	-0.02	0.02	-0.01	-0.02	0.05
(AFLP)	0.07*	0.10*	0.08*	0.08*	0.04*	0.11*

The * symbol corresponds to a significant difference after Bonferroni's adjustment (mtDNA) or after 1000 random (AFLP) randomizations, and the ** symbol corresponds to a value of $P < 0.05$, but is non-significant after adjustments.

Designatable units

This report covers two designatable units of *P. a. cornutus* that breed in Canada, the Western Population, which includes birds breeding from British Columbia to the extreme northwestern part of Ontario, and the Magdalen Islands Population, which includes birds breeding on the Magdalen Islands (Quebec) and any other sporadic breeders that occur in Quebec. The latter is the only known breeding population in eastern North America and has been well established for at least 100 years.

The rationale for separating the species into two designatable units is based on three criteria. First, there is a natural disjunction in the range of the two units, with more than 2,000 km separating the population on the Magdalen Islands from the nearest populations in Manitoba and northwestern Ontario. Secondly, the populations occupy different eco-geographic zones. Finally, the significant differences in allele frequencies based on mtDNA and AFLP markers between the Magdalen Island population and most of the Western Population suggest some genetic divergence between the two populations (Table 1).

The wintering grounds of the Magdalen Islands Population are unknown, however, it is possible that the two units overlap on the wintering range. If so, some genetic mixing between the two populations could occur.

There is no information on whether the populations show differences in morphology, life history or behaviour.

DISTRIBUTION

Global range

The Horned Grebe is found across Eurasia and North America. In Eurasia, it breeds in a few isolated areas in Iceland, northeastern Scotland, northwestern Norway and extensively (generally between the 50th and 65th parallels north) from southeastern Norway and central Finland to Siberia and southward of central Russia, Lake Baikal, Kamchatka and the extreme west end of China. It is a rare breeder in Greenland and an occasional breeder in the Faroe Islands (Fjeldså, 1973a; O'Donnel and Fjeldså, 1997; Stedman, 2000). Its breeding range in North America is restricted to the northwest part of the continent and is located primarily in Canada (Figure 3), with the core of the population breeding in the Prairies. In the United States, it breeds in central and southern Alaska and locally in a number of northwestern states, namely Washington, Idaho, Montana, North Dakota, South Dakota (irregularly) and Minnesota (irregularly). Some individuals also breed sporadically in certain parts of Oregon (American Ornithologists' Union, 1998; Stedman, 2000).

Winter range

In Eurasia, the species winters mainly on the coasts from Iceland, the British Isles and Norway to the Mediterranean, the Black Sea and the Caspian Sea. In Eastern Asia, the birds winter along the coasts of Japan, Korea and China (Fjeldså, 1973a; Cramp and Simmons, 1977; American Ornithologists' Union, 1998).

In North America, the Horned Grebe winters on the Pacific coast from the Aleutians and south coastal Alaska to northern Baja California (Stedman, 2000). It also migrates overland, following the Mississippi Valley or the Atlantic migration corridors to winter on the Atlantic coast and in the Gulf of Mexico. Many also winter on inland bodies of water (Root, 1988; Stedman, 2000). Based on Christmas Bird Counts (CBC) from 1964 to 2005 for the United States and Canada, an average of 41% of Horned Grebes winter on the west coast of the continent, while 47% winter on the east coast (including Florida) (National Audubon Society, 2006). Only 6% of birds counted were reported in states located on the Gulf of Mexico (Texas, Louisiana, Mississippi and Alabama), and 6% in other inland states of the continent.

The wintering grounds of the Magdalen Islands Population are unknown, but it is presumed that the birds winter along the Atlantic coast of North America.

Canadian range

Approximately 92% of the North American breeding range of the Horned Grebe is in Canada. It breeds from British Columbia to extreme northwestern Ontario. The range includes Yukon, the Mackenzie River Valley in the Northwest Territories, extreme southern Nunavut, all of the Prairies, where it is most abundant, and a disjunct population on the Magdalen Islands (Sugden, 1977; Godfrey, 1986; Stedman, 2000).

In British Columbia, it is considered a rare summer visitor along the coast, whereas it is a widespread breeder east of the coastal mountains. It also occurs in all interior valleys, on the south-central high plateaus, in the Peace River lowlands and in the northern portion of the province. The highest abundances are found in the Chilcotin-Cariboo Basin and the Thompson-Okanagan Plateau regions (Campbell *et al.*, 1990).

In Yukon, it is a common to uncommon breeder north to Old Crow Flats. In the Northwest Territories (NWT), the Horned Grebe nests in low densities throughout much of the boreal and subarctic regions. The highest documented densities (>4 birds/km²) have been observed in the southern NWT. Average grebe population densities throughout the rest of the boreal and subarctic NWT are apparently much lower (probably less than 0.1 bird/km² overall) (Stotts, 1988; Fournier and Hines, 1999; Canadian Wildlife Service, 2007a).

In Alberta, the Horned Grebe breeds in the Prairie-parkland ecological region, where it was detected in 31% of the first Atlas of Breeding Birds survey squares. It also bred in the Boreal Forest (21% of the squares), Prairies ecological region (10% of the

squares), the Rocky Mountain foothills (5% of the squares) and in the Rockies (3% of the squares) (Semenchuk, 1992). The second Atlas (Semenchuk, 2007) suggests that the distribution of Horned Grebe has decreased in the northwestern part of the province. The second edition also indicated that Horned Grebes were most often found in the Grassland and Parkland and were found only occasionally in the Boreal Forest, Foothills, and Rocky Mountain (Semenchuk, 2007).

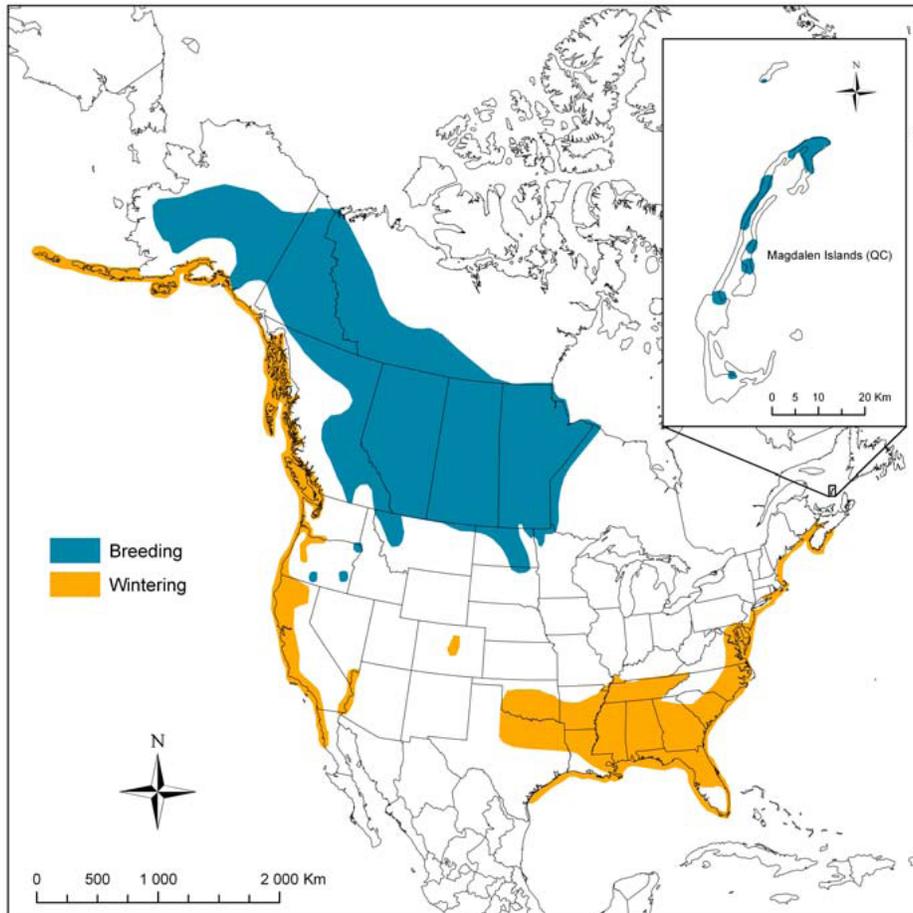


Figure 3. Breeding and winter ranges of the Horned Grebe (*P. auritus*) in North America. Adapted from Stedman (2000).

