Species at Risk Act
Management Plan Series

Management Plan for the Great Blue Heron *fannini* subspecies (*Ardea herodias fannini*) in Canada

Great Blue Heron, *fannini* subspecies

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

Cover illustration: photo by Ross Vennesland

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[1] www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

Preface

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

The Minister of Environment and Climate Change and Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Great Blue Heron *fannini* subspecies and has prepared this management plan as per section 65 of SARA. To the extent possible, it has been prepared in cooperation with the province of British Columbia as per section 66(1) of SARA.

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

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

Acknowledgments

This management plan was prepared by Ross Vennesland of the Parks Canada Agency, and Dan Shervill and Holly Middleton of Environment and Climate Change Canada (ECCC). Additional reviews by Eric Gross and Megan Harrison (ECCC) added to the document. Input was provided by the British Columbia chapter of the Canada/US Heron Working Group including Kym Welstead (British Columbia Ministry of Forests, Lands and Natural Resource Operations (BC MFLNRO)), Trudy Chatwin (BC MFLNRO), Berry Wijdeven (BC MFLNRO) and Rob Butler (Pacific WildLife Foundation).

[2] www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2

Executive Summary

The Great Blue Heron *fannini* subspecies (*Ardea herodias fannini*) (hereafter Pacific Great Blue Heron) is a large wading bird that is mostly blue-grey in colour, with accents of chestnut and blue, streaks of white, and long plume-like feathers. The Pacific Great Blue Heron was assessed as Special Concern in 1997 and again in 2008 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) due to a small population size, declining productivity, and threats related to Bald Eagle (*Haliaeetus leucocephalus*) predation, habitat loss, and human disturbance. The species was listed on Schedule 1 of the *Species at Risk Act* (SARA) in 2010.

Pacific Great Blue Herons are found in coastal British Columbia and from Washington State to Southeast Alaska. The most recent population estimate for the Pacific Great Blue Heron is 4000-5000 nesting adults with evidence suggesting that nesting productivity has declined along with population size during winter and possibly the breeding season as well. Herons forage along the coast, on tidal mudflats, in fresh and saltwater wetlands, along rivers, lakes, and in grassy field habitats. Pacific Great Blue Herons typically nest in small or large woodlands near foraging areas. Nesting colony locations are dynamic, especially in areas of high disturbance.

The main threats facing Pacific Great Blue Herons are predation and harassment by Bald Eagles, which can cause colony abandonment and reduced nesting productivity, and nesting and foraging habitat loss due to commercial and residential development. Other threats include habitat loss from forest harvesting and utility line creation and maintenance, disturbance by human activities (resulting in reduced nesting productivity), road mortality, and aquaculture operations.

The management objective for Pacific Great Blue Heron is:

To ensure that all four recognized Pacific Great Blue Heron Conservation Regions in coastal British Columbia have stable or locally increasing numbers of Pacific Great Blue Herons.

Broad strategies and conservation measures to help achieve this management objective are outlined in Section 6.2 and 6.3 of this document.

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1. COSEWIC* Species Assessment Information

Date of Assessment: April 2008

Common Name (population): Great Blue Heron *fannini* subspecies

Scientific Name: *Ardea herodias fannini*

COSEWIC Status: Special Concern

Reason for Designation: In Canada, this subspecies is distributed along the coast of British Columbia with a relatively small population that is concentrated at a few breeding colonies in southern British Columbia. There is evidence of declines in productivity and it is unclear whether the population is stable or declining. Threats from eagle predation, habitat loss and human disturbance are ongoing, particularly in the southern part of the range where concentrations of birds are highest.

Canadian Occurrence: British Columbia

COSEWIC Status History: Designated Special Concern in April 1997 and April 2008.

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

2. Species Status Information

The Great Blue Heron *fannini* subspecies (*Ardea herodias fannini*; hereafter Pacific Great Blue Heron) has been assessed as a species of Special Concern in Canada (COSEWIC 2008) and has been listed on Schedule 1 of the federal *Species at Risk Act* (SARA) since 2010. Canada supports approximately half of the global population of the Pacific Great Blue Heron.

Table 1. List and Description of Various Conservation Status Ranks for the Pacific Great Blue Heron (NatureServe 2013).

