

COSEWIC
Assessment and Status Report

on the

Hudsonian Godwit
Limosa haemastica

in Canada



THREATENED
2019

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada



COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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

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COSEWIC Assessment Summary

Assessment Summary – May 2019

Common name

Hudsonian Godwit

Scientific name

Limosa haemastica

Status

Threatened

Reason for designation

This large Arctic-nesting shorebird is poorly monitored on its known breeding grounds in the Hudson Bay Lowlands, Mackenzie Delta, and Alaska. However, both migration monitoring and winter surveys indicate substantial population declines over the past two to three generations. Key threats include reduced suitability of nesting habitat and changes in prey availability arising from climate change, and overgrazing by abundant geese in the Hudson Bay Lowlands, as well as loss of habitat and disturbance on the wintering grounds in South America.

Occurrence

Yukon, Northwest Territories, Nunavut, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Québec, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador

Status history

Designated Threatened in May 2019.



COSEWIC Executive Summary

Hudsonian Godwit *Limosa haemastica*

Wildlife Species Description and Significance

Hudsonian Godwit is a large, long-legged shorebird with a long, slightly upturned bill. The species exhibits sexual dimorphism in both size and plumage, with females larger and heavier than males and paler overall in breeding plumage. Males have distinctive red chest colouring during the breeding season, while females are a lighter rufous colour. Both males and females are greyish-brown in non-breeding plumage.

Spatial segregation and genetic differentiation provide evidence for potential subdivision of Hudsonian Godwit into three designatable units (DUs), corresponding to breeding subpopulations in the Hudson Bay Lowlands, Mackenzie Delta, and Alaska, respectively. Although there are also three primary wintering areas in South America that are believed to generally correspond to the separate breeding subpopulations, the linkages between breeding and wintering grounds remain only partially understood and there is evidence of individuals moving among the wintering regions. Considering also the limited sample size of genetic studies to date, the potential extent of exchange of individuals among breeding subpopulations is uncertain. Therefore, currently available evidence is considered to be insufficient to delineate evolutionarily distinct populations of Hudsonian Godwit in Canada, and the species is assessed as a single DU.

Hudsonian Godwit was for many decades considered one of North America's rarest birds because it was seldom seen. It has one of the longest migration routes among Western Hemisphere shorebirds, and covers much of the distance through non-stop flights spanning multiple days.

Distribution

Hudsonian Godwit breeds in sub-Arctic and Boreal regions of Canada and Alaska and overwinters in the southernmost regions of South America. Some local breeding sites may remain undiscovered. The main known breeding areas in Canada are along the Hudson Bay Lowlands in Manitoba and Ontario, and in the Mackenzie Delta, Northwest Territories. In Alaska, breeding is known from four areas in the central, western, and southern parts of the state.

Within Canada, the primary staging areas on southbound migration are the coast of James Bay for birds from the Hudson Bay Lowlands and Mackenzie Delta, and prairie lakes in Saskatchewan for birds from Alaska. Migrants then fly long distances east and southward over the Atlantic Ocean, often stopping at staging areas in northern or central South America for up to several weeks before continuing to wintering grounds farther south. Breeding subpopulations are believed to largely be associated with separate wintering grounds, with birds from the Hudson Bay Lowlands wintering primarily in Tierra del Fuego and southern Patagonia, those from the Mackenzie Delta wintering mostly around Samborombon Bay in northern Argentina, and those from Alaska generally wintering on Chiloe Island and the adjacent mainland of Chile. On northbound migration, most birds fly non-stop from their wintering grounds to the United States Gulf Coast and follow a common route north through the U.S. Great Plains, then diverge from the eastern Canadian prairies to their breeding grounds. Hudsonian Godwit occurs regularly during breeding or migration in all three territories and in provinces from British Columbia to Québec, as well as occasionally in fall in all of the Atlantic provinces.

Habitat

Hudsonian Godwit breeds in wetland habitats (sedge meadows and muskeg) in sub-Arctic and Boreal regions. It uses a wide variety of habitats on migration, including freshwater marshes, saline lakes, flooded fields, shallow ponds, coastal wetlands and mudflats. On the wintering grounds, Hudsonian Godwit mainly forages in large shallow bays, lagoons, or estuaries with extensive intertidal mudflats, and roosts in a range of habitats, such as upper tidal flats, sand spits, rocky shorelines, salt marshes, and grasslands. The species faces habitat loss and degradation at all stages of its annual cycle, primarily through climate change and development.

Biology

Hudsonian Godwit reaches sexual maturity at three years of age, and individuals appear to remain on their wintering grounds until ready to breed. Females lay a single clutch of four eggs but may lay a second clutch if the nest is lost to predation. Generation time is estimated to be 7.7 years. The species primarily feeds on invertebrates, although plant tubers are also known to be part of the diet.

Population Sizes and Trends

Systematic long-term monitoring data are lacking for this species, and estimates of population size and trends are considered imprecise. The most recent population estimate for Hudsonian Godwit is approximately 41,000 mature individuals (24,300 individuals in the Hudson Bay Lowlands, 800 in Mackenzie Delta, and 15,750 in Alaska). Migration monitoring trend data from 1995 to 2016 (just under 3 generations) indicate a 6% annual decline (71% cumulative decline) in total population size, although the reliability of the estimate is low because of limited data coverage (only from stopover sites in eastern North America). Surveys on the wintering grounds indicate an annual decline of 4.08% in Tierra del Fuego from 2002 to 2018, equivalent to a three-generation decline of 62%, but stable

numbers at Chiloe Island since the late 1980s. Considering the relative size of the wintering populations, the overall annual rate of decline over the past 16 years is approximately 2.5%, corresponding to 44% over three generations (23 years).

Threats and Limiting Factors

Hudsonian Godwit faces numerous threats throughout its annual cycle. Climate change, and severe weather, as well as natural system modifications, are likely the most serious risks.

Climate change is predicted to affect Hudsonian Godwit in numerous ways. Rising sea levels are expected to reduce coastal foraging habitat throughout its annual cycle. Warmer and drier conditions will cause tundra and prairie wetlands to shrink. Northward advancement of the treeline may reduce the availability of suitable nesting habitat, particularly in the Mackenzie Delta. Altered climate regimes along the northbound migration route and on the breeding grounds appear to be causing an ecological mismatch between timing of breeding and peak prey abundance for birds in the Hudson Bay Lowlands and the Mackenzie Delta. Droughts could affect most Hudsonian Godwits, primarily on the Great Plains during spring migration. Warming temperatures along the migration route are predicted to increase the frequency and severity of extreme weather, which could cause direct mortality of birds, as well as delays in migration.

Much of the South American wintering grounds are threatened by habitat loss and degradation. Urban sprawl affects foraging habitat in Patagonia, whereas expanding aquaculture and algal harvesting activities threaten it on Chiloe Island, where beachfront housing development is also reducing the availability of upland roosting habitat. At their wintering grounds as well as stopover sites, Hudsonian Godwits face additional disturbance from boat traffic, humans, and dogs.

Most Hudsonian Godwits are exposed to pollution in agricultural systems, either on migration, on the wintering grounds, or both, which may reduce prey quality and abundance. Petrochemical pollution from ships and industrial discharge is a concern, especially along the coast of South America. Portions of the Hudson Bay Lowlands are exposed to overgrazing of their tundra habitat by geese, although the impacts on Hudsonian Godwit remain unclear.

Protection, Status and Ranks

Hudsonian Godwit is protected in Canada under the *Migratory Birds Convention Act, 1994* and in the United States under the *Migratory Bird Treaty Act*. The International Union for Conservation of Nature (IUCN) ranks the species as Least Concern globally. The Canada and U.S. Shorebird Conservation Plans recognize it as a species of high concern and it is on the North American Bird Conservation Initiative's watch list. NatureServe designates both the global and Canadian breeding populations as apparently secure. The Canadian Endangered Species Conservation Council (CESCC) considers Hudsonian Godwit to be vulnerable.

TECHNICAL SUMMARY

Limosa haemastica

Hudsonian Godwit

Barge hudsonienne

Range of occurrence in Canada (province/territory/ocean): Yukon, Northwest Territories, Nunavut, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Québec, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador

Demographic Information

| | |
|--|---|
| Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines (2017a) is being used) | 7.7 years, based on IUCN equation 2 |
| Is there an [observed, inferred, or projected] continuing decline in number of mature individuals? | Yes, observed |
| Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations] | -32% within 2 generations (15 years), based on a trend of -2.5% per year from 2002 to 2018 |
| [Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations]. | -44% inferred over 3 generations (23 years), based on a trend of -2.5% per year from 2002 to 2018 |
| [Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations]. | Projected further decline of 10-70% over three generations, based on result of high impact from the threats calculator. |
| [Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future. | Inferred decline of 20 to 60% over three generations, considering past declines and future projections. |
| Are the causes of the decline a. clearly reversible and b. understood and ceased? | a. No b. Yes, in part c. No |
| Are there extreme fluctuations in number of mature individuals? | No |

Extent and Occupancy Information

| | |
|---|-------------------------|
| Estimated extent of occurrence (EEO) | 936,428 km ² |
| Index of area of occupancy (IAO) (Always report 2x2 grid value). | 124,832 km ² |
| Is the population "severely fragmented" i.e., is >50% of its total area of occupancy in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse? | a. No b. No |

| | |
|---|---|
| Number of “locations”* (use plausible range to reflect uncertainty if appropriate) | Likely >10 |
| Is there an [observed, inferred, or projected] decline in extent of occurrence? | No |
| Is there an [observed, inferred, or projected] decline in index of area of occupancy? | No |
| Is there an [observed, inferred, or projected] decline in number of subpopulations? | No |
| Is there an [observed, inferred, or projected] decline in number of “locations”**? | No |
| Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat? | Yes, decline in quality of habitat observed on wintering grounds and inferred/projected on breeding grounds due to drying of wetlands |
| Are there extreme fluctuations in number of subpopulations? | No |
| Are there extreme fluctuations in number of “locations”**? | No |
| Are there extreme fluctuations in extent of occurrence? | No |
| Are there extreme fluctuations in index of area of occupancy? | No |

Number of Mature Individuals (in each subpopulation)

| Subpopulations (give plausible ranges) | N Mature Individuals |
|--|----------------------|
| Hudson Bay Lowlands | 19,900 – 28,700 |
| Mackenzie Delta | 585 – 1020 |
| Alaska | 15,750 |
| Total | 36,235 – 45,470 |

Quantitative Analysis

| | |
|--|----------------|
| Is the probability of extinction in the wild at least [20% within 20 years or 5 generations, or 10% within 100 years]? | Not calculated |
|--|----------------|

* See Definitions and Abbreviations on [COSEWIC web site](#) and [IUCN](#) (Feb 2014) for more information on this term

Threats (direct, from highest impact to least, as per IUCN Threats Calculator)

Was a threats calculator completed for this species? Yes on April 12, 2018

Overall threat of high impact based on:

- i. Climate change and severe weather (low to medium impact threat)
- ii. Natural system modifications (low to medium impact threat)
- iii. Residential and commercial development (low impact threat)
- iv. Agriculture and aquaculture (low impact threat)
- v. Human intrusions and disturbance (low impact threat)
- vi. Invasive and other problematic species and genes (low impact threat)
- vii. Pollution (low impact threat).

What additional limiting factors are relevant?

Hudsonian Godwit is a long-distance migrant. It relies on a small number of high-quality stopover sites on migration and must closely track environmental conditions to complete its breeding period within the short sub-Arctic summer; an apparent mismatch between insect emergence and timing of nesting may be an emerging concern. Godwits congregate in large numbers at staging and stopover sites, and during the overwintering season in South America.

Rescue Effect (immigration from outside Canada)

| | |
|--|--------------------------------------|
| Status of outside population(s) most likely to provide immigrants to Canada. | Alaskan population apparently stable |
| Is immigration known or possible? | Not known, but possible |
| Would immigrants be adapted to survive in Canada? | Yes |
| Is there sufficient habitat for immigrants in Canada? | Yes |
| Are conditions deteriorating in Canada?+ | Yes |
| Are conditions for the source (i.e., outside) population deteriorating?+ | Yes |
| Is the Canadian population considered to be a sink?+ | No |
| Is rescue from outside populations likely? | No |

Data Sensitive Species

| | |
|-----------------------------------|----|
| Is this a data sensitive species? | No |
|-----------------------------------|----|

Status History

COSEWIC: Designated Threatened in May 2019.

Status and Reasons for Designation:

| | |
|------------------------------|------------------------------------|
| Status: Threatened | Alpha-numeric codes: A2b |
|------------------------------|------------------------------------|

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

Reasons for designation:

This large Arctic-nesting shorebird is poorly monitored on its known breeding grounds in the Hudson Bay Lowlands, Mackenzie Delta, and Alaska. However, both migration monitoring and winter surveys indicate substantial population declines over the past two to three generations. Key threats include reduced suitability of nesting habitat and changes in prey availability arising from climate change, and overgrazing by abundant geese in the Hudson Bay Lowlands, as well as loss of habitat and disturbance on the wintering grounds in South America.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals):

Meets A2b, Threatened. Inferred 44% decline in number of mature individuals over the past three generations.