In Saskatchewan, the Horned Grebe is a common summer resident in the Prairie-parkland and Prairie ecological regions, but less common and localized in the boreal and subarctic regions (Smith, 1996).

In Manitoba, the Horned Grebe breeds throughout the province with the exception of certain eastern regions. It is probably more common in the Minnedosa region, but its abundance in the Prairie region fluctuates according to the water level. The species is generally less abundant in summer in the southeastern part of the province. Some individuals breed in Churchill, mainly in marshes near Akudlik and in the Goose Creek region (Holland and Taylor, 2003).

In Ontario, the Horned Grebe appears to be an irregular, rare breeder. Records of the species before 1938 suggest that it may have occasionally bred in the southern part of the province (Peck and James, 1983; Godfrey, 1986). Work carried out for the first Ontario Breeding Bird Atlas (1981-1985) confirmed Horned Grebe breeding at only one site, which was in the extreme northwestern part of the province (i.e. Fort Severn near Hudson Bay), but there was no evidence of breeding in this area in the second Ontario Breeding Bird Atlas (2001-2005). The second Ontario Breeding Bird Atlas did find breeding evidence from northwestern Ontario adjacent to Manitoba (Opasquia Provincial Park, Pikangikum Lake and the Rainy River sewage lagoons) (Hoar, 2007).

In Quebec, the species breeds annually, but only on the Magdalen Islands, where a small population has been breeding for at least a century (Young, 1897; Shaffer and Laporte, 2003). On this 202-km² archipelago, the Horned Grebe is found primarily in the northeastern portion, East Point, the North Dune and the furrows of the South Dune. It also breeds at Brion Island and has previously bred at Baie du Portage (Shaffer and Laporte, 2003). The species breeds sporadically elsewhere in Quebec. Rare breeding records date back more than 40 years, coming from Lake Gamache on Anticosti Island in 1919 (Lewis, 1924; Ouellet, 1969), Lake Saint-Anne on the North Shore in 1959 (Ouellet and Ouellet, 1963) and Lake Perceval at Valcartier in 1960 and 1964 (Larivée, 2006). The breeding records from along the St. Lawrence corridor in the summer season suggest that the species may occasionally breed locally elsewhere in Quebec (Godfrey, 1986; Lepage, 1995).

In the Atlantic Provinces, the only known breeding record for Horned Grebe dates back to 1873 and comes from southwest New Brunswick, near Milltown (Squires, 1976).

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).

The Extent of Occurrence (EO) for the Western Population of the Horned Grebe was calculated using the minimum convex polygon method for the breeding range of the species in Canada, excluding the Magdalen Islands Population (Table 2). The Area of Occupancy (AO) was based on the estimated population size range of 100,000 to 250,000 pairs, each occupying an average territory of 0.78 ha (see below; Table 2). The EO for the Magdalen Islands Population was calculated using the minimum convex polygon method and including the Magdalen Islands and Brion Island (Table 2). The Index of Area of Occupancy for the Magdalen Islands Population was calculated by counting all grid cells of 2 km x 2 km (the value was also calculated using a 1 km x 1 km

grid) that intersected one of the ponds / marshes used by the Horned Grebe, and the AO was calculated by adding the area of all ponds / marshes above.

Table 2. Extent of Occurrence and Area of Occupancy of the Western and Magdalen Islands Populations of Horned Grebe in Canada. Source: COSEWIC Secretariat.

Population	Extent of Occurrence	Index of Area Occupancy	Area of Occupancy
Western	5,100,000 km ²	>2000 km ²	780–1,950 km ²
Magdalen Islands	772 km ²	100 km ² (43 km ² with 1 km x 1 km grid)	12.2 km ²

HABITAT

Habitat requirements

Breeding range

The Western Population of the Horned Grebe breeds primarily in the temperate zone such as the Prairies and Parkland Canada, but it can also be found in more boreal and subarctic zones. It generally nests in freshwater and occasionally in brackish water on small ponds, marshes and shallow bays on lake borders (Cramp and Simmons, 1977; Godfrey, 1986). These ponds are found both in open and forested areas (Sugden, 1977; Campbell *et al.*, 1990). In the Prairies, it prefers lakes and permanent or semi-permanent natural ponds which last until autumn. It also uses reservoirs and artificial ponds created by river damming and excavation for road construction or for retaining rain or spring water (Caldwell, 2006).

The Horned Grebe will use a broad range of pond sizes (0.24 to 18.2 ha) but generally prefers ponds ranging from 0.30 to 2 ha (Fournier and Hines, 1999; Gingras and Beyersbergen, 2003; Gingras and Beyersbergen, unpublished data). Ponds must contain areas of open water (over 40%) and beds of emergent vegetation (Faaborg, 1976; Sugden, 1977; Godfrey, 1986; Ulfvens, 1988).

Nests consist of a floating or emerging mass of plant material and are constructed within the fringes of emergent vegetation and in shallow water (Palmer, 1962; Shaffer and Laporte, 2003), between 0 and 140 cm (with average values at around 40 cm) (Fjeldså, 1973b; Sugden, 1977). The Horned Grebe primarily uses eutrophic environments, although it is also able to breed successfully on oligotrophic ponds (Ulfvens, 1988).

In the Magdalen Islands Population, the average pond size used for breeding is 0.7 ha (n=24) and the average maximal depth of the ponds is 89 cm (n=26). These ponds are usually fresh-water, with a few exceptions, in which brackish water habitats are used. On average, 51% of the surface of the ponds is covered by emergent vegetation and the mean water depth near nest locations is 49 cm (Shaffer and Laporte, 2003).

Migration route

Little information is available on the particular requirements of the Horned Grebe during migration, but it has been observed on lakes, rivers and marshes. Some birds follow coastlines as part of their migration.

Winter range

Horned Grebes generally winter in marine habitats, mainly estuaries and bays (Palmer, 1962). Birds are found in greatest numbers in coastal habitats, including areas that offer some degree of protection (Root, 1988). Some birds winter on inland lakes and rivers in areas where the minimum temperature in January is higher than -1°C (Root, 1988; Stedman, 2000).

Habitat trends

In the Prairies, wetlands have been impacted severely by conversion of grassland to cropland and wetland drainage (Sugden and Beyersbergen, 1984; NatureServe, 2006). Recent analyses of habitats included in the Prairie Habitat Joint Venture (PHJV) have quantified wetland loss in these regions between 1985 and 2001 (Watmough and Schmoll, in press). Gross wetland loss over that period was 5% (984 ha) and the results for all ecoregions indicate a declining trend in wetland areas. Low prairies, wet meadows and shallow marshes made up 50% of the total loss, cultivated wetland cover 40% and deep marsh and open water habitats combined almost 4% of lost wetland areas (Watmough and Schmoll, in press). The annual rate of net wetland loss (number of wetlands) between 1985 and 1999 for the three Prairie Provinces is as follows: Alberta 0.48%, Saskatchewan 0.24% and Manitoba 0.32% (Watmough *et al.*, 2002). There has been little change in the rate of wetland loss in recent decades. The main causes of loss include agriculture (67%), rural development (10.3%) and other uses (22.7%) (Watmough *et al.*, 2002).