Global (G) Rank*	National (N) Rank*	Sub-national (S) Rank*	COSEWIC Status	BC List	BC Conservation Framework**
G5T4 (apparently secure)	Breeding season N3 (vulnerable); Non-breeding season N4 (apparently secure)	Sub-national (Province of British Columbia): Breeding season S2S3 (imperiled to vulnerable); Non-breeding season S4 (apparently secure)	SC (Special Concern)	BLUE	Priority 1 under Goal 3

*Rank 1– critically imperiled; 2– imperiled; 3– vulnerable to extirpation or extinction; 4– apparently secure; 5– secure; T - status of a subspecies.
** The three goals of the BC Conservation Framework are: 1. Contribute to global efforts for species and ecosystem conservation; 2. Prevent species and ecosystems from becoming at risk; 3. Maintain the diversity of native species and ecosystems.

3. Species Information

3.1. Species Description

The Pacific Great Blue Heron is a large wading bird that stands more than one metre tall. It has long rounded wings, a long neck, a short tail, and its legs resemble stilts. It is mostly blue-grey in colour, with accents of chestnut and blue, streaks of white, and long plume-like feathers. When flying, it uses deep and slow wingbeats and carries its head tucked into an ‘S’ shape between its shoulders.

The Pacific Great Blue Heron forages along the seacoast, mostly in fresh and saltwater wetlands, along rivers and lakes, but also in grassy areas such as farmer’s fields, irrigation ditches, and highway rights-of-way. Pacific Great Blue Herons generally nest in woodlands near foraging areas. They typically nest colonially (2-400 pairs) using large stick nests built in mature trees between 20 and 30 m above the ground, and within 10 km of suitable marine or freshwater foraging grounds. Nesting colony locations can be dynamic, especially in areas of high disturbance. Large colonies sometimes stay in one location for several decades, but smaller ones may relocate every few years (COSEWIC 2008; Vennesland and Butler 2011). Clutch size is 3-5 eggs (Butler 1997; Vennesland and Butler 2011). Eggs are semi-oval and a dull pale blue (Vennesland and Butler 2011). Nestlings are semi-altricial and fledge about 60 days after hatching (Butler 1989).

For more detailed information on the Pacific Great Blue Heron, please see COSEWIC (2008), Butler (1997), and Vennesland and Butler (2011).

3.2. Population and Distribution

Populations and Their Distribution

About 4000-5000 Pacific Great Blue Herons are found in Canada (all in British Columbia (BC)) compared to 9500-11000 globally (COSEWIC 2008). In Canada, the Pacific Great Blue Heron resides year round on the coast of British Columbia including Vancouver Island, Haida Gwaii, and other offshore islands (Figure 1). All known nesting occurrences of the Pacific Great Blue Heron are within the Coastal Western Hemlock and Coastal Douglas-fir Biogeoclimatic Zones (COSEWIC 2008). Four Conservation Regions are recognized based on degree of isolation, population sizes, and differences in trends and threats: Haida Gwaii, Vancouver Island, Lower Fraser River Valley, and Mainland Coast (Figure 1).

Population size has been difficult to estimate for the Pacific Great Blue Heron because colonies are not stable entities and herons are difficult to identify individually (COSEWIC 2008). Most coastal areas outside the Strait of Georgia[3], which comprises a portion of both the Lower Fraser River Valley and Vancouver Island Conservation Regions (Figure 1), have not been systematically surveyed (Butler 1997; COSEWIC 2008). In the future, adoption of a standard tracking method (Vennesland and Norman 2006) would provide consistent monitoring throughout the subspecies' Canadian range.

[3] Defined here as the coastal areas in the Lower Fraser River Valley and Vancouver Island Conservation Regions.

Figure 1. Canadian range of the Pacific Great Blue Heron, showing the potential area of occupancy and the four Conservation Regions. For the entire range, the potential area of occupancy is defined as terrestrial areas within the Coastal Douglas-fir and Coastal Western Hemlock Biogeoclimatic zones that are less than 10 km from a potential foraging area. Potential foraging areas are defined as the entire coastline and major river systems.

Status and Trends of Populations

Population status and trends have been assessed using various sources of information, primarily using measures of nesting productivity, annual changes in colony occupancy (active nest counts), and various population indices. The following information is from COSEWIC (2008), with updated analyses, where available.