Criterion B (Small Distribution Range and Decline or Fluctuation):

Not applicable. EOO and IAO both exceed thresholds.

Criterion C (Small and Declining Number of Mature Individuals):

Not applicable. The number of mature individuals greatly exceeds thresholds.

Criterion D (Very Small or Restricted Population):

Not applicable. The number of mature individuals greatly exceeds thresholds.

Criterion E (Quantitative Analysis):

Not applicable. Analysis not conducted.



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 (2019)

| | |
|------------------------|--|
| 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.

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

COSEWIC Status Report

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Hudsonian Godwit

Limosa haemastica

in Canada

2019

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Order: Charadriiformes

Family: Scolopacidae

Scientific name: *Limosa haemastica* (Linnaeus 1758)

English name: Hudsonian Godwit

French name: Barge hudsonienne

Cree name: Che-chish-kae-wainae (Sutherland pers. comm. 2018)

Inuktitut name: Sigguraujaquqtujuag (Watts and Smith 2014)

Spanish names: Aguja De Mar, Becasa De Mar (Cornell University 2015), Becacina De Mar, Picopando Ornamentado (NatureServe 2017), Picopando del Este (NABCI 2016)

Portuguese name: Maçarico De Bico Virado (NatureServe 2017)

Hudsonian Godwit is a monotypic species (AOS 2019). In the past its common names were Ring-tailed Marlin and Goose-bird. Junior synonyms of *Limosa haemastica* are *L. hudsonica*, *L. edwardsii*, *L. alba*, and *L. australis* (Walker *et al.* 2011).

Although Hudsonian Godwit is morphologically highly similar to Black-tailed Godwit (*L. limosa*), mitochondrial control region variation is highly divergent (5%) between them, indicating that they warrant recognition as separate species (Höglund *et al.* 2009).

Morphological Description

Hudsonian Godwit is a large shorebird with a long, slightly upturned bill and long legs (Walker *et al.* 2011). The bill is bicoloured in both sexes, transitioning from a pinkish red base to a black tip, but the base turns orange in males during courtship (Walker *et al.* 2011). Hudsonian Godwit is sexually dimorphic, with females tending to be larger and heavier than males and paler overall in breeding plumage, when males have dark rusty red chests and black barring above, while females have lighter rufous underparts and more mottling above (Senner 2010; Walker *et al.* 2011). Both sexes have a broad white wing stripe, dark underwings, white rump and white base to their black tail (Walker *et al.* 2011). In non-breeding plumage, males and females have greyish brown upperparts and whitish underparts. Juvenile birds are similar in appearance to non-breeding adults, but browner (Walker *et al.* 2011).

Hudsonian Godwit is not easily confused with other shorebird species. It is larger than dowitchers (*Limnodromus* spp.) and snipes (*Gallinago* spp.), and typically smaller and darker than Black-tailed and Bar-tailed Godwits (*L. lapponica*). It is also smaller than the Marbled Godwit (*L. fedoa*), which is more cinnamon brown in colour (Walker *et al.* 2011). In flight Hudsonian Godwit can be distinguished from other godwit species by its white wing stripe, dark underwings, and dark tail with wide white base/rump (Walker *et al.* 2011). Non-breeding birds are similar in size to Willet (*Tringa semipalmata*), but have longer bills with a pink base, darker legs and lack the Willet's diagnostic black-and-white outer wing pattern (Walker *et al.* 2011).

Population Spatial Structure and Variability

No morphological variation has been documented among breeding subpopulations (Walker *et al.* 2011). However, Haig *et al.* (1997) conducted an analysis of random amplified polymorphic DNA (RAPD), finding significant population variation ($F_{ST} = 0.69$, $X^2 = 239.7$, $df = 14$, $n = 20$, $p = 0.00$) between breeding individuals from the Hudson Bay Lowlands and Mackenzie Delta. Fall migrants at Quill Lakes, Saskatchewan, were more similar to those from the Mackenzie Delta, but were still clearly differentiated in a cluster analysis.

Designatable Units

Hudsonian Godwit breeds in three relatively distinct areas: the Hudson Bay Lowlands (Manitoba and Ontario), the Mackenzie Delta (Northwest Territories, and probably Yukon), and parts of central, western, and southern Alaska (Sutherland and Peck 2007; Senner 2010; Walker *et al.* 2011; Cannings pers. comm. 2019). Based on isolated observations of individuals elsewhere in the sub-Arctic during the breeding season, it is possible that additional breeding sites remain to be discovered (Walker *et al.* 2011). Although such sites would likely involve only a small number of individuals, they could reduce the apparent gaps in distribution.

In general, it is thought that birds from the Hudson Bay Lowlands overwinter in Tierra del Fuego (Argentina and Chile) and southern Patagonia (Argentina), those from the Mackenzie Delta overwinter along the north coast of Argentina, centred around Samborombon Bay (Bahía de Samborombón), and Alaskan breeders overwinter on Chiloe Island (Isla de Chiloé) and adjacent mainland Chile (Morrison and Ross 1989; Senner 2010; Figure 1). However, evidence for migratory connectivity is primarily based on tracking of birds from Alaska, with 28 of 30 colour-marked Alaskan individuals re-sighted at Chiloe Island and a geolocator study of 26 Alaskan individuals also showing consistent wintering at Chiloe Island (Senner 2012; Senner *et al.* 2014). Data are more limited for Canadian birds, with seven of nine colour-marked individuals from Churchill, Manitoba (Hudson Bay Lowlands) re-sighted in Tierra del Fuego, and two satellite-tracked individuals from Mackenzie Delta followed to Samborombon Bay, one of which continued on to Tierra del Fuego and Chiloe Island (Senner 2012; Watts and Smith 2014). More generally, migrants from all breeding subpopulations appear to follow a similar migratory route south across the Atlantic Ocean, and north from the Gulf of Mexico to the northern Great Plains, although in spring it appears that the Alaskan birds migrate a few weeks earlier than those breeding in Canada (Senner 2010; Walker *et al.* 2011; Senner 2012; Figure 2).

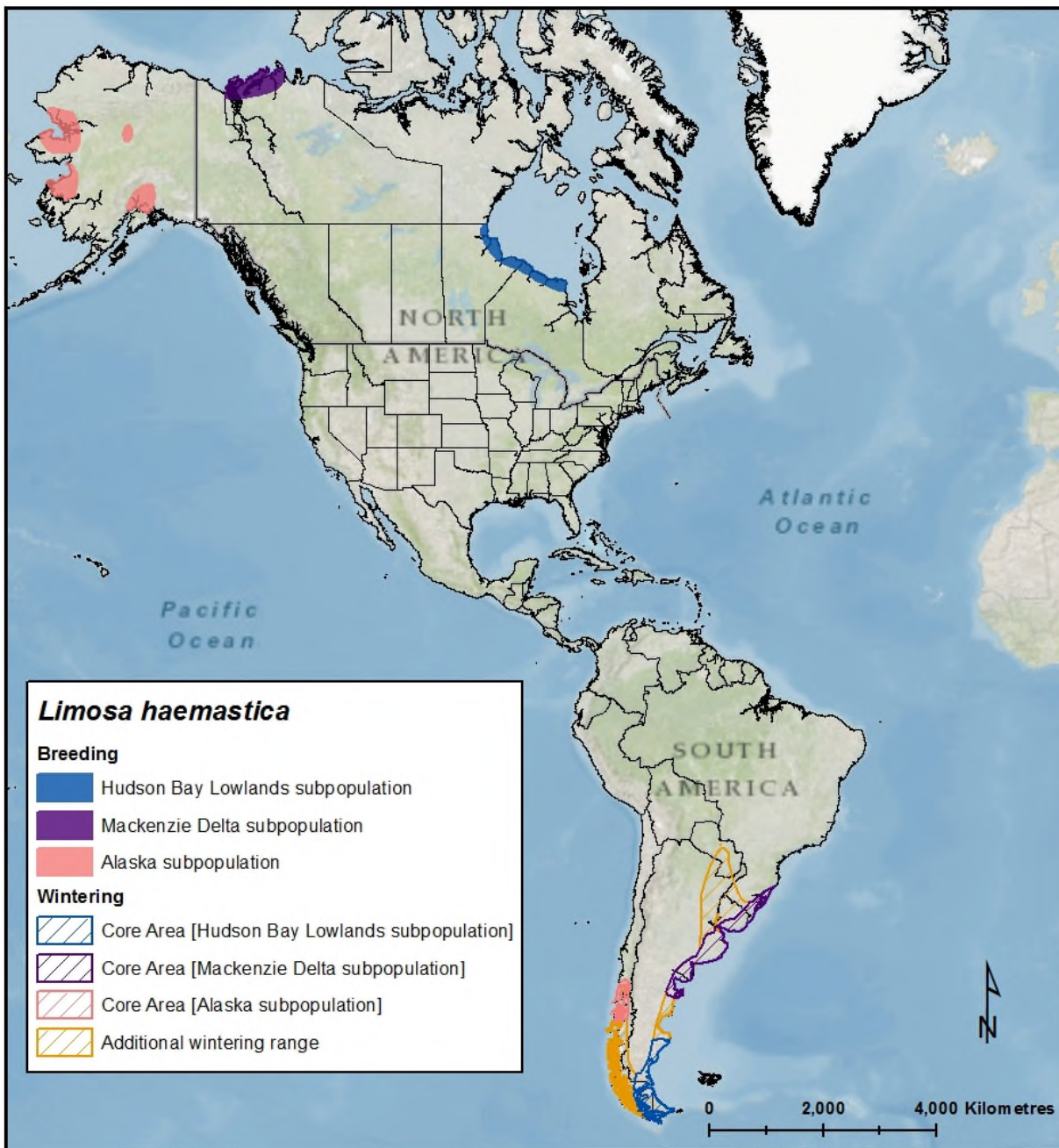


Figure 1. Global Distribution of Hudsonian Godwit, illustrating three relatively distinct breeding and wintering grounds. Yellow shaded areas on wintering grounds represent additional non-breeding range, where individuals from two or more breeding areas may occur (Morrison and Ross 1989; Blanco *et al.* 2008; Senner 2010; Walker *et al.* 2011).

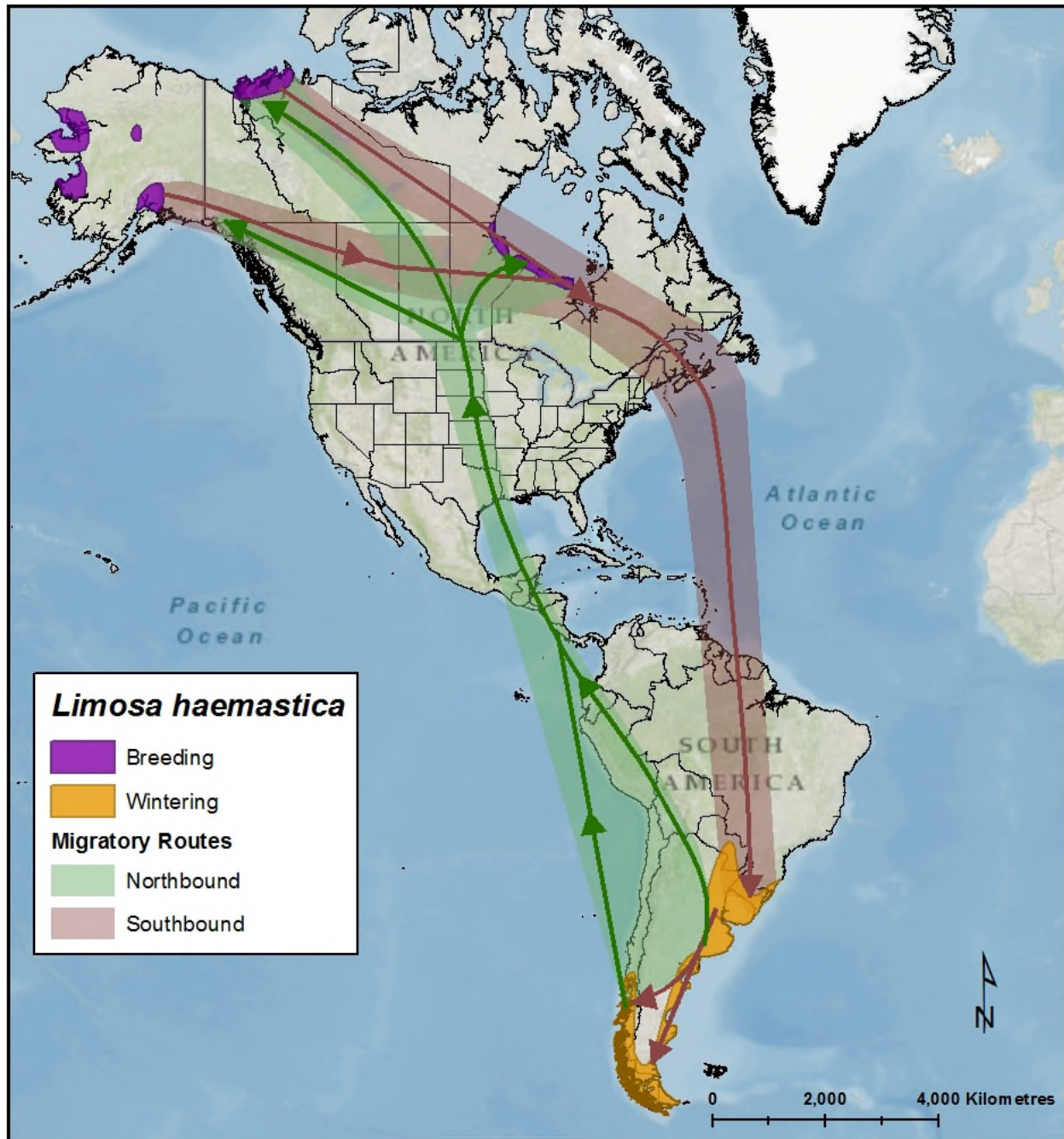


Figure 2. Generalized migration routes of Hudsonian Godwit between breeding and wintering grounds. Note that individual routes may vary considerably (Morrison and Ross 1989; Blanco *et al.* 2008; Senner 2010; Walker *et al.* 2011).