In addition to permanent habitat loss, which is part of a long-term habitat trend, Horned Grebes are also facing more short-term or medium-term habitat loss due to drought. For example, the number of ponds in the Prairie Pothole region ranged from good in 1986, to very poor during the 1988-1993 drought, to excellent in 1994-1995 (Austin, 1998). The worst recorded drought in 100 years on the Prairies occurred between autumn 1999 and spring 2004 (Drought Research Initiative, 2007). Dry conditions on the Prairies are not restricted to a particular area and were concentrated in southern regions in 1971, 1973, 1977, 1984, 1985, 1988, 1996, 1997, 2001 and northern regions in 1968, 1969, 1970, 1972, 1981, 1990, 1992, 1998 and 2002 (Agriculture and Agri-Food Canada, 2007).

The number of May ponds, which are used to assess breeding habitat for waterfowl in the Prairies and Parklands, shows no significant long-term trends for the Canadian Prairies (U.S. Fish and Wildlife Service, 2005; Canadian Wildlife Service Waterfowl Committee, 2007). It is not clear, however, that the estimated number of May ponds is a good indicator of Horned Grebe breeding habitat availability.

On the Magdalen Islands, 42 of approximately 250 ponds have been identified as suitable for Horned Grebe breeding. These ponds were identified using a logistic regression model designed following the characterization of 161 ponds and taking into account historical breeding records (Shaffer and Laporte, 2003). The number of existing ponds has been relatively stable over time (Shaffer *et al.*, 1994). Nevertheless, other factors, such as the presence of the Pied-billed Grebe (*Podilymbus podiceps*), eutrophication or the drying of certain ponds, have reduced the availability of preferred habitat.

Habitat protection/ownership

The breeding range of the Western Population of the Horned Grebe covers most of the Prairie, Boreal Plains, Taiga Plains, Taiga Cordillera, Montane Cordillera and Boreal Cordillera ecozones (Table 3). Wetlands account for approximately 25% (709,469 km²) of the area of these ecozones (3.5 to 45.7%, depending on the ecozone). Of this wetland area, 5.9% is strictly protected (IUCN cat. 1, 2 or 3*) and 2.2% is protected to a lesser extent (IUCN cat. 4, 5 or 6). The breeding range of the Horned Grebe also includes a small portion of the vast Taiga Shield and Boreal Shield ecozones. In southern parts of the range, in particular, many of the small wetlands (ponds) used by Horned Grebe are found on private land.

On the Magdalen Islands, almost half of the ponds preferred by the Horned Grebe are located on protected lands. In the île de l'Est sector, there is the Pointe de l'Est National Wildlife Area, which is managed by the Canadian Wildlife Service, and other lands protected by conservation organizations covering an area of 1,049 ha. An additional 1,290 ha adjacent to this reserve form part of the Pointe-de-l'Est Wildlife Preserve. Furthermore, at Brion Island, all the ponds are located within the limits of the Brion Island Ecological Reserve, under the jurisdiction of the Quebec government.

Table 3. Proportion of Canadian wetlands protected by IUCN* conservation category for ecozones that include a significant portion of the breeding range of the Horned Grebe. Source: Wildlife Habitat Canada (2003).

Conservation category	Total area of wetlands (km ²)	Area of protected wetlands (km ²)	% of strictly protected wetlands	% of less protected wetlands	% of ecozone occupied by wetlands
Taiga Plain	231,119	16,525	5.1	2.1	40.2
Taiga Cordillera	21,142	1,361	3.8	2.6	8.4
Boreal Plain	309,644	31,477	8.3	1.9	45.7
Boreal Cordillera	15,732	1,143	6.5	0.7	3.5
Montane Cordillera	28,441	1,582	5.5	0.1	6
Prairie	103,391	5,726	1.1	4.4	22.6
Total	709,469	57,814	5.9	2.2	24.6

* According to the IUCN protected area classification system (1 = strict nature reserve or wilderness area; 2 = national park; 3 = natural monument/specific natural feature; 4 = habitat/species management area; 5 = protected landscape/seascape; 6 = managed natural resources protected area).

BIOLOGY

Life cycle and reproduction

The Horned Grebe generally breeds in its first year, but a certain number of non-breeding adults may be observed on the breeding grounds (Palmer, 1962). In some areas, 75% of the population arrives on the breeding grounds in pairs (Fjelds  1973d; Jim Hines, Canadian Wildlife Service, Biologist, NWT). Unpaired Horned Grebes seek mates as soon as they arrive on the breeding grounds. Site and mate fidelity have also been observed in Horned Grebes (Ferguson, 1981). In Alaska, Horned Grebes show fidelity to certain lakes or to the region in which they were banded during the moulting period (July and August) (Stout and Cooke, 2003).

The Horned Grebe is usually a solitary nester (Palmer, 1962), but several breeding pairs may occasionally nest on the same pond when it is sufficiently large and there are abundant food resources (Fjelds , 1973c; Sugden, 1977). These loose colonies have a maximum of 20 breeding pairs (Campbell *et al.*, 1990). The Horned Grebe is known to aggressively defend its territory against conspecifics and other species (Storer, 1969; Fjelds , 1973d). Ferguson (1977) estimated that the size of the area defended averaged 0.78 ha and ranged from 0.05 to 2.70 ha.

The Horned Grebe's nest is composed of plant matter and is affixed to emergent vegetation. Occasionally, the Horned Grebe builds its nest in areas devoid of vegetation, establishing it on masses of floating algae, shallowly submerged logs, floating branches, or platforms of human origin (Ulfvens, 1988; Campbell *et al.*, 1990). Near Yellowknife, nests occurred primarily in cattail (*Typha latifolia*) or flooded willows and sedge (*Carex* spp.). Cattail and *Sphagnum* spp. were present in 83%, 75% and 41% respectively of all Horned Grebe nests (n=236) (Fournier and Hines, 1999).

On the Magdalen Islands, the Horned Grebe uses primarily bulrushes (*Scirpus lacustris*) and more rarely, cattails (*Typha sp.*), bur-reeds (*Sparganium sp.*) and bladderworts (*Utricularia sp.*) for nest construction.

The dates of nest-building and egg-laying initiation can vary considerably from year to year depending on weather conditions (Palmer, 1962; Fjeldså, 1973c; Ferguson, 1977; Fournier and Hines, 1999). High spring temperatures favour early egg laying (Ferguson, 1977). The species is an indeterminate layer and both adults share incubation (Stedman, 2000). It can also rebuild its nest and can lay up to four replacement clutches if previous clutches are destroyed (Fjeldså, 1973c; Ferguson, 1977). Hatching is asynchronous and lasts for several days, with a hatching interval of one to two days. The chicks are dependent on the adults for food for 14 days after hatching, but are normally independent at around 19 to 21 days (Fjeldså, 1973c; Ferguson, 1977).

Reproductive success

In the Western Population, reported clutch sizes vary from an average of 5.3 (n=114 clutches) to 5.9 (n=79) eggs/clutch (Ferguson and Sealy, 1983; Fournier and Hines, 1999) and hatching success from 30.3% (Ferguson and Sealy, 1983) to 60% (Fournier and Hines, 1999). The average number of young produced has been reported at 2.2/ successful nest (i.e. those fledging at least one young, range 1.6–2.6) and 1.4/ breeding pair (range 0.6–2.0) (Fournier and Hines, 1999).

In the Magdalen Islands Population, the average clutch size is 4.4 and ranges from 3 to 6 eggs (n=16) and the hatching success is 54% (n=67) (Shaffer and Laporte, 2003). The minimum productivity estimate based on observations of breeding birds is 0.6 young/pair, although fall counts at East Pond suggest two young/ breeding pair. The latter estimate assumes that the individuals observed in the fall at the East Pond only include those from the local population.