Productivity trends

Nesting productivity (number of chicks fledged per active nest) has declined significantly since the 1970s, perhaps by as much as 50% (COSEWIC 2008). Vennesland (unpubl. data) recently updated analyses used for COSEWIC (2008) using data from 1987 to 2009 and found that the decline in nesting productivity has intensified (the declines have increased over time and the statistical significance of the declines has become stronger). Furthermore, productivity declines appear to be high at large colonies that produce most of the fledglings for the subspecies. These colonies are concentrated in the Lower Fraser River Valley where there is a large and growing human population. This human population growth adjacent to the heron colonies has resulted in declines in habitat as well as increased disturbance from both humans and urbanized predators (COSEWIC 2008).

The demographic analysis reported in COSEWIC (2008) indicated that only the Lower Fraser River Valley Conservation Region is producing enough young to sustain its numbers. It is hypothesized that fledglings from this region are dispersing to Vancouver Island and augmenting those populations because productivity there appears to be low, but overall population counts are nonetheless stable (COSEWIC 2008; Chatwin et al. 2009). If this is the case, the Lower Fraser River Valley population is crucial to the subspecies as a whole. This important area is also under the greatest threat from human and Bald Eagle disturbance and has the highest level of habitat destruction on the coast (COSEWIC 2008).

Changes in range and colony occupancy (active nest counts)

One portion of the Mainland Coast Region, the Sunshine Coast, has seen a strong decline in nesting population size, and one portion of the Vancouver Island Region, northeastern Vancouver Island, has seen a complete absence of productivity in recent years (COSEWIC 2008; Chatwin pers. comm. 2014). Based on these data, a breeding range retraction may be occurring along the northern margin of the southern range.

COSEWIC (2008) analyzed the flux in the numbers of active nests in colonies to identify changes in colony size from nesting surveys. That analysis summed the annual changes in colony sizes for individual colonies that had available data (i.e., estimated the net change in active nest numbers from year to year). COSEWIC reported stable nesting numbers for Pacific Great Blue Heron colonies in the Strait of Georgia up to 2005 (i.e., no evidence of net change over the period). However, a reanalysis using

data up to 2009 (R. Vennesland, unpubl. data) has shown an overall decline in active nests, equivalent to a loss of 357 nests over all years summed (Figure 2). It must be noted that this analysis was limited to colonies with consecutive observations over consecutive years and, thus, may not provide a full picture of population trends. Nevertheless, large changes in nesting numbers should be apparent.

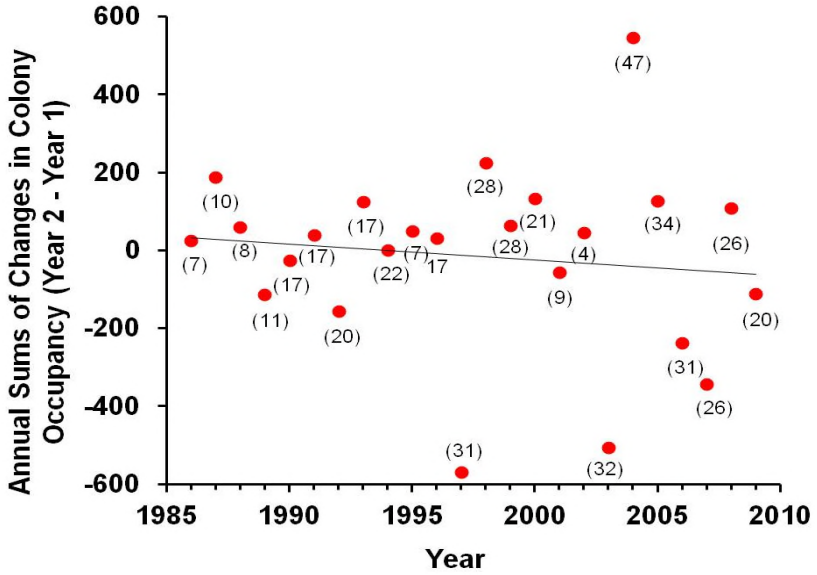

Figure 2. Annual sums of increases and decreases (i.e., net year-to-year change) in the number of active nests at Pacific Great Blue Heron colonies in south coastal British Columbia from 1986 to 2009. Sample sizes of colonies included in annual sums are provided in brackets.