The degree of genetic divergence observed between the Hudson Bay Lowlands and Mackenzie Delta breeding subpopulations (Haig *et al.* 1997) is as high as or higher than values reported between species, based on RAPD analysis (Hey and Pinho 2012). However, this was a single analysis with a sample size of only 20 individuals. Haig *et al.* (1997) also noted that while the Saskatchewan migrants were more similar to the Mackenzie Delta breeders than those from the Hudson Bay Lowlands, they were sufficiently different to suspect that the migrants were of Alaskan origin.

COSEWIC recognizes DUs as discrete and evolutionarily significant populations which, if lost, would likely not be replaced through natural dispersion (COSEWIC 2015). To be recognized as a DU, a population must meet at least one line of evidence regarding each of discreteness and evolutionary significance. For Hudsonian Godwit, the genetic study by Haig *et al.* (1997) appears to satisfy criteria D1 for discreteness (genetic distinctiveness including inherited traits and/or neutral genetic markers) and E1 for evolutionary significance (evidence that populations differ markedly in genetic characteristics thought to reflect relatively deep phylogenetic divergence), and possibly also D2 for discreteness (natural disjunction in geographic range such that local adaptation is likely), though evidence of local adaptations is not known. However, considering the small sample size for the genetics research, the potential for mixing among subpopulations given their overlap during migration and winter (Andres *et al.* 2012), and the limited data on migratory connectivity of Canadian breeders, the weight of evidence is insufficient to confidently support the delineation of separate DUs. As a consequence, the three breeding areas are considered to represent distinct subpopulations, but are treated as a single DU for the purpose of this assessment.

Special Significance

Hudsonian Godwit was for many decades considered one of the continent's rarest birds because it was seldom seen (Morrison 1984; Senner 2008; Walker *et al.* 2011). Many major migratory stopover sites and wintering areas have been identified since the 1940s (Hagar 1966; Morrison 1984; Morrison and Ross 1989), but aspects of the breeding range remain undescribed (Walker *et al.* 2011).

Hudsonian Godwit has one of the longest migrations of any North American shorebird species, travelling approximately 32,000 km round trip annually between breeding grounds in North America and wintering grounds in South America, often undertaking much of this migration through long non-stop flights over several days (Senner 2013).

No Aboriginal Traditional Knowledge is currently available for this species.

DISTRIBUTION

Global Range

Hudsonian Godwit is a long-distance migrant that breeds in sub-Arctic and Boreal regions of Canada and Alaska and overwinters in the southernmost regions of South America. The species primarily breeds in two disjunct areas of Canada (see **Canadian Range**), as well as in Alaska (Figure 1).

Southbound migrants from both the Hudson Bay Lowlands and Mackenzie Delta stage along the coast of James Bay (Morrison and Harrington 1979; Watts and Smith 2014); those from Alaska stage in south-central and western Alaska (e.g., upper Cook Inlet, Aropuk Lake) and the Canadian Prairies (Senner 2010; Walker *et al.* 2011). All birds fly east from there and then south over the western Atlantic Ocean without stopping, to Amazon Basin stopover sites and eventually onwards to their wintering grounds farther south (Senner 2010; Walker *et al.* 2011) (Figure 2).

The wintering range is primarily along the coasts of Argentina and southern Chile (Figure 1). Areas of particular importance are Samborombon Bay, Argentina; Tierra del Fuego [especially San Sebastian Bay (Bahía San Sebastián, Argentina) and Lomas Bay (Bahía Lomas, Chile)]; and Chiloe Island and the adjacent mainland of Chile (Morrison and Ross 1989; Senner 2010). Lesser numbers occur elsewhere along the Argentinean and Chilean coasts, in the Argentinean interior, and along the coasts of Peru and southern Brazil (Senner 2010).

On their northbound migration, Hudsonian Godwits are believed to fly non-stop between southern South America and the United States Gulf Coast. Once in North America, all birds migrate through the central United States, staging at areas in Texas, Oklahoma, Kansas, Iowa, Nebraska, Minnesota, South Dakota, and North Dakota, as well as parts of the Canadian Prairies, before diverging to their respective northern breeding grounds (Senner 2010) (Figure 2).

Canadian Range

Hudsonian Godwit is known to breed primarily in two regions of Canada (Figure 1):

- Hudson Bay Lowlands in Manitoba and Ontario (around Churchill and La Perouse Bay and along southern Hudson Bay to Cape Henrietta Maria region; Sutherland and Peck 2007). Several individuals and pairs have also been recorded on Akimiski Island in James Bay over multiple breeding seasons from 2001 to 2005, but no evidence of breeding has been found (Sutherland and Peck 2007).

- Mackenzie Delta in Northwest Territories (extending east to Anderson Delta; Senner 2010). Small numbers of migrant Hudsonian Godwits are also regularly observed in southern Yukon during May and early June, and although no evidence of breeding has been found, there are multiple observations and eBird records from the Yukon portion of the Mackenzie Delta between mid-June and mid-July, corresponding to the peak of the breeding season (Sinclair *et al.* 2003; Bennett pers. comm. 2017; eBird 2017; Eckert pers. comm. 2017; Sinclair pers. comm. 2017; Cannings pers. comm. 2019).

Breeding has also been documented in the Chilkat Pass area of northern British Columbia (one nest in 1963 and three observations of pairs: in 1957, 1981 and 1983; Campbell *et al.* 1990). It is unclear whether these individuals were more closely associated with the Mackenzie Delta or the Alaskan breeding subpopulation. It is also possible that there are some undiscovered breeding sites between the Mackenzie Delta and Hudson Bay Lowlands.

The west and southeast coast of James Bay (in Ontario and Québec respectively) is a particularly important stopover area during fall migration; a smaller number of Hudsonian Godwits (believed to be from Alaska) pass through sites in Saskatchewan, most notably Quill Lakes, Luck Lake, Opuntia Lake, and Porter Lake (Morrison and Harrington 1979; Morrison 1984; Alexander *et al.* 1996; Benoit 2004; Aubry and Cotter 2007; Beyersbergen 2009b,c; Senner 2010; Walker *et al.* 2011). Relatively small and variable numbers stage in the Gulf of St. Lawrence and Bay of Fundy before migrating south, and small numbers stop over at other sites from the Great Lakes through the Atlantic provinces (Morrison 1984; Hicklin 1987; Aubry and Cotter 2007; ECCC 2017a). Quill Lakes and Luck Lake are also used by Hudsonian Godwit during spring migration (Senner 2010).

Extent of Occurrence and Area of Occupancy

Estimates of the extent of occurrence (EOO) and index of area of occupancy (IAO) for Hudsonian Godwit are imprecise because the species is not well monitored in Canada. Isolated observations of birds during the breeding season outside known breeding areas (e.g., in the Northwest Territories and Nunavut, along the Hudson Bay coast in Manitoba, inland from the Hudson Bay coast and on Akimiski Island in James Bay) (Sutherland and Peck 2007; Walker *et al.* 2011) suggest that additional breeding areas may exist. The distribution of Hudsonian Godwit in Canada was mapped based on available survey data (CWS surveys [Beyersbergen and Norton 2005; Beyersbergen and Duncan 2007; Beyersbergen 2009a,b,c]; Canadian Museum of Nature 2015; eBird 2017; Program for Regional and International Shorebird Monitoring [PRISM: the Boreal Shorebird Survey, the James Bay Shorebird Project, the Ontario Shorebird Survey, Long Point Bird Observatory Monitoring; CWS, Ontario Region 2017; Bird Studies Canada 2018]; NHIC 2017; Parks Canada 2017).

The EOO, based on the minimum convex polygon around all known breeding sites in Canada, is 936,428 km². The IAO, determined using a 2 km x 2 km grid over the known breeding areas in Canada, is 124,832 km² (Figure 3).

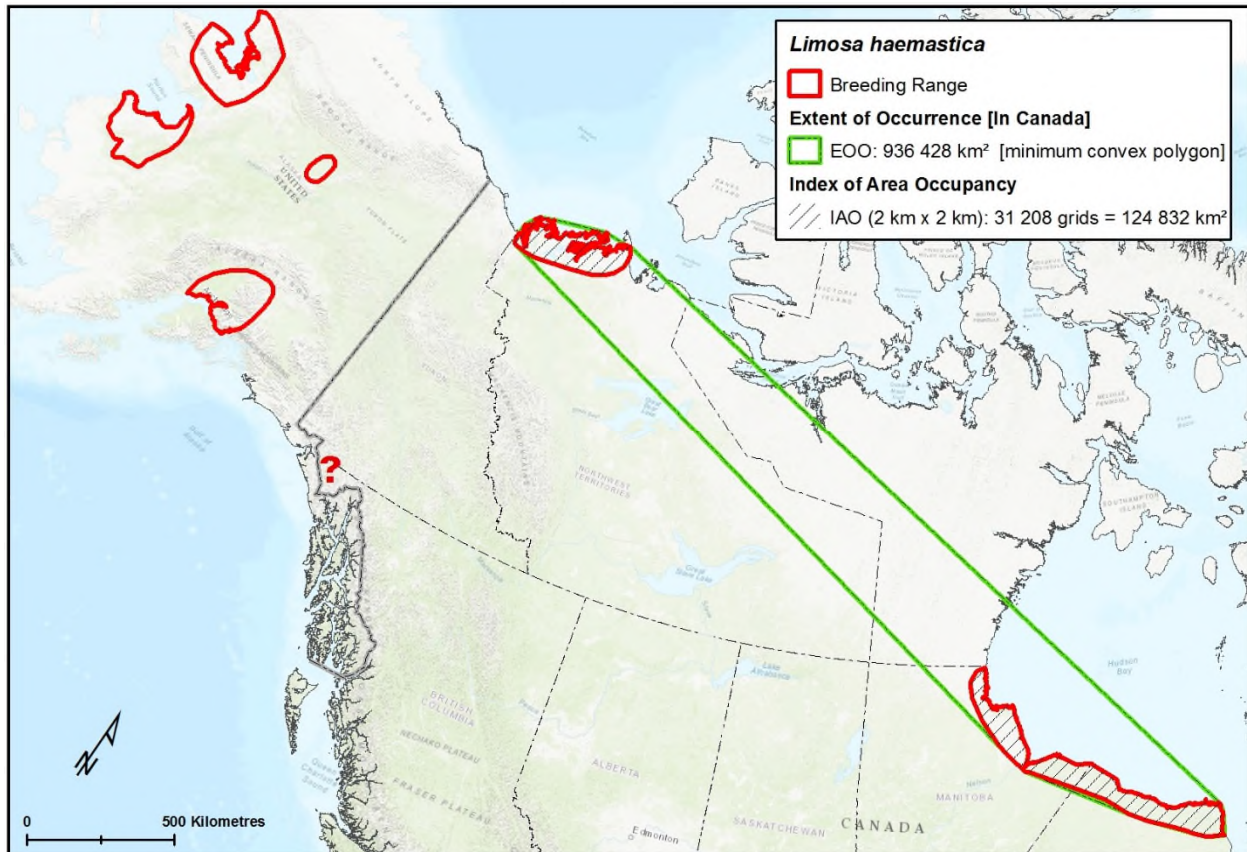


Figure 3. Map of breeding range, used for calculation of extent of occurrence (EOO) and index of area of occupancy (IAO) of Hudsonian Godwit in Canada.

Search Effort

Monitoring of Hudsonian Godwit is limited on its breeding grounds and during migration in Canada. The species breeds in low densities at isolated sites that are widely dispersed across the sub-Arctic and Boreal regions (Andres *et al.* 2009), largely beyond the reach of the North American Breeding Bird Survey (ECCC 2017b). Stopover sites on northbound migration through the North American Great Plains tend to be quite ephemeral, changing from one year to the next (Senner 2010). Most information on distribution and abundance is summarized from local surveys at migratory staging and stopover sites in North America (e.g., prairie lakes, James Bay) as well as from major wintering sites in South America, where annual surveys of the main areas in Tierra del Fuego have been carried out since 2000 (Morrison pers. comm. 2018).