Predators

Horned Grebe eggs are taken by raccoons (*Procyon lotor*), American Crow (*Corvus brachyrhynchos*), Common Raven (*Corvus corax*), Black-billed Magpie (*Pica pica*) and various gull species (*Larus spp.*). Chicks can be subject to predation by the northern pike (*Esox lucius*) and by gulls. Adults may be taken by mink (*Neovison vison*) and possibly foxes (Ferguson, 1977; Fournier and Hines, 1999; Stedman, 2000).

On the Magdalen Islands, the red fox (*Vulpes vulpes*), Great Blue Heron (*Ardea herodias*), Great Black-backed Gull (*Larus marinus*), Common Raven and American Crow represent potential predators (Shaffer *et al.*, 1994; Shaffer and Laporte, 2003). The absence of raccoons on the archipelago limits the number of potential predators, but minks have recently escaped from mink-rearing farms on the Magdalen Islands, therefore making them potential predators.

Diet

The Horned Grebe is a diver that catches and eats most of its prey underwater, bringing larger prey items, such as certain fish and amphibians, to the surface before swallowing them (Storer, 1969). It also picks insects from the water surface and from aquatic plants (Stedman, 2000). During the summer, it forages in shallower freshwater and in winter, in fresh or brackish water close to the coast (Stedman, 2000). Its diet consists of fish, insects, crustaceans, leeches, small frogs, salamanders and tadpoles (Palmer, 1962).

Dispersal/migration

The Horned Grebe migrates at night over land towards its wintering sites along the Pacific, Atlantic and Gulf coasts (Palmer, 1962). It does not appear to have specific routes and individuals migrate over a broad front. In fact, the Horned Grebe is regularly observed in various places in the United States and in southern Canada, resting on lakes and rivers. Some individuals can also migrate by day, individually or in loose aggregations, especially along the coasts (Palmer, 1962; Stedman, 2000). Significant diurnal migrations are sometimes observed on the Great Lakes within the Point Pelee Birding Area (Wormington, 2008)

On the Magdalen Islands, adults gather on the East Pond where they gradually moult from breeding to non-breeding plumage before migrating to the wintering areas (Shaffer and Laporte, 2003). The last individuals generally leave the archipelago at the end of September or at the beginning of October (Fradette, 1992; Shaffer and Laporte, 2003; Richard, 2005).

Interspecific interactions

The Horned Grebe defends its territory aggressively and has been observed chasing Mallard (*Anas platyrhynchos*), Green-winged Teal (*Anas crecca crecca*) and Northern Pintail (*Anas acuta*) (Fjeldså, 1973d). Pied-billed Grebes have successfully displaced Horned Grebes from breeding ponds (n=9) (Osnas 2003). Red-necked Grebes also displace Horned Grebes. In southern Manitoba, small- and medium-sized ponds traditionally occupied by Horned Grebes are now mostly used by Red-necked Grebes (K. De Smet, Biologist, Conservation, Manitoba).

Adaptability

The Horned Grebe is vulnerable to changes in water quality near its breeding sites. In particular, it generally occupies small, shallow ponds that are sensitive to eutrophication, drainage and drought.

POPULATION SIZES AND TRENDS

Search effort

There are no national surveys for inland waterbirds in general or Horned Grebes in particular. In North America, the North American Breeding Bird Survey (BBS) and the Christmas Bird Count (CBC) are the two most significant programs monitoring bird population trends. The CBC is the best method for determining Horned Grebe population trends because it surveys most of the North American population, the vast majority of which breed in Canada, while they are on the wintering grounds.

Western Population

The BBS is carried out during the breeding season by volunteers who note the abundance of all bird species detected along randomly selected routes across the continent. Each participant makes three-minute stops every 0.8 km along a 39.4-km long survey route. In 2005, 434 routes were surveyed in Canada, and more than 2,000 in the United States. Fewer than 150 routes in North America can, however, be used to analyze Horned Grebe population trends. The majority of these routes are in Canada.

The BBS provides the only long-term, extensive survey information on Horned Grebe population trends on their breeding range. It has, however, several disadvantages in terms of monitoring Horned Grebe populations. The BBS is a roadside survey, which does not allow for good coverage of a wetland species such as the Horned Grebe. Also, there are very few BBS routes in the northern prairies and in the Northwest Territories. Thus, population abundance and trends for Horned Grebes based on BBS data are biased toward the southern portion of their range.

The CBC is carried out over a three-week period between mid-December and early January each year. Thousands of volunteer observers, in approximately 2,000 locations in North America, note all species observed and the number of individuals in a circular area of 15 km in radius. The main advantage of this method is that it samples most of the Horned Grebe population, predominately birds that breed in Canada, as it winters along the coasts of North America (Sauer *et al.*, 1996). One of the disadvantages of this method is that in winter the Horned Grebe occurs mainly on large bodies of water and on the coast, so the birds may be located a fair distance from observers, which makes them difficult to count. However, the areas selected for the CBC are often located close to areas with large concentrations of birds (Sauer *et al.*, 1996).

Breeding Bird Atlas projects in different regions (British Columbia, Alberta, Saskatchewan and Ontario) collect information on species distribution during the breeding season. These atlases are produced periodically (generally, every 20 years) so that changes in the species distribution can be monitored over time.

Spring aerial and ground waterfowl surveys are carried out by the Canadian Wildlife Service in association with the U.S. Fish & Wildlife Service and provide data

on the abundance of the Horned Grebe in certain Prairie regions. Although these surveys are focused primarily on waterfowl, efforts have been underway since 1999 to count grebes that are present along the survey transects. Currently, this is the most complete data source for estimating Horned Grebe abundance and population trends in the Prairies. The accuracy and precision of the methodology has not, however, been evaluated for this species.

Magdalen Islands Population

The main survey information on the Magdalen Islands Population comes from annual monitoring of Horned Grebe nesting sites on the Magdalen Islands carried out by the Canadian Wildlife Service. Counts are made of the number of nests and adults during the breeding period and also the number of adults and young on East Pond, the largest on the Magdalen Islands and the moulting ground for the Horned Grebe, during weekly visits between early August and early October. In eastern Quebec, Horned Grebe sightings are rare until mid-September or early October and become occasional or frequent mainly from about the second week in October (Otis *et al.*, 1993; Larivée, 1993). There is therefore little chance that Horned Grebe counts at the East Pond include migrating individuals coming from elsewhere in North America, but this possibility can not be excluded.

The Breeding Bird Atlas projects done in Quebec and in the neighbouring provinces and the ÉPOQ database (Étude des populations d'oiseaux du Québec) (Larivée, 2006) give some insight on the species distribution.

Abundance

Western Population

The size of the North American population of Horned Grebes is poorly known. A frequently cited estimate from Wetlands International (2002) has a very wide range (100,000 to 1 million individuals) of values, which remains unchanged in recent (2005) drafts of the Waterbirds Population Estimates document (Wetlands International, 2005). The highest Horned Grebe densities are probably found in the wetlands of the Prairies, where densities of 1.5 to 3.3 pairs per km² have been observed (Sugden, 1977). High densities have also been recorded near Yellowknife, NWT (2.2 pairs per km² average) on similar-sized study areas used by Sugden (1977) (Fournier and Hines, 1999). However, densities near Yellowknife would not be representative of a broad area of Taiga Shield/ Taiga Plains habitat (Fournier and Hines, 1999).

In 2005, 16,000 Horned Grebes were counted in all North American Christmas Bird Counts and the maximum number of individuals recorded in the history of these counts is approximately 20,300 in 1998 (National Audubon Society, 2006). These counts clearly do not constitute an exhaustive inventory of the population and do not cover the species' entire wintering range.