Winter counts

A recent analysis of Bird Studies Canada's Coastal Waterbird Survey (CWS) data from the winters of 1999 to 2009 showed a significant decline in the Pacific Great Blue Heron numbers along the Strait of Georgia, averaging -2.3% per year (Crewe et al. 2011). Assuming an average age of 5.6 years in the Pacific Great Blue Heron population (COSEWIC 2008), this rate of decline would mean a decline in the population of 39% over 3 generations (the time period relevant to status assessments by COSEWIC). As the CWS methodology is robust, this likely represents a real decline in the winter numbers in the Strait of Georgia.

3.3. Needs of the Great Blue Heron *fannini* subspecies

Pacific Great Blue Herons require productive foraging areas during breeding and non-breeding seasons. In the breeding season, they require suitable nesting locations within 2.9-10 km of their foraging areas (Butler et al. 1995). Due to the propensity of this species to relocate nesting colonies from time to time (COSEWIC 2008), they also require sufficient alternate nesting habitat near to foraging areas to facilitate future breeding.

The following section is a brief description of the habitat needs of the Pacific Great Blue Heron. For more detailed information on the habitat requirements of this species, please see Butler (1995, 1997); Gebauer and Moul (2001); COSEWIC (2008); and Vennesland and Butler (2011).

Foraging Habitat Requirements

The Pacific Great Blue Heron forages in marine, brackish, and fresh water as well as in some terrestrial environments such as grassy areas including farm fields (Vennesland and Butler 2011). Important foraging habitats include aquatic areas such as tidal mudflats (especially those with beds of Common Eelgrass, *Zostera marina*), riverbanks, lakeshores, and wetlands (Butler 1997; Gebauer and Moul 2001). During winter, when aquatic prey are more difficult to hunt due to a lack of low tides during daylight, fallow farm fields and associated ditches become important foraging habitat for both adult and juvenile herons (Butler 1995; 1997). This species is a prey generalist that forages on a wide variety of animals, including fish (Shiner Perch (*Cymatogaster aggregata*), gunnel (*Apodichthys* spp. and *Pholis* spp.), juvenile herring (*Clupea pallasii*), Bay Pipefish (*Syngnathus griseolineatus*) and sculpin (*Cottus* spp.)), small mammals, insects, amphibians, and crustaceans (Butler 1995; 1997; Vennesland and Butler 2011).

Since tracts of potential foraging habitat appear to be vacant during the year, foraging habitat does not appear to be limiting the overall Pacific Great Blue Heron population in Canada (COSEWIC 2008). It is possible that the use of suitable foraging habitat in certain urban localized areas is limited by the availability of undeveloped nesting habitat (e.g., the heavily developed Burrard Inlet).

Nesting Habitat Requirements

Pacific Great Blue Herons nest primarily in trees; their colonies commonly are situated in forests near to (usually within 2.9 km of, but up to 10 km from) suitable foraging areas (Butler 1995; Vennesland and Butler 2011; Azerrad 2012). Nest sites often are selected in areas that minimize the potential for disturbance by human activities, but frequently they nest small remnant patches surrounded by development, including small woodlands and even solitary trees in rare cases (Butler 1997; Vennesland and Butler 2011). Pacific Great Blue Herons usually nest in colonies containing 2 to 400 nests (Vennesland and Butler 2004) although they sometimes nest solitarily. Primary tree species used for nesting include Red Alder (*Alnus rubra*), Black Cottonwood (*Populus balsamifera*), Bigleaf Maple (*Acer macrophyllum*), Sitka Spruce (*Picea sitchensis*), and Douglas-fir (*Pseudotsuga menziesii*) (Gebauer and Moul 2001).

In the Lower Fraser River Valley, where about 60% of the Canadian population occurs, nesting habitat is thought to be limited. For example, around Boundary Bay, where there is little suitable forested habitat remaining within 10 km of foraging areas, Pacific Great Blue Herons have been found nesting in untraditional habitats such as hedgerows (B. Smith, unpubl. data; GBHE Working Group pers. comm. 2013). However, nesting

habitat likely is not limiting numbers in most portions of the Canadian range (e.g., less developed areas of the coast, such as the Mainland Coast and Haida Gwaii).