Hudsonian Godwit has been recorded by regional PRISM surveys across Canada (Atlantic Canada Shorebird Survey, Arctic PRISM, Ontario Shorebird Survey and Prairie Shorebird Survey; Elliott and Smith 2012; Pirie *et al.* 2012; Rausch and Johnston 2012; Bird Studies Canada 2017, 2018). Prairie shorebird surveys conducted by the Canadian

Wildlife Service (CWS) have documented the species on migration (e.g., aerial and ground surveys in Alberta and Saskatchewan; Beyersbergen and Norton 2005; Beyersbergen and Duncan 2007; Beyersbergen 2009a,b,c; McKellar pers. comm. 2017).

HABITAT

Habitat Requirements

Breeding

Hudsonian Godwit breeds in wetland habitats in sub-Arctic and Boreal regions. Nesting sites are located in open sedge meadows or muskeg on the tundra, often close to the treeline and small ponds, rivers or tidal mudflats along the coast (Senner 2010; Walker *et al.* 2011; NatureServe 2017). Birds nest on the ground in a depression lined with a few leaves, typically on a dry hummock near small birches (*Betula* spp.) or other shrubs, which may be used for concealment (Ehrlich *et al.* 1988; Walker *et al.* 2011).

Swift *et al.* (2017a) found that Hudsonian Godwit breeding in Churchill, Manitoba, and Beluga River, Alaska preferred nest sites with high plant diversity and cover, predominantly composed of graminoids and forbs, but with moderate amounts of shrubs as well. Birds nested close to shallow water but avoided large open non-vegetated areas (Swift *et al.* 2017a). Much apparently suitable nesting habitat is unoccupied by Hudsonian Godwit, however, which suggests either that some habitat features important to the species may still need to be identified (Senner 2010), or that habitat is not at full carrying capacity. The extent of vernal flooding when birds arrive on the breeding grounds may also influence nest site selection. Nests tend to be on slightly elevated knolls in otherwise wet graminoid tundra and fens. These sites likely emerge from spring flooding earlier than lower lying areas (Sutherland pers. comm. 2018). Other factors may also drive nest site location. For example, the clustered distribution of nests at Beluga River was not associated with habitat characteristics, predation risk, or distance to roads, but was influenced by social cues (i.e., proximity to other Hudsonian Godwit nests and Mew Gull, *Larus canus*, nests; Swift *et al.* 2017b).

Migration

Hudsonian Godwits use a wide variety of habitats on migration. The key fall stopover sites are marshes and saline lakes in the Canadian Prairies and coastal wetlands and exposed mudflats along James Bay and to a lesser extent Hudson Bay (Morrison and Gaston 1986; Alexander and Gratto-Trevor 1997; Benoit 2004). During spring migration, birds visit wetland habitats in the North American Great Plains, such as flooded agricultural fields, marshes, shallow ponds, sloughs, sewage lagoons, and mudflats, as well as lakes and reservoirs with low water levels (Senner 2010; Walker *et al.* 2011).

Stopover sites provide critical resources allowing birds to replenish fat reserves and prepare for or recover from extreme long-distance migration (Skagen and Knopf 1994; Senner *et al.* 2014). At the end of the breeding season, sites on the Canadian Prairies and in James Bay appear to be the only localities regularly used as stopover areas by most southbound birds between the breeding grounds and the Amazon Basin and must therefore be of high quality to support the long-distance flight (Hagar 1966; Morrison 1984; Senner *et al.* 2014). Smaller numbers are also observed annually between mid-July and mid-August in the Mingan Archipelago of Québec, including birds wintering in both Argentina and Chile, based on sightings of colour-banded individuals (Aubry pers. comm. 2019).

Wintering

Hudsonian Godwits use both freshwater and marine habitats on the South American wintering grounds. Foraging sites are typically in large shallow bays or estuaries with extensive intertidal mudflats (Morrison and Ross 1989; Senner 2008, 2010). Sites are characterized by soft substrates, which are linked to higher foraging and prey capture rates than sandy sediment (Senner and Coddington 2011). Birds forage less commonly in sewage lagoons, salt and freshwater marshes, brackish swamps, inland saline lakes, flooded rice fields, and upland grasslands (Senner 2010; Walker *et al.* 2011). Roosting sites are often situated several kilometres from foraging grounds and include muddy substrates along high tide lines in intertidal bays, sand spits, small freshwater islands (in lakes or rivers), rocky shorelines, salt marshes, and grasslands (Senner 2010; Walker *et al.* 2011).

Habitat Trends

Historical changes in habitat quantity or quality for Hudsonian Godwit are largely unknown because much of its breeding, wintering, and migratory habitat is remote (Walker *et al.* 2011). The spatially and temporally dynamic nature of habitat used on migration through inland areas (i.e., wetlands and flooded fields) further complicates tracking of habitat trends (Skagen and Knopf 1994; McIntyre *et al.* 2014). However, it is likely that most Hudsonian Godwits face ongoing habitat loss and degradation at all stages of their annual cycle.

Breeding

Hudsonian Godwits breeding in the Hudson Bay Lowlands may be affected by hyperabundant goose populations in the area. Overgrazing by rising populations of geese (Snow Goose, *Anser caerulescens*; Ross's Goose, *Anser rossii*; and Canada Goose, *Branta canadensis*) on the tundra around Churchill, Manitoba in recent years has led to widespread alteration of habitat (Sammler *et al.* 2008; Rockwell *et al.* 2009; Senner 2010; Swift *et al.* 2017a). Intense herbivory by geese in freshwater graminoid wetlands dramatically changes soil chemistry and vegetation structure, leading to dry non-vegetated areas that are avoided by Hudsonian Godwit (Swift *et al.* 2017a). Over time, these isolated small barren patches coalesce into more extensive stretches of degraded habitat (Rockwell *et al.* 2009). The pattern has also been documented in Wapusk National Park, east of Churchill (Rockwell *et al.* 2009)

Migration

Hudsonian Godwit faces shrinking habitat on migration as well. Overgrazing by hyperabundant geese may also be affecting stopover sites along James Bay. The Prairie Pothole Region of the northern Great Plains has lost between 40 and 70% of its wetlands since European settlement (Bartzen *et al.* 2010), and agricultural activities altered wetland levels or affected vegetation growth in over 90% of wetlands in the Canadian Prairies from 1985 to 2005, with ephemeral wetlands being the most sensitive and slowest to recover (Bartzen *et al.* 2010). The Rainwater Basin, a vast wetland complex stretching over 10,000 km² in south-central Nebraska, is a common stopover site for Hudsonian Godwit on spring migration north. Approximately 90% of the original wetlands in the Rainwater Basin have been lost to land conversion since the late 1800s (McIntyre *et al.* 2014). It is estimated that approximately 1 million hectares of grassland habitat was lost to crop production across the entire Great Plains in 2015-2016 alone (WWF 2017).

Many remaining prairie wetlands are surrounded by farmland, and have become degraded by agricultural runoff, which introduces pesticides and sediment into surface waters (Jorgensen 2004). In addition, consolidation drainage (in which many small wetlands are drained to produce fewer larger and deeper wetlands) is common in agricultural areas, resulting in hydrological changes which reduce invertebrate prey abundance (McCauley *et al.* 2015).

In Texas, changes to rice farming practices may reduce the availability of flooded fields for birds during spring migration (Senner 2010). Urban sprawl throughout the Great Plains (particularly in Texas) further contributes to loss of habitat for northbound migrants (Senner 2010).

Wintering

More than half of identified major overwintering sites in South America are experiencing habitat loss and degradation (Senner 2008). In Chile, Chiloe Island and surrounding areas are subject to a growing aquaculture industry, as well as shoreline development and disturbance by dogs, all of which threaten the quality of intertidal mudflat habitat (Senner 2008; Andres *et al.* 2009). In Argentina, Bahia Blanca is among the most contaminated estuaries in the country because of runoff from industrial activity (agro- and petrochemicals). Tierra del Fuego, where the greatest concentration of overwintering Hudsonian Godwits occurs, is exposed to a particularly high risk of oil spills because of its proximity to major shipping routes (Senner 2010).

BIOLOGY

There has been limited research on the biology of Hudsonian Godwit, and most has focused on breeding grounds near Churchill, Manitoba, and in Alaska (e.g., Williamson and Smith 1964; Hagar 1966; Jehl 1971; Senner 2013; Senner *et al.* 2017).

Life Cycle and Reproduction

Information is lacking on age of first reproduction in Hudsonian Godwits. Other godwit species (i.e., Bar-tailed and Black-tailed Godwits) reach sexual maturity and typically start breeding at 2 years of age (European Communities 2007; Kaufman 2017), and this is assumed to be the case for Hudsonian Godwit as well (Walker *et al.* 2011). Pair bonds are established at the breeding grounds. A single clutch of four eggs is produced annually, although females may re-lay if the clutch is lost to predation (Walker *et al.* 2011). Early studies of Churchill birds showed hatching success of 83-85% (Hagar 1966; Jehl 1971). Observed nest survival rates over the 23-day incubation period range from 0.173 ± 0.146 in Churchill, Manitoba ($n = 57$ nests) to 0.64 ± 0.285 in Beluga River, Alaska ($n = 70$; Senner *et al.* 2017). Chick survival rates over the 21-day fledgling period range from 0.12 ± 0.07 in Churchill (both for initial attempts and re-nests) to 0.29 ± 0.17 (for first nests) and 0.01 ± 0.001 (for re-nests) in Beluga River (Senner *et al.* 2017). The lower survival rates for Churchill chicks appears to be related to cold temperatures during the incubation period (when young are not yet fully homeothermic) and due to lower prey abundance during the fledgling period (Senner *et al.* 2017).

The adult survival rate for Hudsonian Godwit is at least 80% based on geolocation tracking data (Senner *et al.* 2014). For the similarly sized Marbled Godwit, two studies estimated adult survival rate of 87% (Colwell *et al.* 1995) and 96% (Gratto-Trevor 2000). Based on this, a minimum adult survival rate of 85% is assumed for Hudsonian Godwit.

Using the IUCN (2017a) equation of $1/\text{adult mortality} + \text{age of first reproduction}$, generation length for Hudsonian Godwit is estimated as 7.7 years (given that IUCN defines age as “1” until an individual has reached 24 months). This is slightly shorter than the 8.7 years reported in the IUCN Red List species account (BirdLife International 2016), but as no assumptions are provided for that estimate, the shorter generation length is considered to be more reliable.

Physiology and Adaptability

The Hudsonian Godwit's long-distance migration strategy (multi-day non-stop flights of several thousand kilometres) is thought to impose high physiological demands on the species. Other long-distance migrant shorebirds are known to double their body mass, increase flight muscle and shrink digestive organs in preparation for the migratory journey (e.g., Red Knot, *Calidris canutus*; Semipalmated Sandpiper, *Calidris pusilla*; Piersma *et al.* 1999; Dietz *et al.* 2007; Maillet and Weber 2007). Hudsonian Godwits are believed to make non-stop flights between North America and South America on both north- and southbound migrations. Once birds reach North America on the migration north, they follow a relatively narrow path through the mid-continent in a relatively short period of time (late April through May), with individuals possibly making only a single stop for refueling (Skagen *et al.* 1999; Espinosa *et al.* 2005; see **Dispersal and Migration**). Senner (2010) suggested that godwits fly as far as is physiologically possible before stopping to refuel. They therefore likely require a network of high-quality stopover sites along migration routes to meet their

significant energetic needs (Senner *et al.* 2014). Loss of suitable stopover habitat containing abundant resources could drastically tax physiological capacity and threaten the ability of individuals to complete migration (Senner 2013).

As a long-distance migrant breeding in highly variable sub-Arctic and Boreal conditions, Hudsonian Godwit has a relatively small window of time available for breeding each year (approximately 9 to 10 weeks; Senner 2013; Senner *et al.* 2014). To successfully reproduce during the short sub-Arctic summer, the species must accurately track local resource conditions, so that breeding efforts are synchronized with the period of maximum invertebrate prey abundance (Senner 2012). This appears to be a growing challenge in the Hudson Bay Lowlands. The average timing of the maximum prey period has not changed on the breeding grounds around Churchill, Manitoba over the last 40 years (Senner *et al.* 2017). Hudsonian Godwits, however, arrive on the Churchill breeding grounds at least 10 days later than they did 40 years ago, which Senner (2012) suggested may be a function of migration slowing down in the northern United States and southern Canada in response to cooler, later spring weather there than in the past. This shift in arrival may mean that Churchill birds experience an ecological mismatch between breeding period and resource phenology, which could negatively affect reproductive success (Senner 2012).

An ecological mismatch may also exist in the Mackenzie Delta, because Hudsonian Godwits breeding there migrate north at the same time as Hudson Bay Lowlands birds and are thus exposed to the same asynchronous climate conditions through the North American Great Plains, followed by rapid warming on their breeding grounds (Senner 2013). The asynchrony in timing between breeding and resource abundance is likely to increase as climate change continues (Senner 2013).