According to data collected from the Canadian Prairies between 2001 and 2005 during the Springtime Waterfowl Surveys (SWS), the average size of the Horned Grebe population for the region covered by the Prairie Habitat Joint Venture (PHJV) is 153,615 (Caldwell 2006). Estimates based on BBS data give similar results to those based on the SWS for Alberta (BBS: 71,665; SWS: 78,090) and Manitoba (BBS: 8,262; SWS: 10,752), but not Saskatchewan (BBS: 325,554; SWS: 69,124) (Peter Blancher, Research Scientist, Environment Canada, unpublished data). It is possible that the survey routes used for the BBS surveys in Saskatchewan are within habitats that are particularly favourable to the Horned Grebe, thereby biasing the estimate (P. Blancher, Research Scientist, Environment Canada).

The Horned Grebe is common in British Columbia and its breeding population probably ranges between 20,000 and 50,000 individuals, while there are 10,000 to 30,000 individuals on wintering grounds (A. Breault, Canadian Wildlife Service, BC). The breeding population for the Yukon is roughly estimated at greater than 10,000 birds (C. Eckert, Yukon Department of Environment; P. Sinclair, Canadian Wildlife Service).

In the Northwest Territories, only approximate numbers are available from the 1980-1982 Waterfowl Breeding Ground Surveys. Stotts (1988) has analyzed non-waterfowl birds data from these surveys and has estimated the Horned Grebe population at 23,042 birds for the 707,592 km² area covered.

In Ontario, the first Breeding Bird Atlas assessed the province's breeding population at 10 pairs or less per year (Eagles, 1987). That number did not change much in the second edition, where breeding evidence was reported in four squares compared to three in the first edition (Hoar, 2007). Since most of its potential breeding range lies in remote areas of northwestern Ontario that was not well covered, the Horned Grebe could be more common than either atlas suggests (Hoar, 2007).

On the basis of these estimates, excluding regions with no available estimate (Northern Alberta and Northern Saskatchewan), it is likely that the Western Population of the Horned Grebe totals between 200,000 and 500,000 individuals.

Magdalen Islands Population

According to surveys carried out by the Canadian Wildlife Service from 1993 to 2006 in Quebec, which covered most of the optimal habitats on the Magdalen Islands, no more than 25 adults were ever sighted during the same breeding season, and only five adults were sighted in 2005, for a yearly average of 15 adults. Although there was some variation in search effort between years, the majority of ponds were visited annually. Only part of East Pond on the main island and a pond on Brion Island were excluded on some years.

Fluctuations and trends

Western Population

North American Breeding Bird Survey (BBS)

Based on BBS data, the Horned Grebe population has shown a significant long-term decline of 2.7%/year between 1968 and 2007 (Figure 4, Table 4). This amounts to a loss of 66% of the population over this time period. The population has also shown a significant short-term decline of 5.2%/year over 12 years or three generations (1995-2007; Table 4). At this rate, the population will have decreased by 47% over the last three generations.

Alberta, Saskatchewan and Manitoba have all shown negative long-term trends, as have Alberta and Saskatchewan in the short-term (Table 4). There were not enough routes with the Horned Grebe in Manitoba to calculate a short-term trend or in British Columbia to calculate long or short-term trends.

BBS data also suggest a contraction in the breeding range towards the northwest (Gingras and Beyersbergen, 2003).

Table 4. Horned Grebe population trends in Canada based on data from the Canadian Breeding Bird Survey (Downes *et al.* 2008; Collins pers. comm. 2008).

Area	1968–2007			1995–2007		
	Trend	P	N	Trend	P	N
Canada	- 2.7	**	142	- 5.2		89
Alberta	- 7.3	**	52	- 5.6		41
Saskatchewan	- 2.7		53	- 6.2		24
Manitoba	- 3.8		17	–		–

Trend = average of the annual percentage of change in a bird population; ** indicates $P \leq 0.05$, * indicates $0.05 < P < 0.1$; Blank indicates $P > 0.10$). N = total number of routes used in calculating the trend. Not enough routes to calculate a trend for Manitoba from 1995-2007.

Christmas Bird Count (CBC)

The CBC is the best method for determining Horned Grebe population trends because it surveys most of the population while it is on the wintering grounds. CBC data show a significant long-term decline of 1.5%/year between 1966 and 2005 (95% confidence limits -2.4 to -0.8%/yr; Figure 5). Given this rate of decline, the Horned Grebe population will have decreased by 45% over the last 39 years (Niven *et al.*, 2004). CBC data also show a significant decline in the most recent 12-year period (1993-2005) of 1.25%/year (95% confidence limits -1.8% to -24.7%/year; Figure 5), which amounts to a 14% decrease in the population over the last three generations.

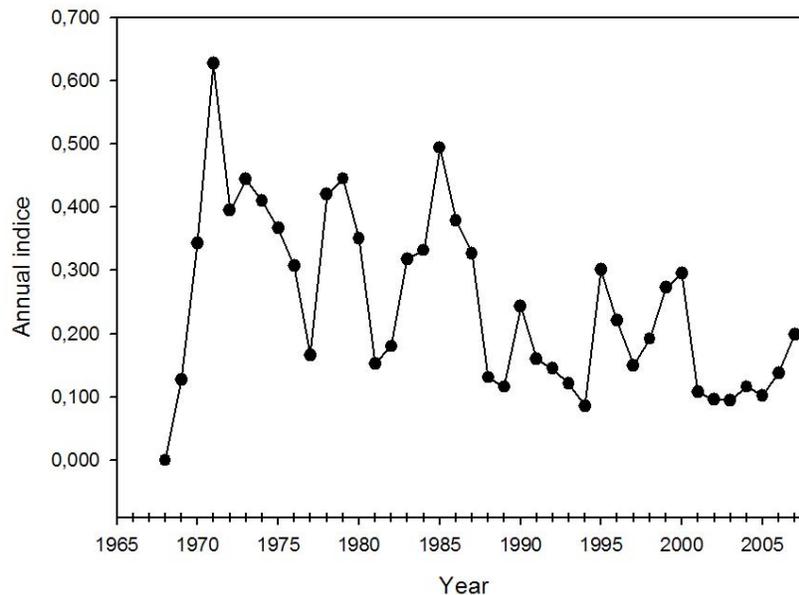


Figure 4. Annual indices of population change for the Horned Grebe in Canada based on Breeding Bird Survey data (1968 - 2007) from Downes *et al.* (2008).

Other information sources

In Alberta, ornithologists have observed an apparent decline in Horned Grebe numbers (G. Beyersbergen, CWS biologist, Alberta). Nevertheless the second edition of the Atlas of Breeding Birds of Alberta reports an increase in relative abundance detected in the Grassland, where the Horned Grebe was observed more frequently in Atlas 2 than in Atlas 1. A decline was, however, detected in the Boreal Forest where it was observed less frequently in Atlas 2 than in Atlas 1. No change was detected in Foothills, Parkland and Rocky Mountain (Semenchuk, 2007).

In Manitoba, Holland and Taylor (2003) note that in the past, the Horned Grebe declined in the south of the province following wetland drainage for agricultural purposes. Since wetland drainage has not been as extensive in the past few decades, the recently noted decline may be due to other factors. Indeed, a species that was abundant and frequently observed for 30 years in the Prairie Potholes region in southern Manitoba is now becoming much rarer.

In southern British Columbia, downward trends were also observed and are likely due in part to the drought which persisted in the south of the province from 2001 to 2005 (A. Breault, Canadian Wildlife Service, BC).