Furthermore, within the Lower Fraser River Valley, Pacific Great Blue Herons were shown to select nesting locations within 200 m of an active Bald Eagle nest (Jones 2009). The relationship between eagles and herons is discussed in greater detail in the Threats section.

Pacific Great Blue Heron colonies tend to move in relation to predation events or human disturbance. Herons subject to increasing levels of disturbance may relocate more often as they try to find less disturbed sites. Large colonies (those above 50 nests) tend to stay in one location for a substantial amount of time (sometimes many decades), but smaller colonies may relocate every few years (Butler 1997; Vennesland 2000; Vennesland and Butler 2011). Therefore, it is important that Pacific Great Blue Herons, particularly those in smaller colonies, have sufficient habitat for both current and future nesting needs. In areas where high levels of human and Bald Eagle disturbance occur, the need for alternate nesting habitat is greater. Pacific Great Blue Herons will return to an abandoned nesting location after one or more years of absence although this is uncommon (Moul et al. 2001; Chatwin et al. 2006).

4. Threats

4.1. Threat Assessment

The threat classification below is based on the World Conservation Union–Conservation Measures Partnership (IUCN-CMP) unified threats classification system (CMP website, IUCN CMP 2006). Under this system, threats may be observed, inferred, or projected to occur in the near term, and are characterized in terms of scope, severity, and timing. Threat "impact" is calculated from scope and severity. For information on how the values are assigned, see Master et al. (2009) and table footnotes. Overall threat score for Pacific Great Blue Heron is calculated as 'Medium' as a result of the cumulative impact of a large number of low-level and one medium-level threats.

Table 2. Threat Assessment Table.

Threat No.	Threat Description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Low	Small	Serious-Moderate	High
1.1	Housing & urban areas	Low	Small	Moderate-Slight	High
1.2	Commercial & industrial areas	Low	Small	Serious-Moderate	High
1.3	Tourism & recreation areas	Negligible	Negligible	Moderate-Slight	High
2	Agriculture & aquaculture	Low	Small	Extreme-Serious	High
2.1	Annual & perennial non-timber crops	Negligible	Negligible	Extreme-Serious	High
2.2	Wood & pulp plantations	Negligible	Negligible	Extreme-Serious	High
2.4	Marine & freshwater aquaculture	Low	Small	Moderate-Slight	High
3	Energy production & mining	Negligible	Negligible	Extreme-Serious	Moderate
3.2	Mining & quarrying	Negligible	Negligible	Extreme-Serious	Moderate
4	Transportation & service corridors	Low	Large	Slight	High
4.1	Roads & railroads	Low	Large	Slight	High
4.2	Utility & service lines	Low	Large	Slight	High
4.4	Flight paths	Negligible	Negligible	Slight	High

5	Biological resource use	Low	Small	Slight	High
5.1	Hunting & collecting terrestrial animals	Negligible	Small	Negligible	High
5.3	Logging & wood harvesting	Low	Small	Slight	High
6	Human intrusions & disturbance	Low	Large	Slight	High
6.1	Recreational activities	Low	Large	Slight	High
6.3	Work & other activities	Negligible	Negligible	Slight	High
7	Natural system modifications	Negligible	Small	Negligible	High
7.2	Dams & water management/use	Negligible	Small	Negligible	High
7.3	Other ecosystem modifications	Negligible	Negligible	Unknown	High
8	Invasive & other problematic species & genes	Medium	Pervasive	Moderate	High
8.1	Invasive non-native/alien species	Negligible	Negligible	Unknown	High
8.2	Problematic native species	Medium	Pervasive	Moderate	High
9	Pollution	Unknown	Pervasive	Unknown	High
9.2	Industrial & military effluents	Unknown	Pervasive	Unknown	High

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

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

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or 3-generation timeframe. For this species a generation time of 5.6 years (COSEWIC 2008) was used resulting in severity being scored over a 17.8-year timeframe. It is usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit $\underline{>}$ 0%).