Dispersal and Migration

Hudsonian Godwits are long-distance migrants that travel the full length of the Western Hemisphere on an annual basis (Senner 2013). Their migration route is elliptical: the southbound journey takes birds from sub-Arctic breeding grounds over the western Atlantic to South America, and the northbound journey takes them up through South America to the Gulf of Mexico, the central U.S. and Canada (Senner 2010; Figure 2). Little is known of the exact pathways flown by Hudsonian Godwit between continents on north and south migrations, but it appears that godwits routinely fly multi-day, non-stop journeys in both directions. Adults breeding near Beluga River, Alaska that were equipped with light level geolocation trackers made non-stop flights greater than 6500 km over 5 days heading south, and greater than 10,000 km over 7 days heading north (Senner *et al.* 2014). Birds showed high fidelity to general stopover areas throughout the migration cycle, with 92% (24 out of 26) of birds stopping in the same series of areas each year from 2009 to 2012 (Senner 2013).

Some males begin to migrate south as early as late June, but the majority of Hudsonian Godwits leave the breeding grounds from mid-July through early August (Senner 2010). Birds initially stage at major sites south of the breeding grounds during July and August, such as Aropuk Lake (Yukon River Delta, Alaska) and Quill, Porter, and Luck

Lakes (Saskatchewan) for Alaskan birds, and James Bay primarily for Canadian birds, although at least some from Alaska pass through as well (Morrison and Harrington 1979; Morrison 1984; Senner 2010; Walker *et al.* 2011; Senner *et al.* 2014). The species occurs frequently in small numbers at stopover sites along the Atlantic coast (e.g., Gulf of St. Lawrence, Bay of Fundy), although the origin of these birds is not known. Individuals from all subpopulations then fly non-stop from staging sites to stopover sites in northern South America, particularly in the Amazon Basin, and arrive in southern Brazil and northern Argentina in September (Senner 2010).

Three adult Hudsonian Godwits from the Mackenzie Delta were satellite tracked in 2013 (Watts and Smith 2014; Seaturtle.org 2019). The birds left the Mackenzie River area in early July, with two flying approximately 2500 km southeast to Churchill in less than three days, and the third stopping over for a week in southern Saskatchewan before heading northeast and also visiting Churchill. Contact with the latter bird was lost there, but the other two were tracked to South America. The male remained in the Hudson Bay area for 6 weeks, then flew >6000 km non-stop over five days to the Orinoco River Basin in Venezuela, where he stayed for three weeks before moving on to the Amazon Basin for one month, and then gradually south until reaching Samborombon Bay in early December. The female moved slowly southeast along Hudson Bay and James Bay over a period of three months, then flew >5000 km non-stop over 4 days to the Caribbean coast of Colombia, staging there for three weeks before moving on to Bolivia for three weeks, and then moving slowly across southern Argentina to reach Samborombon Bay in early February. She remained in Argentina for the next 25 months, but alternated between Samborombon Bay and Tierra del Fuego during this period, and then briefly visited Chiloe Island in April 2016 before migrating north, but the signal was lost during migration (Seaturtle.org 2019).

As suggested by the satellite telemetry results above, immature birds may remain in South America year-round until they are ready to breed in their third or even fourth year. Northbound migration begins in late February and early March. Few observations exist of Hudsonian Godwits between South America and the south Texas coast (uncommon along the Pacific coast of Guatemala and in southern Mexico), and geolocator data suggest this part of the journey is often made in a single non-stop flight (Walker *et al.* 2011; Senner *et al.* 2014). Hudsonian Godwits exhibit a bimodal arrival pattern in North America, with the first group making landfall off the Gulf of Mexico in early April (believed to be Alaskan breeders) and the second group arriving in late April and early May (believed to be Canadian breeders from both Hudson Bay Lowlands and Mackenzie Delta; Senner 2012). Birds migrate north through the Central Flyway (mainly Oklahoma, Kansas, Nebraska, South Dakota, North Dakota, Manitoba and Saskatchewan), reaching Alaska breeding grounds in early to mid-May, Mackenzie Delta breeding grounds in late May, and Hudson Bay Lowlands breeding grounds in late May and early June (Senner 2010).

Interspecific Interactions

Hudsonian Godwits feed primarily on invertebrates, such as insect larvae and small snails during the breeding season, and worms, bivalves and crabs during the non-breeding season (Walker *et al.* 2011). However, a study of spring migrants stopping over at Quill Lakes, Saskatchewan, reported a heavy reliance on plant tubers, with Sago Pondweed (*Stuckenia pectinatus*) comprising 96% of gut contents (Alexander *et al.* 1996).

Several species prey on Hudsonian Godwit, including Gyrfalcon (*Falco rusticolus*) on adults, Northern Harrier (*Circus hudsonius*) and Red Fox (*Vulpes vulpes*) on adults and chicks, and Common Raven (*Corvus corax*) on eggs (Walker *et al.* 2011). Adults have been observed mobbing Bald Eagle (*Haliaeetus leucocephalus*), Golden Eagle (*Aquila chrysaetos*), Rough-legged Hawk (*Buteo lagopus*), Short-eared Owl (*Asio flammeus*), Herring Gull (*Larus argentatus*) and Parasitic Jaeger (*Stercorarius parasiticus*) suggesting that these species are predators as well (Walker *et al.* 2011).

Hudsonian Godwits breeding in Beluga River, Alaska have been found to nest in association with Mew Gulls, potentially as an anti-predator strategy (Swift *et al.* 2017b). Mew Gulls are loud and aggressive defenders of their nests, which may benefit nearby Hudsonian Godwit nests. Adult godwits move chicks away from Mew Gull nests, however, once eggs hatch to avoid fledgling predation (Swift *et al.* 2017b).

Hudsonian Godwits breeding in the Hudson Bay Lowlands are experiencing habitat degradation due to overgrazing by geese (Snow Goose, Ross's Goose and Canada Goose). Goose populations are rapidly increasing in the area, resulting in loss of preferred nesting habitat for Hudsonian Godwit (Swift *et al.* 2017a). Birds nesting near Churchill also suffer heavy egg predation by Common Ravens (Walker *et al.* 2011).

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

Population estimates for Hudsonian Godwit are calculated primarily from counts at South American overwintering sites, such as Chiloe Island, Tierra del Fuego and Samborombon Bay, and at North American stopover sites on migration (e.g., James Bay on southbound migration, the U.S. Prairie Potholes Region on northbound migration). Although most of these efforts are coordinated by government agencies, coverage has been variable (e.g., 1 year in Samborombon Bay, 2 years in the Prairie Potholes, 19 years in Tierra del Fuego). The highly dispersed and often inaccessible breeding sites make monitoring difficult during the breeding season, and no systematic surveys exist for the species on the breeding grounds (Andres *et al.* 2009; Senner 2010; Walker *et al.* 2011). Hudsonian Godwit is monitored during the breeding season as part of the Canadian Wildlife Service's Arctic PRISM in the Mackenzie Delta, but individuals are encountered relatively infrequently compared with other shorebird species (Bart and Smith 2012; Rausch and Johnston 2012). The species is also documented through breeding bird atlas efforts in Manitoba and

Ontario, although search effort within the breeding range is limited (Bird Studies Canada *et al.* 2008; Artuso *et al.* 2018). Bart and Smith (2012) concluded that a “special survey effort” would be required to adequately monitor Hudsonian Godwit during the breeding season. The estimated population size of the species, based on counts in winter and on migration, appears to be greater than the number likely nesting in known breeding areas, suggesting that additional breeding sites remain to be discovered (Senner 2010).

Aerial surveys of wintering sites in Tierra del Fuego have been conducted annually since 2000, with coverage of both Bahia Lomas and Bahia San Sebastian since 2002 (Morrison pers. comm. 2018). These surveys provide the longest and most consistent data set available for estimating trends. On Chiloe Island, ground counts (either walking or from fixed census points) and aerial surveys have been conducted periodically at sites where birds are known to occur (Espinosa *et al.* 2005; Andres *et al.* 2012).

Migration monitoring likely samples a small proportion of the total population (Government of Canada 2014). Variable inter-annual wetland conditions in the North American Great Plains result in unpredictable abundance patterns of shorebirds at any given site, complicating long-term monitoring (Alexander and Gratto-Trevor 1997). Hudsonian Godwits are recorded on migration through the Atlantic Canada Shorebird Survey, Ontario Shorebird Survey, and the Prairie Shorebird Surveys (all part of PRISM), but observations tend to be scattered and sparse (Smith pers. comm. 2017). Trend estimates have been derived from these migration survey data for the period 1974-2016, but their precision is considered low because they may be biased by:

- insufficient data (very few individuals were counted overall, and only eastern North America had enough counts to be included in calculations);
- inter-annual changes in stopover duration and distribution during migration (limiting the ability to track the species from year to year) (Smith pers. comm. 2017).

Abundance

Table 1 summarizes population estimates for Hudsonian Godwit. The most recent published total population estimate for Hudsonian Godwit is 77,000 individuals, comprising 56,000 in Tierra del Fuego associated with the Hudson Bay Lowlands subpopulation, and 21,000 near Chiloe Island associated with the Alaska subpopulation (Andres *et al.* 2012). This represents an increase over the previous estimate of 70,000 individuals (Morrison *et al.* 2006), solely based on a more intensive survey of overwintering birds along the Pacific coast near Chiloe Island, Chile that increased the estimate of the Alaska subpopulation from the previous value of 14,000 (Andres *et al.* 2009). However, more recent monitoring in Tierra del Fuego indicates an average count of 32,400 over the most recent one-generation period (2011-2018; Morrison unpubl. data). The only complete survey focused on the presumed core wintering grounds of the Mackenzie Delta subpopulation in Samborombon Bay was conducted in 2014, yielding an estimate of 1070 individuals (Martinez-Curci and Isacch 2017).

Table 1. Population estimates for Hudsonian Godwit, expressed as numbers of individual birds, including both mature individuals and those of non-breeding age.

| Subpopulation / Survey location | Estimate ¹ | Survey Year(s) | Confidence | Survey timing | Source |
|--|-----------------------|------------------------|-----------------------|------------------|---|
| Hudson Bay Lowlands (Tierra del Fuego) | 56,000 ± 28,000 | 2000-2006 | Moderate ² | Winter | Morrison <i>et al.</i> 2006 ³ |
| Hudson Bay Lowlands (Tierra del Fuego) | 32,400 ± 5,900 | 2011-2018 ⁴ | High ⁵ | Winter | Morrison unpubl. data |
| Mackenzie Delta (Samborombon Bay) | 1070 ± 290 | 2014 | High ⁵ | Winter | Martínez-Curci and Isacch 2017 |
| Alaska (Chile) | 14,000 ± 7000 | 1993-2005 | Moderate ² | Winter | Brown <i>et al.</i> 2001; Morrison <i>et al.</i> 2006 |
| Alaska (Chile) | 21,000 | 2007-2008 | High ⁶ | Winter | Andres <i>et al.</i> 2009 ³ |
| All | 70,100 ± 30,385 | 2002-2003 | Moderate | Spring migration | Skagen <i>et al.</i> 2008 ⁷ |

¹ Estimate is reported with standard deviation or range of predicted values where available.

² Morrison *et al.* (2006) applied a moderate degree of certainty to surveys that are targeted toward a narrowly distributed species whose populations tend to concentrate to a high degree either in a restricted habitat or a small number of sites; the estimate is considered to be within 50% of the real number (range of values reflected in the “Estimate” column).

³ Considered to be the most recent estimate by Andres *et al.* (2012)

⁴ Average count over the most recent one-generation period.

⁵ Confidence based on relatively low coefficient of variation.

⁶ Andres *et al.* (2012) considered confidence to be high for results based on a targeted survey or census of a population.

⁷ The estimate reflects an assumption that 73% of the total population was sampled.

In all cases, winter surveys have not distinguished among age classes. However, as Hudsonian Godwits do not mature until two years old and assuming that first-winter birds account for approximately 25% of the wintering population, the number of mature individuals can be estimated by adjusting winter counts accordingly. The most recent revised estimates would be approximately 24,300 for the Hudson Bay Lowlands, 800 for Mackenzie Delta, and 15,750 for Alaska, for a total of approximately 41,000 mature individuals. This is considerably lower than the total estimate of 70,100 mature individuals by Skagen *et al.* (2008) based on spring migration counts in the U.S. Prairie Potholes region. However, the surveys underlying that estimate were conducted in 2002 and 2003; applying the average annual decline of 4.08% observed in Tierra del Fuego from 2002 to 2018 (see **Fluctuations and Trends**) yields a revised estimate of 37,500 that is comparable to the numbers derived from winter surveys.

Fluctuations and Trends

Historical information on population trends is largely lacking because there has been limited long-term monitoring of this sparsely distributed species. Hudsonian Godwit was hunted heavily for food during the 19th century in North and South America, which likely led to population declines. The species is thought to have declined in the early 1900s, based on observations in Argentina (Walker *et al.* 2011). It was commonly recorded in Alaska in the late 1800s but was not observed in the state from 1907 to 1951, although this may largely reflect the remoteness of breeding sites and limited search effort (Williamson and Smith 1964). Hudsonian Godwit was first described near Churchill, Manitoba in the 1930s, when it was considered very rare in the area (Taverner and Sutton 1934). By the 1960s, however, the species was common there (Hagar 1966; Jehl and Smith 1970). Numbers then appear to have declined in the James Bay and Hudson Bay area between the late 1970s and early 1990s (Morrison 1991; Rockwell *et al.* 2009). Hudsonian Godwit was recorded in nearly three times more squares during the 2001-2005 Ontario Breeding Bird Atlas (61) compared with the 1981-1985 Atlas (22; Bird Studies Canada *et al.* 2008), but this likely reflects considerably greater effort in the Hudson Bay Lowlands during the second atlas.