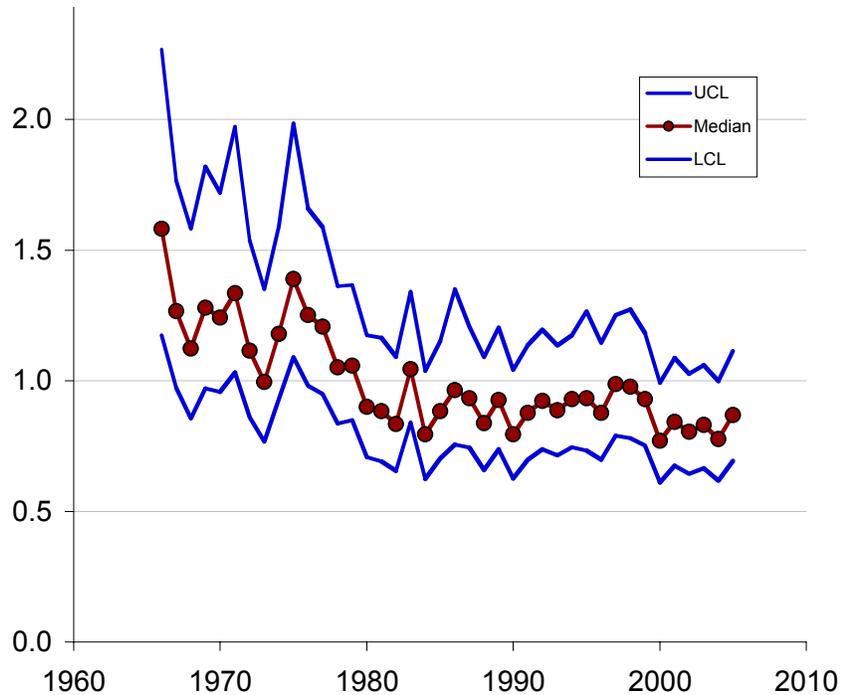


Figure 5. Indices of relative abundance for Horned Grebes observed during all Christmas Bird Counts in the United States and Canada from 1966 to 2005 (data from the National Audubon Society, 2006).

In the Northwest Territories, numbers and productivity of Horned Grebes have been monitored annually from 1986 to 2007 near Yellowknife (Fournier and Hines, 1999; Canadian Wildlife Service, unpublished data). Like other northern areas, the 38-km² study area has relatively stable water conditions compared to some other parts of the Horned Grebe range. Breeding populations near Yellowknife show considerable annual variability but no clear long-term trend in population size (Fournier and Hines, 1999; Canadian Wildlife Service, unpublished data). Similarly, annual indices of productivity have varied substantially from year to year without any apparent long-term trend, thus there is no evidence of population decline in NWT (Jim Hines, Canadian Wildlife Service, NWT).

Magdalen Islands Population

The population on the Magdalen Islands has declined by 2%/year between 1993 and 2007 (Figure 6). At this rate, the population will have decreased by 22% over the last 12 years or three generations. Moreover, in recent years (2000-2007), most of the birds and nests found during the breeding season were concentrated on one major pond (East Pond) and on Brion Island. Other breeding areas of the archipelago seem to be deserted (Canadian Wildlife Service, unpublished data).

Records from the previous century suggest that the population was higher than it is today. Job (1902) reported that the Horned Grebe was the only species of grebe nesting on the Magdalen Islands. He also noted that it was abundant, as he found one pair per small pond and several on larger ponds. The abundance indices given by Job (1901, 1906), Philipp (1913) and Bent (1919), as well as reports of 40 individuals on August 11, 1949 (Hagar, 1949) and 41 individuals in the late summer of 1989 (Fradette, 1992), all indicate that the population was higher in previous times.

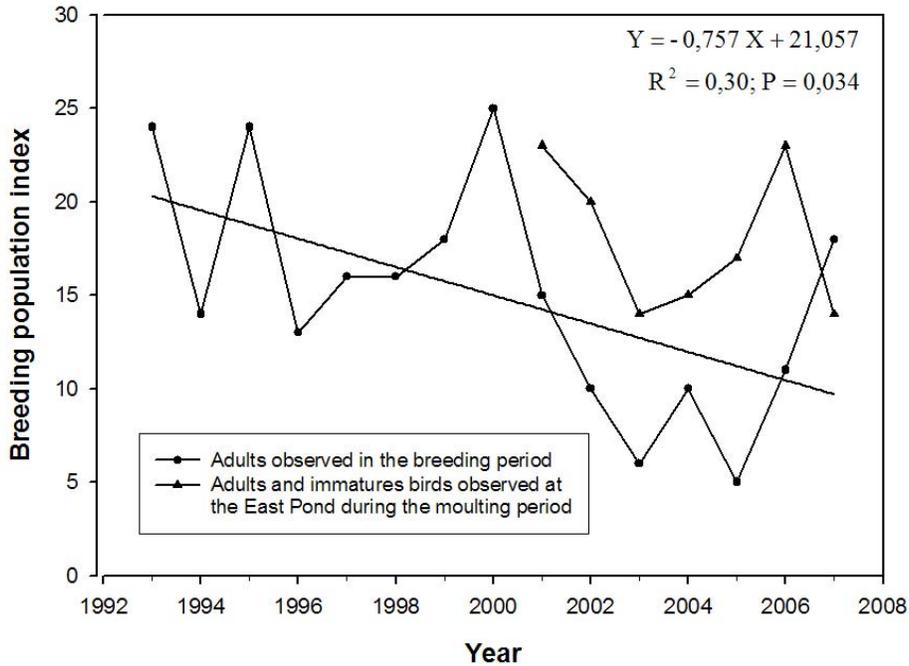


Figure 6. Number of adult Horned Grebes during the breeding season and the number of adults and immatures during the moulting period on the Magdalen Islands (Quebec) from 1993 to 2007 (source: Canadian Wildlife Service, unpublished data).

Rescue effect

Most of the Horned Grebe population is found in Canada, so rescue from the U.S. would be limited, although possible from Alaska.

LIMITING FACTORS AND THREATS

The causes of population decline for this species are not known. The information below includes the most probable threats to this species.

Environmental conditions and habitat loss

The massive destruction and drainage of wetlands on the Prairies primarily occurred before the recent decline in grebe numbers. Nevertheless, the permanent loss of wetlands continues, mainly because of agricultural activity and rural development (Watmough *et al.*, 2002; Watmough and Schmoll, in press). Habitat loss can also be temporary. The Prairie region undergoes cycles of drought followed by heavier rainfall, which can result in temporary loss of breeding ponds (Van der Valk, 2005; U.S. Fish and Wildlife Service, 2005). Breeding sites can also be degraded through eutrophication from the accumulation of fertilizers, contamination and other alterations resulting from agriculture and rural development.

The length and frequency of droughts in the Prairies is expected to increase in the future, due to climate change. According to the Canadian Global Climate Model, the southern Prairies could experience serious summer deficiencies in soil moisture by the end of this century. Higher temperatures will intensify drought conditions and also bring about wetter periods, but overall the prediction is that soil moisture will become more variable (Natural Resources Canada, 2007).

Weather conditions can also significantly affect water levels. Heavy rainfall combined with wind and waves during storms can flood nests (Shaffer and Laporte, 2003). Conversely, if rainfall is too low, shallow ponds may dry up and become unsuitable for nesting. Storms encountered during migration can also affect the Horned Grebe, as shown in three documented cases in which 68, 75 and 124 individuals were found on the ground following storms (Hodgdon, 1979; Bell, 1980; Eaton, 1983).

Predation

Nest predation is considered a major factor limiting the reproductive output and population size of waterfowl, although there is wide variation in predation rates among species (Sargeant and Raveling, 1992; Johnson *et al.*, 1992). In the Prairies, predation problems are often related to large-scale habitat degradation coupled with changes in predator communities (Sovada *et al.*, 2001).

The major expansion of some predators in the Prairies could be a possible limiting factor and cause of population decline in the Western Population of grebes. BBS trends show a substantial increase in Common Raven and Black-billed Magpie since the 1970s (Canadian Wildlife Service, 2008). Raccoons have also expanded their range in the Prairies during the 1900s (Larivière, 2004).

In the Magdalen Islands Population, any predation of adults, chicks or nests can affect the persistence of this small population. Predation of eggs and of one adult has already been reported (Canadian Wildlife Service, unpublished data).