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

4.2. Description of Threats

The overall threat score for Pacific Great Blue Heron is medium due to the cumulative impact of a large number of low impact threats and one medium impact threat. The single largest impact score ('medium') is the threat from increasing Bald Eagle predation at colonies. Habitat loss to residential and commercial development is predicted to have a low overall impact on the Pacific Great Blue Heron population in Canada over a 10-year period. Although the severity of this threat is predicted to be moderate to serious, the scope is small because over such a short period of time only a small number of herons will be directly impacted.

IUCN – CMP Threat 1. Residential and Commercial Development

Threat 1.1 - Housing and Urban Areas; Threat 1.2 - Commercial and Industrial Areas
Residential and commercial development can threaten Pacific Great Blue Heron colony placement and nesting success due to the direct loss of suitable nesting habitat associated with development and colony disturbance as a result of noise and human activity. Construction work has resulted in the abandonment of Pacific Great Blue Heron nests (Simpson and Kelsall 1978; Simpson 1984). The largest development pressure is expected in the Lower Fraser River Valley and southern portions of Vancouver Island. Over the next 17.8 years (three generations), it is anticipated that a small number of existing colonies will be affected by housing or industrial development on terrestrial landscapes. Commercial developments in nearby marine areas (e.g., shipping terminals) and upland foraging areas (e.g., residential and commercial development on farmland) are expected to have a small negative impact at the Tsawwassen colony, the largest colony in Canada, as well as other smaller nearby colonies.

Loss of Nesting Habitat

Loss of suitable nesting habitat has been widespread and continuous throughout the Strait of Georgia, especially near urban areas such as Victoria and Vancouver (Moore 1990; Butler 1997; Gebauer and Moul 2001; COSEWIC 2008). About 80% of the Canadian population of the Pacific Great Blue Heron nests in the two most heavily developed Conservation Regions on the coast of British Columbia: Lower Fraser River Valley and Vancouver Island (COSEWIC 2008). Intensive monitoring of Pacific Great Blue Heron colonies, from 1972 to 1985 and from 1998 to 1999, documented at least 12 previous colony locations primarily lost due to habitat destruction around the Strait of Georgia (Forbes et al. 1985; Vennesland 2000).

Loss of Foraging Habitat

Few data are available on the loss of foraging habitat, but, similar to nesting habitat, the most important foraging habitats for Pacific Great Blue Heron in Canada are located around the most developed areas of the coast and especially at the western margin of the Lower Fraser River Valley. On a 2009 survey from the BC Ferries causeway near Tsawwassen, nearly 700 Pacific Great Blue Herons were counted within 500 m north

and south of the causeway (R. Vennesland unpub. data). This count over an estimated 1 km^2 accounts for approximately 14% of the entire Canadian population (COSEWIC 2008). In the Lower Fraser Basin from Vancouver to Hope, 85% of bogs, marshes, swamps, and fens were dyked and converted for urban and agricultural use between 1827 and 1990 (Boyle et al. 1997). Loss of estuarine foraging habitat on Vancouver Island to sawmill and pulpmill expansion and paving of estuaries is ongoing (Chatwin pers. comm. 2014).

Interplay of Nesting and Foraging Habitat

Pacific Great Blue Herons require nesting areas within 10 km of foraging habitat (Butler et al. 1995). Knight (2009) examined the location and productivity of colonies on the south coast of British Columbia and found that Pacific Great Blue Herons are being pressured by human development as they try to nest in areas that avoid human development while remaining near suitable foraging areas.

Habitat loss due to residential and commercial development is predicted to have a low overall impact on the Pacific Great Blue Heron population in Canada over a 17.8-year period. Although the severity of this threat is predicted to be moderate to serious, the scope is small because over this period only a small number of herons will be directly impacted.

IUCN – CMP Threat 2. Agriculture & Aquaculture

Threat 2.4 Marine & Freshwater Aquaculture
Netting and other structures surrounding shellfish aquaculture, salmon operations, and hatcheries can negatively impact Pacific Great Blue Herons; herons may become ensnared in netting, which can cause injury or death. The overall impact of this threat is low because it will only affect a small proportion of the population.

Commercial development on agricultural land, such as greenhouses, is discussed under Threat 1.