Data from North American migration survey sites indicate a long-term (1974 to 2016) trend of -3.44% annually (95% confidence interval [CI] -10.9 to 5.82), and a short-term (1995 to 2016, nearly three generations) annual trend of -6.01% (95% CI -13.3 to 3.16; Table 2). However, there is high variability in these estimates, and reliability is considered poor as it is unclear what proportion of the overall population is represented by these trend data (Smith and Smith 2018).

Table 2. Population trend estimates for Hudsonian Godwit based on North American migration surveys 1974-2016. Total number of counts for the period is 18,346 (approximately 400 counts per year), recorded at 120 sites (approximately 50 sites per year; Smith and Smith 2018).

| Survey Area | 1974-2016 | | 1995-2016 | |
|------------------------|-----------------------|-------------------------|-----------------------|-------------------------|
| | Annual Percent Change | 95% Confidence Interval | Annual Percent Change | 95% Confidence Interval |
| Atlantic Canada | -4.26 | -5.05 to -3.43 | -6.8 | -8.29 to -5.28 |
| Ontario | -6.82 | -9.58 to -4.11 | -9.29 | -12.4 to -6.31 |
| Northeast U.S. Coastal | -7.74 | -8.95 to -6.44 | -10.2 | -12.1 to -8.28 |
| East Inland | 2.23 | -1.11 to 5.62 | -0.48 | -3.97 to 3.24 |
| Total | -3.44 | -10.9 to 5.82 | -6.01 | -13.3 to 3.16 |

More comprehensive surveys of the major wintering areas in Tierra del Fuego also indicate a decline, with an annual trend from 2002 to 2018 (just longer than two generations) of -4.08% (95% CI -6.19 to -2.14; Figure 4), a rate equivalent to -61.6% over three generations (23 years; 95% CI -77.0, -39.2). On the other hand, Andres *et al.* (2009) found no evidence for change in the wintering population around Chiloe Island since the

mid-1980s to early 1990s. Considering that Tierra del Fuego accounts for 60% of the wintering population (see **Abundance**), and that the trend for others is either apparently stable (Chiloe Island) or unknown (Samborombon Bay), the overall rate of decline over the past two generations is estimated to be about -2.5% per year, or 44% over three generations.

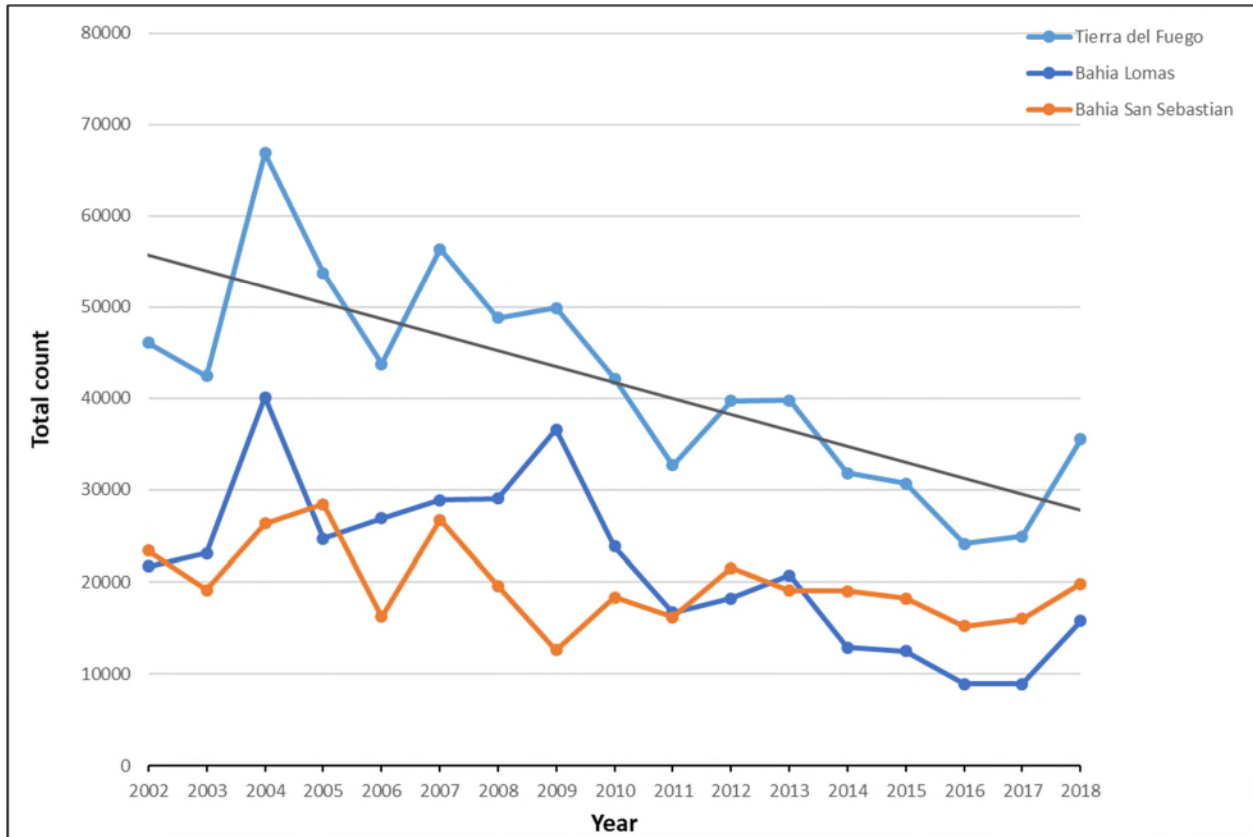


Figure 4. Total counts of wintering Hudsonian Godwits in Tierra del Fuego, Argentina, from 2002-2018, based on annual surveys of two major sites, Bahia Lomas, Chile and Bahia San Sebastian, Argentina, showing a fitted trend line to the total numbers for Tierra del Fuego (Morrison unpubl. data).

Rescue Effect

Andres *et al.* (2012) observed no change in numbers overwintering on Chiloe Island between the mid-1980s and the early 1990s. Although the Alaskan breeding subpopulation appears to show high migratory connectivity with wintering grounds at Chiloe Island, there is likely sufficient overlap with the Canadian breeding subpopulations during migration and during winter that there is at least potential for rescue, especially of the closer Mackenzie Delta subpopulation. However, if the rate of exchange of individuals among subpopulations is low, as is suggested by the available data regarding migratory connectivity and genetic differentiation (Haig *et al.* 1997), it might be insufficient to achieve rescue if the Canadian subpopulations were to decline rapidly.

THREATS AND LIMITING FACTORS

Threats

Hudsonian Godwit faces numerous threats throughout its annual cycle. Climate change and severe weather, as well as natural system modifications, are likely the most serious risks. Threats are described below and summarized in Appendix 1 following the IUCN-CMP (International Union for the Conservation of Nature – Conservation Measures Partnership) unified threats classification system, based on the standard lexicon for biodiversity conservation of Salafsky *et al.* (2008), which resulted in an overall impact score for Hudsonian Godwit of high. The following assessment considers threats on breeding, migration, and wintering grounds where data exist, with threats presented in order of greatest to least impact.

Category 11: Climate change and severe weather (low to medium impact threat)

Climate change is predicted to affect Hudsonian Godwits in multiple ways. The impact of current and near future changes is most likely to be low to medium, but with potential to increase over time.

Habitat Shifting and Alteration

Rising sea levels will eventually threaten coastal habitat used by Hudsonian Godwit throughout its annual cycle (Senner 2010), although effects are likely to develop over the course of several decades (Galbraith *et al.* 2002), and changes on the breeding grounds may be offset to some degree by post-glacial rebound (DFO 2013). Melting permafrost is expected to affect foraging habitat on the breeding grounds, draining tundra wetlands and ponds as the water table lowers (Rouse *et al.* 1997; Avis *et al.* 2011). Warming temperatures (combined with more frequent and severe droughts) will reduce North American inland wetland habitat on both fall and spring migration routes (Johnson *et al.* 2010; Shafer *et al.* 2014).

Northward advancement of the treeline in sub-Arctic and Arctic environments may affect the availability of suitable nesting habitat in the future (Caccianiga and Payette 2006; Tape *et al.* 2006; Danby and Hik 2007; Ballantyne and Nol 2011). Encroachment of woody vegetation may benefit the species in some areas over the short-term, because birds breed in areas interspersed with shrubs and trees. Nonetheless, breeding habitat is likely to become increasingly limited as ecological succession proceeds, forcing birds to move farther north to breed (Swift *et al.* 2017a). Birds already breeding at the northernmost extent of the continent (such as those in the Mackenzie River Delta) will not have the option to expand their breeding range northward (Senner 2010).

Altered climate regimes occurring along the northbound migration route and on the breeding grounds are also affecting Hudsonian Godwits. Birds breeding in the Hudson Bay Lowlands face fluctuating climate conditions as they head north, hindering their ability to time breeding with peak resource levels. The decline observed in the Bahia Lomas wintering population from 2002 to 2018 (Figure 4) is believed to be heavily influenced by this phenological mismatch (Morrison unpubl. data; Senner pers. comm. 2017, 2018). Birds breeding in the Mackenzie Delta may also face a similar challenge (Senner 2013). It is anticipated that climate change will continue to cause fluctuating warming patterns throughout the Hudsonian Godwit's annual cycle, making it increasingly difficult for the species to synchronize its breeding period with peak prey levels available to feed young (Senner *et al.* 2014).

Droughts

Drought could affect the majority of Hudsonian Godwits, primarily through conditions on the Great Plains during spring migration, where probability of drought has increased due to water use for agriculture (Skagen 2006). The severity of impacts on the species is uncertain, as it will vary depending on the intensity, frequency, and extent of droughts.

Storms and Flooding

Warming temperatures along the migration route are predicted to increase the frequency and severity of extreme weather (such as hurricanes and tropical storms), which could cause direct mortality of birds, as well as delays in migration (Senner 2013). Especially during fall migration, birds may be blown off course or delayed by strong winds associated with extreme weather and forced to stop in sub-optimal habitat (or areas where they are hunted) to replenish energy reserves drained during extreme weather events (Cook *et al.* 2008; Senner 2013). The increased physiological stress and extended length of migration may further exacerbate the mismatch between arrival on the breeding grounds and peak resource abundance (Senner 2013).

Category 7: Natural system modifications (low to medium impact threat)

Recent migration data have shown that almost all Hudsonian Godwits stop over in the Orinoco or Amazon River basins (Senner 2010; Senner *et al.* 2014). One large dam on the Amazon is to be built in 2019, and others are proposed. However, potential implications for godwits are unclear at this point.

Most Hudsonian Godwits are exposed to the effects of pollution on prey abundance and health, though severity of this exposure is poorly understood. Sedimentation of wetlands in the Great Plains also affects almost all individuals, and the severity is believed to be moderate based on energetic consequences of reduced foraging options (because sedimentation changes wetland plant communities, reducing the density of invertebrate prey; Jorgensen 2004).

Portions of the Hudson Bay Lowlands are affected by hyperabundant geese, which have degraded potential breeding habitat through overgrazing, but the severity of this for godwits remains uncertain. High numbers of geese forage on wetland and tundra vegetation inland from the coast, leading to plant loss, changes in soil properties, and desertification (Jefferies *et al.* 2004; Sammler *et al.* 2008; Rockwell *et al.* 2009). Although Hudsonian Godwit tends to avoid the resulting barren and non-vegetated habitat, there is no evidence that godwit breeding density has been affected by rising goose populations in the Churchill area to date (Sammler *et al.* 2008; Swift *et al.* 2017a).

Category 1: Residential and commercial development (low impact threat)

Senner (2008) estimates that more than half of the major overwintering sites in South America are threatened by habitat loss and degradation. Development likely poses negligible threats to Hudson Bay Lowlands birds overwintering in Tierra del Fuego, but there are localized pressures elsewhere in Argentina, including urban sprawl and construction of ferry terminals and harbours that are likely to affect overwintering birds from both the Hudson Bay Lowlands and Mackenzie Delta (Senner 2008). Beachfront housing development also threatens roosting habitat in some wintering areas (particularly Chiloe Island, affecting overwintering birds from the Alaska subpopulation). There is also ongoing loss from urbanization of stopover habitat for northbound migrants in the Great Plains, especially in Texas (Senner 2010).

Category 2: Agriculture and aquaculture (low impact threat)

Most Hudsonian Godwits rely on agricultural wetlands in the United States and Canada during migration. Past agricultural intensification has already destroyed or degraded significant portions of this wetland habitat, and further changes over the next decade will likely be small in scope.

A growing aquaculture industry, combined with intensive algal harvesting, are threatening intertidal habitat around Chiloe Island, where the Alaskan subpopulation overwinters. Chiloe Island and the surrounding mainland are experiencing rapid development of mussel, oyster and salmon farming, as well as a rise in seaweed harvesting along their shores (Senner 2010). The thriving industries are increasing development along the shoreline, and potentially damaging intertidal invertebrate prey populations (Senner 2008).