Pollution

At sea, this species is vulnerable to oil pollution, since it spends most of its time on the water. Of 34,717 oiled birds killed in eight spills in the southern USA, 12.3 % were Horned Grebes (del Hoyo *et al.*, 1992). In 1976, an oil spill caused the death of more than 4,000 individuals in Chesapeake Bay (Stedman, 2000). During the response to the Cosco Busan oil spill of November 2007, 78 oiled Horned Grebes were collected live and dead (California Department of Fish and Game, 2008). Twelve oiled Horned Grebes were collected after the Selendang Ayu oil spill in Alaska (Alaska Dept. of Environmental Conservation, unpublished data) and 16 were collected during an oiling episode in the winter of 1997-98 in central California (Hampton *et al.*, 2003). Horned Grebes were negatively affected by the Exxon Valdez oil spill in Alaska in March 1989 (Day *et al.*, 1997), with declines that have continued for years following the oil spill (Stephensen *et al.*, 2001).

The large wintering area of this species in North America partially protects this population from catastrophic losses due to isolated oil spills (Stedman, 2000).

Grebes occupy the upper trophic levels of the food chain and are therefore more susceptible to contamination, especially in the case of bioaccumulatable toxic substances. Significant concentrations of DDE and PCB were detected in Horned Grebe eggs collected in Manitoba in 1986 and 1987 (Forsyth *et al.*, 1994). In British Columbia, elevated levels of dioxins and furans have been detected in the liver of Horned Grebes collected downstream from a pulp and paper plant outfall (Vermeer *et al.*, 1993).

Disease

Type E botulism has been reported in the Great Lakes since the late 1990s and may be an important source of mortality for both resident and migrating waterbirds. Horned Grebes were one of the top five affected species of those collected in 2007, with 354 birds affected by botulism (USGS, 2008). The characteristics of the 2007 event were similar to outbreaks that have occurred annually in at least one of the Great Lakes since 1998. In 2006, 2,600 dead birds including Horned Grebe, Common Loon (*Gavia immer*), mergansers, and Red-necked Grebe were reported to have died from Type E botulism on Lake Michigan (USGS, 2007).

Interspecific competition

Horned Grebes in the Western Population may compete with Pied-billed Grebes for breeding habitat. BBS trends suggest an increase in Pied-billed Grebes in British Columbia, Saskatchewan and particularly in Alberta (14.6% per year) from 1997 to 2007

(Canadian Wildlife Service, 2008). Similarly, the Red-necked Grebe may exclude Horned Grebes from nesting on some ponds.

On the Magdalen Islands, the Pied-billed Grebe was first recorded in the archipelago in 1954 (Gaboriault, 1961) and has since grown to 25 breeding pairs (Shaffer and Laporte, 2003). The Pied-billed Grebe excludes the Horned Grebe from potential productive habitats on the archipelago (Shaffer and Laporte, 2003). Four ponds that were used by the Horned Grebe for nesting had both species occupying the pond at the beginning of the season, but only the Pied-billed Grebe pairs completing their breeding (Shaffer and Laporte, 2003).

Population size

The small size of the population (<25 individuals) breeding on the Magdalen Islands makes it susceptible to demographic, environmental and genetic factors. No reduction in the genetic diversity of this population, at least for the genetic markers that have been studied, has been found, however (Boulet *et al.*, 2005).

Human disturbance

On the Magdalen Islands, in particular, disturbance from human visitors may threaten breeding birds. Squatter camps close to breeding ponds is a source of disturbance (Shaffer *et al.*, 1994). In addition, tourism has increased considerably on the Magdalen Islands (e.g. 22,000 tourists in 1998 to 37,000 tourists in 2006), which may also be a source of disturbance.

Commercial fishing

Horned Grebes become entangled and drown in nets in some commercial fishing areas (Harrison and Robins, 1992). This is most likely to occur on large lakes during migration (Riske, 1976; Piersma, 1988; Ulfvens, 1989). Bartonek (1965) estimates that 3,000 grebes and loons were netted annually by fishers on the southern part of Lake Winnipegosis (Manitoba) and Horned Grebes were ranked third in abundance of the netted birds. Commercial fisheries occur on large lakes in Manitoba, but bycatch data are not available for Horned Grebes (Ron Bazin, Canadian Wildlife Service, MB). On the Great Lakes birds are killed annually in fishing nets during both spring and fall migrations (Alan Wormington, Ornithologist, Ontario). There is little evidence of fishing net mortality occurring at sea in North America. Grebes were not reported from a seabird bycatch assessment of salmon gill net fisheries in British Columbia (Smith and Morgan, 2005); however, grebe species have been reported as bycatch in angel shark/halibut set gillnet fisheries in California (Mills *et al.*, 2005).

SPECIAL SIGNIFICANCE OF THE SPECIES

Horned Grebes occupy the upper trophic level and all of their life stages are tied to the water. They, therefore, may be useful indicators of the availability and integrity of wetlands.

Their striking nuptial plumage, spectacular courtship displays and approachable nature also make them popular among bird watchers and ecotourists on the Magdalen Islands (and elsewhere) during the breeding season.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

The Horned Grebe is on the list of “non-game migratory birds” and is protected under the *Migratory Birds Convention Act, 1994*. This Act protects the Horned Grebe as well as its nest and eggs throughout Canada, but does not accord any specific protection to its habitat.

The two subspecies of the Horned Grebe are globally considered to be facing a small risk of extinction and have been placed in the category of “least concern” by the World Conservation Union (IUCN) (O’Donnell and Fjeldså, 1997; BirdLife International, 2004).

The Northern Prairie and Parkland Waterbird Conservation Plan has identified the Horned Grebe as a species of high concern due to the downward trend in its populations and the contraction in its breeding range towards the northwest (Niemuth *et al.*, 2005; Gingras and Beyersbergen, 2003). The North American Waterbird Conservation Plan (NAWCP) also identifies the Horned Grebe as a “species of high concern” (Waterbird Conservation for the Americas, 2006). This status is given to species that are not greatly imperiled, but whose populations appear to be declining and also face other known or potential threats. Canada’s Waterbird Conservation Plan (Wings Over Water) has assigned the category “Moderate concern” to the Horned Grebe population (Milko *et al.*, 2003).

The General Status of Species in Canada considers the species overall as Secure in Canada, with ranks ranging from At Risk in Quebec to Secure in other provinces (CESCC 2006; Table 5). NatureServe ranks the species overall in Canada as globally abundant, widespread and secure (rank¹ G5), with ranks ranging from Secure in the Yukon and Saskatchewan, apparently secure in British Columbia and Manitoba, vulnerable in Alberta and critically imperiled in Ontario and Quebec (NatureServe 2006; Table 5). In the Northwest Territories the Horned Grebe is considered “secure” (Working Group on General Status of NWT Species, 2006).

In Quebec, the rank of S1 assigned to the Horned Grebe indicates that the species is critically at risk. The Horned Grebe was also designated as a threatened species in 2000 under Quebec's *Act Respecting Threatened or Vulnerable Species* (Government of Quebec, 2000). At the present time this designation does not offer any protection to the species' breeding habitat, but protection measures are scheduled to be implemented in 2009 (Daniel Banville, MRNF Biologist, QC).

Table 5. Ranks assigned to the Horned Grebe in Canada based on NatureServe¹ (2006) and General Status Ranks (CESCC 2006).

Region	Nature Serve	General Status
Alberta	S3B	Sensitive
Manitoba	S4B*	Secure
Newfoundland	SNA	-
Nova Scotia	S4M,S4N	Secure
Ontario	S1B	May be at risk
Quebec	S1B	At risk
Yukon Territory	S5B	Secure
British Columbia	S4B	Secure
New Brunswick	S4M,S4N	Secure
Northwest Territories	SNRB	Secure
Nunavut	SNRB	Undetermined
Prince Edward Island	SNA	Accidental
Saskatchewan	S5B	Secure
Canada	N5B	Secure

* Manitoba breeding population, which was previously ranked S4S5, has recently been assigned the rank S4 by NatureServe.