IUCN – CMP Threat 4. Transportation and Service Corridors

Threat 4.1 Roads & Railroads
Birds flying over a road encounter the risk of a collision while birds foraging in roadside ditches may be disturbed or killed by traffic. A large proportion of the Canadian population of Pacific Great Blue Heron encounters at least one road each day (GBHE Working Group pers. comm. 2014). Herons at the largest colony (Tsawwassen, about 700 nesting individuals) must fly over the BC Ferries causeway multiple times per day to reach their intertidal foraging grounds. Roads associated with commercial development on the south coast are slated to be built in the near future, further increasing this danger. A large proportion of the population encounters roads; however, the overall impact of this threat is predicted to be low because the number of birds actually struck is small.

Threat 4.2 Utility and Service Lines
A large proportion of the Pacific Great Blue Heron population regularly crosses powerlines or is potentially disturbed by powerline maintenance adjacent to a colony (Welstead pers. comm. 2015). They can be harmed by the physical force of hitting transmission or service line wires, but they also can be electrocuted when they strike service lines by making contact between the energized conductors. Herons are considered to be particularly susceptible to collisions with lines because they lack flight agility owing to their large heavy body, wide wingspan, and, consequently, flight style (Next Environmental Inc. 2005). Due to their large size, they also can make electrical contact while perched on poles or at switchyards which can result in electrucution (BC Hydro pers. comm. 2015).

Given that there are thousands of kilometers of service and transmission lines within the potential area of occupancy, it is suspected that this is a widespread threat, but there is little data on the impact to heron populations. Site-specific research on bird collisions with the Roberts Bank Causeway transmission line since 1984 have shown that Pacific Great Blue Herons collide with transmission lines relatively less than other species (Hemmera 2014). Hemmera found 3 heron carcasses within 20 m of the transmission line during 15 months of surveying. They extrapolated that number to 7 herons per year after accounting for surveyor bias, scavenging, and available serach area was accounted for. However, they were unable to separate line collisions from truck strikes or predation, so their estimate represents mortality from all sources. Flight behavior observations at the Roberts Bank Causeway recorded herons adjusting their flight behavior when approaching the transmission lines, possibly in response to the highly visible Spiral Vibration Dampeners installed on the line (Next Environmental Inc. 2005).

There are at least two recent examples where the clearing and maintenance of utility corridors have come in close proximity to active Pacific Great Blue Heron colonies; however, while disturbance did occur, neither colony was abandoned due to the work (GBHE Working Group pers. comm. 2013). Because powerline maintenance and construction is primarily in heavily-developed areas, where the largest colonies also occur, a large proportion of the population is predicted to be affected. However, the overall impact of this threat is predicted to be low because evidence that it has resulted in colony abandonment is limited.

IUCN – CMP Threat 5. Biological Resource Use

Threat 5.3 Logging and Wood Harvesting
Logging of suitable nest trees and habitat adjacent to colonies can result in both direct habitat loss and disturbance (Forbes 1985; Vennesland 2000). There is at least one recent case where logging occurred within a few hundred metres of nest trees and may have contributed to colony abandonment (GBHE Working Group pers. comm. 2013). Affected individuals likely move to another colony with a resulting short-term decrease in productivity. Loss of nest trees and associated disturbance is expected to have a low

impact overall because the proportion of the population affected is small and the effects on displaced individuals are not severe/permanent.

IUCN – CMP Threat 6. Human Intrusions and Disturbance

Threat 6.1 Recreational Activities
Recreational activities in this context are broadly defined as any human leisure activity that can disturb Pacific Great Blue Herons (e.g., use of parkland, dogs running off-leash, fishing in shallow intertidal areas, paddleboarding/canoeing/kayaking, etc.). Recreation can disturb nesting Pacific Great Blue Herons (Vos et al. 1985; reviewed by Parnell et al. 1988; Vennesland and Butler 2011). Colony abandonment has been linked to repeated pedestrian intrusions (Mark 1976; Rodgers and Smith 1995; Vennesland and Butler 2004; Eissinger 2007). Even low-level pedestrian activity near colonies has been linked with reduced nesting productivity (Vennesland and Butler 2004).