Category 6: Human intrusions and disturbance (low impact threat)

Disturbance is primarily an issue on the wintering grounds, although it may also occur at stopover sites on migration. Boat traffic and use of beaches and adjacent grassy areas by people and dogs can disturb foraging and roosting sites. Most interactions are likely brief but recurring disturbance of roosting habitat in particular may reduce the birds' physical fitness, with potential implications for spring migration and breeding productivity.

Aquaculture and seaweed harvesting on the Chilean wintering grounds expose Hudsonian Godwits from the Alaskan subpopulation to considerable disturbance. The increased boat traffic and human activity in these areas cause birds to abandon or avoid important foraging habitat (Senner 2008). From 50 to over 200 people may participate in algal collection at a single site during low tide, interfering with shorebird feeding (Senner 2010). Birds are also subject to disturbance at stopover sites in Argentina that are popular tourist beaches, such as San Antonio Oeste, affecting birds from the Hudson Bay Lowlands, and Punta Rasa, affecting birds from the Hudson Bay Lowlands and possibly Mackenzie Delta (Senner 2010).

Category 8: Invasive and other problematic species and genes (low impact threat)

Dogs on beaches cause disturbance to most overwintering godwits. There is no evidence of dogs killing godwits, but the cumulative disturbance is believed to have a slight effect on health. Dogs are widespread throughout the wintering range, but particularly abundant on Chiloe Island and around Rio Grande, Argentina, but somewhat less numerous in other parts of Tierra del Fuego.

Natural predators (such as ravens and foxes) have increased in parts of the north. This may be particularly notable in areas where predator numbers are subsidized by human resources (e.g., in the Churchill, Manitoba area, hatching success has been reduced due to predation). Reduced reproductive output can have a considerable impact on a species with a relatively long generation time.

Category 9: Pollution (low impact threat)

Petrochemical pollution from ships and industrial discharge into coastal waters is a concern, especially on South American wintering grounds (Senner 2010). Most individuals are likely exposed to low-intensity contamination, with little severity; exposure to larger spills is rare, but would have greater consequences for those affected, with population level implications due to the species' long generation time.

A large proportion of individuals is exposed to agricultural runoff (containing pesticides and other agrochemicals) at stopover sites in the North American Great Plains and on South American wintering sites, but there has been little research on effects. These toxins tend to accumulate in aquatic invertebrates that are prey for many shorebird species (Braune and Noble 2009). Evidence of a high proportion of aquatic plants in the diet at a spring stopover site in the Canadian Prairies suggests the species may be somewhat protected from elevated levels of agricultural contaminants, at least during migration (Braune and Noble 2009).

Category 5: Biological resource use (negligible impact threat)

Hudsonian Godwit was heavily hunted commercially in the 19th century in North and South America (Walker *et al.* 2011). Today, it is still hunted in parts of the Caribbean, South and Central America but the degree of impact is unknown (Walker *et al.* 2011). Hudsonian

Godwit has traditionally been hunted on migration by the James Bay Cree, but it is unlikely that this traditional harvest has a significant impact on the species (Sutherland pers. comm. 2018). It may be accidentally harvested in Alaska, because of its resemblance to the legally hunted Bar-tailed Godwit (Senner 2010).

Limiting Factors

Hudsonian Godwit is a long-distance migrant that depends on a small number of high-quality stopover sites to meet its demanding physiological needs. It flies non-stop over large distances and depends on these key sites being readily available across the migration route (Senner *et al.* 2014). Prime inland stopover habitat in the North American Great Plains (wetlands and flooded agricultural fields) tends to be ephemeral from year to year, which suggests that protection of a few individual sites is less valuable than a network of sites such as that developed by the Western Hemisphere Shorebirds Reserve Network (WHSRN undated) and other wetland management initiatives (e.g., Ducks Unlimited).

The vast distances separating breeding and wintering grounds, and the small window of time available for breeding in sub-Arctic and Boreal conditions, mean that Hudsonian Godwit must closely track environmental conditions to ensure breeding occurs at the optimal time (Senner 2012). The large number of climate regimes the species is exposed to over its annual cycle make it particularly vulnerable to ecological mismatches between breeding and resource phenology (Senner 2012). As a result, changes to food availability and weather conditions during migration could have profound effects throughout the annual cycle (Senner 2013).

Hudsonian Godwits congregate in large concentrations at a few important stopover and wintering sites, making them susceptible to localized threats, such as habitat loss and degradation, hunting and disturbance, pollution and extreme weather, which could have catastrophic consequences (Walker *et al.* 2011).

Number of Locations

It is difficult to delineate specific locations for Hudsonian Godwit, especially because additional breeding sites may exist that have not yet been identified. The two main breeding areas currently known in Canada (Hudson Bay Lowlands and Mackenzie Delta) likely face the same climate-driven threat of ecological mismatch between breeding and resource phenology. Furthermore, both breeding grounds are threatened by encroachment of woody vegetation under climate change, although the impact on Northwest Territories birds may be more immediate. However, the timing and extent of these effects may vary to a considerable extent based on local conditions. In South America, Hudsonian Godwits overwinter in three distinct core areas, but are also scattered over numerous other coastal and inland sites that are unlikely to be affected by the same single threatening event or singular threat. Thus, while the number of locations is unknown, it is likely more than 10.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

Hudsonian Godwit is protected in Canada under the *Migratory Birds Convention Act, 1994* (Government of Canada 2017) and in the United States under the *Migratory Bird Treaty Act* (USFWS 2017), through prohibitions on harm to birds, nests or eggs.

Non-Legal Status and Ranks

Hudsonian Godwit has been ranked as Least Concern on the IUCN Red List of Threatened Species since 2004 (upgraded from Near Threatened), as it is classified as having a very large range and very large population, although it appears to be declining (IUCN 2017b). It is considered to be a species of high concern in the Canadian and U.S. Shorebird Conservation Plans because of a small population or range (Donaldson *et al.* 2000; U.S. Shorebird Conservation Plan 2004). Hudsonian Godwit is on the North American Bird Conservation Initiative's (NABCI) watch list, recognized as vulnerable to extinction due to population size and trend, breeding distribution, and threats during the non-breeding season (NABCI 2016). NatureServe has designated a global status of G4 (apparently secure; last reviewed in 2016), and a status of N4 for the breeding population in Canada (apparently secure; last reviewed in 2013; NatureServe 2017; Table 3). The Canadian Endangered Species Conservation Council (CESCC) changed its ranking of the species in Canada from apparently secure to vulnerable in 2016 based on an increased level of risk due to a change in population size, distribution or threats (CESCC 2016; Table 3).

Table 3. Conservation Status of Hudsonian Godwit.

| Region | NatureServe 2017 Rank | CESCC 2015 Rank |
|---------------------------|---|---|
| Global | G4 | N/A |
| Canada | N4B – Apparently Secure breeding | N3B, N4N5M -Vulnerable breeding; Apparently Secure to Secure migrant |
| British Columbia | S1S2B – Critically Imperilled to Imperilled breeding | |
| Alberta | S4M – Apparently Secure migrant | N/A |
| Saskatchewan | S4M – Apparently Secure migrant | |
| Manitoba | S4B – Apparently Secure breeding | S3B, S3M – Vulnerable breeding and migrant |
| Ontario | S3B, S4N – Vulnerable breeding; Apparently Secure non-breeding | S3S4B, S4M – Vulnerable to Apparently Secure breeding; Apparently Secure migrant |
| Québec | S3M – Vulnerable migrant | |
| New Brunswick | S4M – Apparently Secure migrant | S3S4M – Vulnerable to Apparently Secure migrant |
| Nova Scotia | S3M – Vulnerable migrant | S1S2M – Critically Imperilled to Imperilled migrant |
| Prince Edward Island | S3S4M – Vulnerable to Apparently Secure migrant | S2S3M – Imperilled to Vulnerable migrant |
| Newfoundland and Labrador | SNA – Not applicable | |

| Region | NatureServe 2017 Rank | CESCC 2015 Rank |
|-----------------------|---|---|
| Yukon | S3M – Vulnerable migrant | |
| Northwest Territories | S3B – Vulnerable breeding | S2S4B, S2S4M – Imperilled to Apparently Secure breeding and migrant |
| Nunavut | S3B – Vulnerable breeding | S3B, S3M – Vulnerable breeding and migrant |
| Alaska | S2S3B – Imperilled to Vulnerable breeding | N/A |

Habitat Protection and Ownership

Over 1% of Hudsonian Godwits are estimated to breed in Kendall Island Migratory Bird Sanctuary, a 632 km² protected area in the outer Mackenzie Delta (Rausch and Johnston 2012). Much of the Hudson Bay breeding range is within Ontario’s Polar Bear Provincial Park, a Wetland of International Importance under the RAMSAR Convention. Hudsonian Godwit has also been recorded on the following federal lands in Canada: Ivvavik National Park (Yukon), Prince Albert National Park (Saskatchewan), Wapusk National Park (Manitoba), Hannah Bay Migratory Bird Sanctuary (Ontario), Moose River Migratory Bird Sanctuary (Ontario), Point Pelee National Park (Ontario), Big Creek National Wildlife Area (Ontario), Prince Edward Point National Wildlife Area (Ontario), Boatswain Bay Migratory Bird Sanctuary (Québec), Baie de L’Isle Verte National Wildlife Area (Québec), Saguenay-St. Lawrence Marine Park (Québec), Mingan Archipelago National Park Reserve (Québec), Prince Edward Island National Park (Prince Edward Island), and Gros Morne National Park (Newfoundland and Labrador; Rausch and Johnston 2012; ECCC 2017a; Parks Canada 2017; Government of Canada 2018).

Major migration stopover sites in the Saskatchewan Prairies are recognized as important habitat through several international programs. Under the Western Hemisphere Shorebird Reserve Network (WHSRN) program, the Quill Lakes are a Site of International Importance, and the Chaplin/Old Wives/Reed Lakes are a Site of Hemispheric Importance (Alexander and Gratto-Trevor 1997; WHSRN undated). The Quill Lakes are also designated as a Wetland of International Importance under the RAMSAR Convention (Alexander and Gratto-Trevor 1997).

In the U.S. Great Plains several wetland areas used by the species on migration receive recognition through the WHSRN program, including Cheyenne Bottoms, Kansas, and Rainwater Basin, Nebraska.

Hudsonian Godwit has been documented in globally significant numbers (>1% of the population) at the following North American Important Bird Areas (IBAs) on migration (BirdLife International 2018):

- Luck Lake (Saskatchewan)
- Porter Lake (Saskatchewan)
- Quill Lakes (Saskatchewan)

- Oak Hammock Marsh Wildlife Management Area (Manitoba)
- Nelson River Estuary and Marsh Point (Manitoba)
- Kaskattama River Mouth (Manitoba)
- Pen Islands (Ontario/Manitoba)
- Albany River Estuary and Associated Coastline (Ontario)
- Pei lay sheesh kow (Ontario; incorporating seven former IBAs including BigPiskwanish Point, East Point, and North Point)
- Shagamu River and Area (Ontario)
- Boatswain Bay (Québec; Benoit 2004)
- Carter Bay (Alaska)
- Susitna Flats (Alaska)

Bahia Lomas, Chile, one of the most important wintering sites for Hudsonian Godwit in South America, is a RAMSAR Wetland of International Importance, a WHSRN Site of Hemispheric Importance, and an IBA (Espoz *et al.* 2011; BirdLife International 2018). Approximately 10% of Hudsonian Godwits overwintering on the Atlantic coast of South America are estimated to reside in Lagoa do Peixe National Park in Brazil, which is also designated as an Internationally Important Site under the WHSRN program, and an IBA (WHSRN undated; BirdLife International 2018).

Hudsonian Godwit occurs at the following South American IBAs on the wintering grounds:

- Bahia de Samborombon y Punta Rasa (Argentina);
- Reserva Costa Atlantic de Tierra del Fuego y Zonas Adyacentes (Argentina);
- Reserva de Biosfera Albufera de Mar Chiquita (Argentina);
- San Antonio Oeste (Argentina);
- Parque Nacional da Lagoa do Peixe (Brazil);
- Bahia de Chullec (Chile);
- Bahia Curaco De Velez (Chile);
- Bahia de Putemun (Chile);
- Bahia de Quellon (Chile);
- Bahia de Quinchao (Chile);
- Bahia de Yaldad (Chile);
- Bahia Lomas (Chile);
- Bahia Rilán (Chile);

- Chacao (Chile);
- Desembocadura del Rio Chamiza, Colhuin-Pelluco (Chile);
- Estero Compu (Chile);
- Estero Huidad (Chile);
- Estuario de Maullin y Cerro Amortajado (Chile);
- Isla Grande de Chiloe (Chile);
- Lenqui (Chile);
- Marisma Buque Quemado (Chile);
- Playa de Pullao (Chile);
- Quemchi Aucar (Chile);
- Santuario de las Aves Bahia de Caulin (Chile);
- Sistema de Bahias TenTen Castro (Chile); and
- Sistema Quetalmahue, Quilo y Mar Brava (Chile; BirdLife International 2018).