¹The status (rank) assigned by NatureServe is made up of a letter which reflects the spatial level for which the status has been granted (G = global, N = national and S = provincial, state or territorial level). The numbers which follow it refer to the following statuses: 1- critically imperiled; 2- imperiled; 3- vulnerable to extirpation or disappearance; 4- apparently secure; 5- demonstrably widespread, abundant and secure. A breeding code is used when a breeding population and a non-breeding population are found within the same province or territory: B = breeding, N = non-breeding, M = migratory. Finally, the code SNA signifies that the definition of a status is not applicable, the code SNR shows that the status has not yet been assessed and the code SX shows that the species is presumed extirpated. Two ranking values next to each other (e.g. S4S5N) show a range of uncertainty regarding the status of the species for the region.

TECHNICAL SUMMARY - Western population

Podiceps auritus

Horned Grebe (Western population)

Grèbe esclavon (Population de l'Ouest)

Range of Occurrence in Canada: British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Yukon, Northwest Territories, Nunavut.

Demographic Information

Generation time (average age of parents in the population)	4 yrs
Observed percent reduction in total number of mature individuals over the last 3 generations. Based on Christmas Bird Count data: - decline of 45% between 1966 and 2005 - decline of 14% in last three generations (12 years)	14%
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 or 5 years, or 3 or 2 generations].	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 or 5 years, or 3 or 2 generations] period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible?	No
Are the causes of the decline understood?	No
Have the causes of the decline ceased?	No
[Observed, inferred, or projected] trend in number of populations	N/A
Are there extreme fluctuations in number of mature individuals?	No
Are there extreme fluctuations in number of populations?	N/A

Extent and Area Information

Estimated extent of occurrence Calculated from the breeding range of the Horned Grebe in Canada (except for Quebec) shown in Figure 3 in this report using "Minimum convex polygon".	5,100,000 km ²
Observed trend in extent of occurrence	Stable
Are there extreme fluctuations in extent of occurrence?	No
Index of area of occupancy (IOA) Calculated as Index of Area of Occupancy (2 km x 2 km grid)	>2000 km ²
Observed trend in area of occupancy	Small decline
Are there extreme fluctuations in area of occupancy?	No
Is the total population severely fragmented?	No
Number of current locations	N/A
Trend in number of locations	N/A
Are there extreme fluctuations in number of locations?	N/A
Trend in area and/or quality of habitat	Declining

Number of mature individuals in each population

Population	N Mature Individuals
Total	200,000 - 500,000
Number of populations (locations)	N/A

Quantitative Analysis

None	Ex.: % chance of extinction in 50 years
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Threats (actual or imminent, to populations or habitats)

Breeding areas	
<ul style="list-style-type: none"> • Permanent loss of breeding habitat from agriculture, development or other land uses • Temporary loss of habitat due to droughts • Increase in predators in the Prairies • Eutrophication and degradation of nesting sites from fertilizers and other agricultural practices 	
Wintering areas and during migration	
<ul style="list-style-type: none"> • Exposure to oil spills. • Bycatch in fishing nets 	

Rescue Effect (immigration from an outside source)

Status of outside population(s)? USA: Most of the population is in Canada	
Is immigration known?	Possible
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely?	Unlikely, most of the population is in Canada

Current Status

COSEWIC: Special Concern (2009)

Status and Reasons for Designation

Status: Special Concern	Alpha-numeric code: None
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Reasons 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.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Does not meet criterion - population decline < 30%.
Criterion B (Small Distribution Range and Decline or Fluctuation): Does not meet criterion - Extent of Occurrence > 20,000 km ² and Area of Occupancy > 2,000 km ² .
Criterion C (Small and Declining Number of Mature Individuals): Does not meet criterion - total population size > than 10,000.
Criterion D (Very Small Population or Restricted Distribution): Does not meet criterion - population size > than 1,000 and Area of Occupancy > than 20 km ² .
Criterion E (Quantitative Analysis): Not done.

TECHNICAL SUMMARY - Magdalen Islands population

Podiceps auritus

Horned Grebe (Magdalen Islands population)

Grèbe esclavon (Population des îles de la Madeleine)

Range of Occurrence in Canada: Quebec

Demographic Information

Generation time (average age of parents in the population)	4 yrs
Observed percent reduction in total number of mature individuals over the last 3 generations. Based on trend calculated from data provided by surveys carried out on the Magdalen Islands between 1993 and 2007.	22%
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 or 5 years, or 3 or 2 generations].	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 or 5 years, or 3 or 2 generations] period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible?	No
Are the causes of the decline understood?	No
Have the causes of the decline ceased?	No
Observed trend in number of populations	Stable
Are there extreme fluctuations in number of mature individuals?	No
Are there extreme fluctuations in number of populations?	Stable

Extent and Area Information

Estimated extent of occurrence Based on minimum convex and including Brion Island	772 km ²
Observed trend in extent of occurrence	Stable
Are there extreme fluctuations in extent of occurrence?	No
Index of area of occupancy (IOA) Calculated as an Index of Area of Occupancy (2 km x 2 km grid): (if using a 1 km x 1 km grid, IAO = 43 km ²)	100 km ²
Observed trend in area of occupancy	Decline
Are there extreme fluctuations in area of occupancy?	No
Is the total population severely fragmented?	No
Number of current locations	One
Trend in number of locations	Stable
Are there extreme fluctuations in number of locations?	No
Trend in area and/or quality of habitat	Stable

Number of mature individuals in each population

Population	N Mature Individuals
Total Number of mature individuals observed between 1993 and 2006.	5 – 25
Number of populations (locations)	One

Quantitative Analysis

None	Ex.: % chance of extinction in 50 years
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Threats (actual or imminent, to populations or habitats)

<p>Breeding areas</p> <ul style="list-style-type: none"> • Geographical isolation • Small population size • Interspecific competition from the Pied-billed Grebe <p>Wintering areas and during migration</p> <ul style="list-style-type: none"> • Exposure to oil spills • Bycatch in fishing nets

Rescue Effect (immigration from an outside source)

Status of outside population(s)?	
USA: Most of the population is in Canada	
Is immigration known?	Possible
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely?	Unlikely, most of the population is in Canada

Current Status

COSEWIC: Endangered (2009)

Status and Reasons for Designation

Status: Endangered	Alpha-numeric code: B1ab(ii,v)+2ab(ii,v); C2a(i,ii); D1
Reasons for designation: The small breeding population of this species has persisted on the Magdalen Islands for at least a century. It has recently shown declines in both population size and area of occupancy. The small size of the population (average of 15 adults) makes it particularly vulnerable to stochastic events.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Does not meet criterion - population decline < 30%.
Criterion B (Small Distribution Range and Decline or Fluctuation): Meets Endangered B1ab(ii,v)+2ab(ii,v) with an Area of Occupancy < 500 km ² , existing at < 5 locations and with an observed decline in area of occupancy.
Criterion C (Small and Declining Number of Mature Individuals): Meets Endangered C2a(i,ii) with a population of < 2,500 and a continuing decline projected in the number of mature individuals and with no population > 250 mature individuals and at least 95% of mature individuals in one population.
Criterion D (Very Small Population or Restricted Distribution): Meets Endangered D1 with a population of < 250 mature individuals.
Criterion E (Quantitative Analysis): Not done.

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Alexandre Rivard has participated in many bird ecology field studies since 1998. He has a master's degree in Ecology and wrote his thesis on diet and contamination in riparian passerines. He has participated in the writing of scientific reports such as a technical report on the status of the Nelson's Sharp-tailed Sparrow in Quebec for the Canadian Wildlife Service. He has also written reports and ornithological columns for the Observatoire d'oiseaux de Tadoussac. He is currently working on issues related to endangered species in cooperation with the Canadian Wildlife Service.

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