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Dr. Andrea Smith is a senior scientist with Hutchinson Environmental Sciences Ltd., based in Bracebridge Ontario. She obtained her M.Sc. in conservation biology and her Ph.D. in evolutionary ecology, both from Queen's University. Andrea's graduate work focused on habitat use of migratory birds in agricultural landscapes of Mexico (M.Sc.) and phylogeography and speciation of seabirds (Ph.D.). Andrea has worked on a variety of research projects relating to species at risk, invasive species, and environmental impact assessment. She has written five previous COSEWIC status reports (on Lark Bunting, Speckled Dace, Buff-breasted Sandpiper, Darkblotched Rockfish and Yellowmouth Rockfish), and a prioritized list of crustacean species potentially at risk in Canada for COSEWIC. Andrea's research interests include documenting the interactive effects of multiple stressors on biodiversity and applying conservation science to develop policy.

COLLECTIONS EXAMINED

No collections were examined for this report.

Appendix 1: Threats Calculator.

Date: 2018-04-12

Assessor(s): Jenny Heron (facilitator), Marcel Gahbauer (co-chair), Andrea Smith, Richard Elliot, Christian Artuso, David Toews, Pam Sinclair, Dave Fraser, Jessica Humber, Syd Cannings, Ann McKellar, Christian Friis, Nathan Senner, Yves Aubry, Andrea Clouston (Secretariat)

| Overall Threat Impact Calculation | | Level 1 Threat Impact Counts | |
|--|---|------------------------------|-----------|
| Threat Impact | | high range | low range |
| A | Very High | 0 | 0 |
| B | High | 0 | 0 |
| C | Medium | 2 | 0 |
| D | Low | 5 | 7 |
| Calculated Overall Threat Impact: | | High | Medium |
| Assigned Overall Threat Impact: | B = High | | |
| Impact Adjustment Reasons: | Although the output suggests a range of medium to high, the categories with plausible medium impacts are significant, and in the case of climate change include two contributing factors, each of which could have a medium impact. | | |
| Overall Threat Comments: | Species assessed as a single designatable unit, but with recognition of three distinct subpopulations, all of which migrate through the prairies / Great Plains, but breed and winter in different areas: Hudson Bay Lowlands (winter in Tierra del Fuego and elsewhere in Argentina), Mackenzie Delta (winter along the northern coast of Argentina), and Alaska (winter on and near Chiloe Island). | | |

| Threat | Impact (calculated) | Scope (next 10 Yrs) | Severity (10 Yrs or 3 Gen.) | Timing | Comments |
|--------|---------------------|---------------------|-----------------------------|-------------------|----------|
| 1 | D Low | Restricted (11-30%) | Moderate (11-30%) | High (Continuing) | |

| Threat | | Impact (calculated) | | Scope (next 10 Yrs) | Severity (10 Yrs or 3 Gen.) | Timing | Comments |
|--------|--|---------------------|-----|---------------------|-----------------------------|-------------------|--|
| 1.1 | Housing & urban areas | D | Low | Restricted (11-30%) | Moderate (11-30%) | High (Continuing) | Although housing developments are not occurring on the tidal flats where overwintering godwits forage, the adjacent flat areas used for roosting are being occupied by beachfront properties in some areas. This is of particular concern in the Castro region of Chiloe Island, where 10,000 to 15,000 individuals overwinter, and there are also development pressures at the north end of the island where another ~7000 individuals overwinter. For Chiloe, scope might be over 30%, but in Bahia Lomas and Tierra del Fuego (Hudson Bay Lowlands subpopulation) development is likely negligible, while elsewhere in Argentina (Mackenzie Delta subpopulation) pressure is localized but overall likely intermediate (i.e., probably small, 1-10%). |
| 1.2 | Commercial & industrial areas | | | | | | |
| 1.3 | Tourism & recreation areas | | | | | | |
| 2 | Agriculture & aquaculture | D | Low | Small (1-10%) | Moderate (11-30%) | High (Continuing) | |
| 2.1 | Annual & perennial non-timber crops | D | Low | Small (1-10%) | Moderate (11-30%) | High (Continuing) | Almost all Hudsonian Godwits frequent agricultural wetlands during migration. However, agricultural intensification has already been extensive, and further changes over the next decade are almost certainly small in scope. Conversion of remaining important stopover habitat may however have a moderate effect. |
| 2.2 | Wood & pulp plantations | | | | | | |
| 2.3 | Livestock farming & ranching | | | | | | |
| 2.4 | Marine & freshwater aquaculture | D | Low | Small (1-10%) | Moderate (11-30%) | High (Continuing) | Aquaculture and algal farming have become widely established on Chiloe Island; associated disturbances are addressed under Threat 6.1. There may be some further small expansion in Chile, with moderate consequences through displacement from winter foraging areas, but this is not recognized as a threat in Argentina (i.e., for overwintering birds from the Hudson Bay Lowlands and Mackenzie Delta subpopulations). |
| 3 | Energy production & mining | | | | | | |
| 3.1 | Oil & gas drilling | | | | | | |

| Threat | | Impact (calculated) | | Scope (next 10 Yrs) | Severity (10 Yrs or 3 Gen.) | Timing | Comments |
|--------|--|---------------------|--------------|---------------------|-----------------------------|-------------------|---|
| 3.2 | Mining & quarrying | | | | | | |
| 3.3 | Renewable energy | | | | | | |
| 4 | Transportation & service corridors | | | | | | |
| 4.1 | Roads & railroads | | | | | | |
| 4.2 | Utility & service lines | | | | | | |
| 4.3 | Shipping lanes | | | | | | |
| 4.4 | Flight paths | | | | | | |
| 5 | Biological resource use | | Negligible | Large (31-70%) | Negligible (<1%) | High (Continuing) | |
| 5.1 | Hunting & collecting terrestrial animals | | Negligible | Large (31-70%) | Negligible (<1%) | High (Continuing) | A substantial percentage of migrants pass through parts of the Caribbean where shorebird hunting persists. However, the frequency of shooting is sufficiently low that severity is believed to be negligible. Some inadvertent mortality may also occur in Alaska, where the similar Bar-tailed Godwit is legally hunted. |
| 5.2 | Gathering terrestrial plants | | | | | | |
| 5.3 | Logging & wood harvesting | | | | | | |
| 5.4 | Fishing & harvesting aquatic resources | | | | | | |
| 6 | Human intrusions & disturbance | D | Low | Large (31-70%) | Slight (1-10%) | High (Continuing) | |
| 6.1 | Recreational activities | D | Low | Large (31-70%) | Slight (1-10%) | High (Continuing) | Primarily a concern on wintering grounds, but also at some stopover sites. Boat traffic and use of beaches and adjacent grassy areas by people and dogs can disturb foraging and roosting godwits. This may be most intense at Chiloe Island, where people collecting algae at low tide can interfere with shorebird feeding. Most interactions are likely brief, but recurring disturbance of roost sites in particular can reduce physical fitness, with potential implications for spring migration and breeding productivity. |
| 6.2 | War, civil unrest & military exercises | | | | | | |
| 6.3 | Work & other activities | | | | | | |
| 7 | Natural system modifications | CD | Medium – Low | Pervasive (71-100%) | Moderate - Slight (1-30%) | High (Continuing) | |

| Threat | | Impact (calculated) | | Scope (next 10 Yrs) | Severity (10 Yrs or 3 Gen.) | Timing | Comments |
|--------|--|---------------------|--------------|---------------------|-----------------------------|---|--|
| 7.1 | Fire & fire suppression | | | | | | |
| 7.2 | Dams & water management/use | | Unknown | Pervasive (71-100%) | Unknown | Moderate (Possibly in the short term, < 10 yrs/3 gen) | Recent migration data have shown that almost all Hudsonian Godwits stop over in the Orinoco or Amazon River basins. One large dam on the Amazon is to be built in 2019, and others are proposed. However, potential implications for godwits are unclear at this point. |
| 7.3 | Other ecosystem modifications | CD | Medium - Low | Pervasive (71-100%) | Moderate – Slight (1-30%) | High (Continuing) | Most Hudsonian Godwits are exposed to the effects of pollution on prey abundance and health, though severity of this exposure is poorly understood. Sedimentation of wetlands in the Great Plains also affects almost all individuals, and the severity is believed to be moderate based on energetic consequences of reduced foraging options. Portions of the Hudson Bay Lowlands breeding subpopulation are additionally affected by hyperabundant geese, which have degraded potential breeding habitat through overgrazing, but the severity of this for godwits remains unclear. |
| 8 | Invasive & other problematic species & genes | D | Low | Pervasive (71-100%) | Slight (1-10%) | High (Continuing) | |
| 8.1 | Invasive non-native/alien species/diseases | D | Low | Pervasive (71-100%) | Slight (1-10%) | High (Continuing) | Dogs on beaches (widespread on wintering grounds, except Tierra del Fuego, and particularly abundant on Chiloe Island) cause disturbance to most overwintering godwits. There is no evidence of dogs killing godwits, but the cumulative disturbance is likely to have a slight effect on health. |
| 8.2 | Problematic native species/diseases | D | Low | Small (1-10%) | Serious - Moderate (11-70%) | High (Continuing) | Natural predators have increased in parts of the north, especially ravens and foxes. This may be particularly notable in areas where predator numbers are subsidized by human resources (e.g., in the Churchill, Manitoba area, hatching success has been as low as 17% due to predation). Reduced reproductive output can have a considerable impact on a species with a relatively long generation time. |
| 8.3 | Introduced genetic material | | | | | | |
| 8.4 | Problematic species/diseases of unknown origin | | | | | | |
| 8.5 | Viral/prion-induced diseases | | | | | | |

| Threat | | Impact (calculated) | | Scope (next 10 Yrs) | Severity (10 Yrs or 3 Gen.) | Timing | Comments |
|--------|---|---------------------|--------------|---------------------|-----------------------------|-------------------|---|
| 8.6 | Diseases of unknown cause | | | | | | |
| 9 | Pollution | D | Low | Pervasive (71-100%) | Slight (1-10%) | High (Continuing) | |
| 9.1 | Domestic & urban waste water | | | | | | |
| 9.2 | Industrial & military effluents | D | Low | Pervasive (71-100%) | Slight (1-10%) | High (Continuing) | Petrochemical pollution from ships and industrial discharge into coastal waters is a concern, especially on South American wintering grounds. Most individuals likely exposed to low-intensity contamination, with little severity; exposure to larger spills is rare, but would have greater consequences for those affected, with population level implications due to long generation time. |
| 9.3 | Agricultural & forestry effluents | | Unknown | Large (31-70%) | Unknown | High (Continuing) | A large proportion of individuals is exposed to agricultural runoff at stopover sites in the North American Great Plains and on South American wintering sites, but there has been little research on effects. |
| 9.4 | Garbage & solid waste | | | | | | |
| 9.5 | Air-borne pollutants | | | | | | |
| 9.6 | Excess energy | | | | | | |
| 10 | Geological events | | | | | | |
| 10.1 | Volcanoes | | | | | | |
| 10.2 | Earthquakes/tsunamis | | | | | | |
| 10.3 | Avalanches/landslides | | | | | | |
| 11 | Climate change & severe weather | CD | Medium – Low | Pervasive (71-100%) | Moderate – Slight (1-30%) | High - Moderate | |
| 11.1 | Habitat shifting & alteration | CD | Medium – Low | Pervasive (71-100%) | Moderate – Slight (1-30%) | High - Moderate | Climate change has started to cause loss of coastal habitat on breeding, stopover, and wintering sites, and this is expected to continue. The decline in the Bahia Lomas wintering population is believed to be influenced by a phenological mismatch for the Hudson Bay Lowlands breeding subpopulation; the Mackenzie Delta subpopulation may be similarly affected, but has not been studied similarly. This has the potential to substantially affect reproductive success, though in the relatively near future is unlikely to exceed moderate severity. |

| Threat | | Impact (calculated) | | Scope (next 10 Yrs) | Severity (10 Yrs or 3 Gen.) | Timing | Comments |
|--------|----------------------|---------------------|--------------|---------------------|-----------------------------|-------------------|--|
| 11.2 | Droughts | CD | Medium – Low | Pervasive (71-100%) | Moderate – Slight (1-30%) | High - Moderate | Drought can affect the majority of Hudsonian Godwits, primarily through conditions on the Great Plains during spring migration, where probability of drought has been exacerbated by water use for agriculture. Years with droughts in this region have been followed by reduced adult survivorship, which has population implications for a long-lived species such as this. Severity is highly uncertain at this point, as it will vary depending on the intensity, frequency, and extent of droughts, but will not likely exceed moderate severity within the next three generations. |
| 11.3 | Temperature extremes | | | | | | |
| 11.4 | Storms & flooding | D | Low | Pervasive (71-100%) | Slight (1-10%) | High (Continuing) | Increased frequency and severity of extreme weather on migration could lead to direct mortality and delays in reaching breeding or wintering grounds. Most individuals are exposed to this threat, but the majority of effects are indirect and addressed under other categories. |
| 11.5 | Other impacts | | | | | | |

Classification of threats adopted from IUCN-CMP (Salafsky *et al.* 2008).