Pacific Great Blue Herons nesting in highly developed areas of British Columbia have shown the capability to become habituated to human activities (e.g., Stanley Park in Vancouver and Beacon Hill Park in Victoria) (Butler 1997; Vennesland 2000). However, rural colonies respond to disturbances at greater distances. At one colony on Vancouver Island (Quamichan Lake, Duncan), adults flushed from their nests when a human approached within 200 m (prior to eggs being laid), 100 m (after eggs were laid), and 10 m (after chicks were hatched) (Butler 1991).

Although Pacific Great Blue Herons at some urban sites (e.g., Stanley Park) may not noticeably respond to human activity, productivity at these locations has been negatively correlated with the level of human activity in the surrounding area (Vennesland 2000; Vennesland and Butler 2004).

Overall, the impact of human disturbance is expected to be low because, although a large proportion of the Canadian population is affected, effects are not severe/permanent.

IUCN – CMP Threat 8. Invasive and Problematic Species and Genes

Threat 8.2 Problematic Native Species
Bald Eagles are the primary predator of the Pacific Great Blue Heron and represent an important threat for the Canadian population (COSEWIC 2008). Raptor populations have been recovering after heavy population declines in the mid-20th century due to contaminants such as dichlorodiphenyltrichloroethane (DDT) (Bednarz et al. 1990; Butler and Vennesland 2000; Kjellen and Roos 2000; Elliott and Harris 2001; Jones 2009). Bald Eagle numbers on the south coast of British Columbia have recovered significantly since the mid-1980s (Elliott and Harris 2001; Jones 2009). Jones (2009) reported that the number of known Bald Eagle nests in the Lower Fraser River Valley increased from 1987 to 2006. As Bald Eagle numbers have increased, attacks on Pacific Great Blue Heron nests appear to have increased. Norman et al. (1989) observed one eagle attack/10.3 hours in 1988, while Vennesland and Butler (2004)

observed one eagle attack/4.3 hours in 1999. Bald Eagle attacks are considered to be a primary reason for reduced nesting productivity and higher rates of colony abandonment in recent years (Butler et al. 1995; Vennesland and Butler 2004). Bald Eagles also occasionally attack and kill adult and juvenile herons on feeding grounds (Butler 1997; Vennesland and Butler 2011).

Pacific Great Blue Herons appear to have responded to increasing Bald Eagle predation by shifting from nesting in a few large colonies to either nesting in smaller colonies or nesting in close proximity to an active eagle nest (Jones 2009). By nesting near an active Bald Eagle nest, some Pacific Great Blue Herons pay a cost in lost eggs, nestlings, or adults but may benefit from reduced predation rate overall as territory defense by the nesting eagles reduces the incidence of predation by other juvenile and non-territorial Bald Eagles (Jones et al. 2013). However, if a nesting pair of eagles fails or abandons their territory, then the Pacific Great Blue Herons are once again vulnerable to increased predatory incursions (Jones 2009).

The effects of Bald Eagle predation on both nesting productivity and adult mortality are pervasive throughout the Canadian range of the Pacific Great Blue Heron and are predicted to have a moderate severity on the affected population. Thus, this threat has the highest overall impact score of all threats considered for this species, with a predicted impact of medium.

IUCN – CMP Threat 9. Pollution

Threat 9.2 Industrial and Military Effluents

Pacific Great Blue Herons rely year-round on nearshore and intertidal environments for foraging (Butler 1997, COSEWIC 2008). Foraging areas are concentrated in a narrow strip along shorelines, and in rich foraging locations (such as Boundary Bay on the Fraser River Delta) hundreds of herons can gather to feed. Due to the large number of commercial and recreational vessels that use this area, these habitats are under threat from both catastrophic oil spills and smaller chronic emissions (e.g., small oil emissions from sewers or recreational boaters).

Pollution from industrial contaminants in the environment (e.g., organochlorine pesticides, polychlorinated biphenyls, dioxins, furans) was seen historically as a significant threat to Pacific Great Blue Heron populations (reviewed by Butler 1992); however, recent research has shown that the prevalence of some of these contaminants has decreased and no longer poses a significant threat to this species (reviewed by Vennesland and Butler 2011). Nevertheless, new chemicals are emerging that might pose a threat to the Pacific Great Blue Heron in the future. In particular, concentrations of polybrominated diphenyl ethers (PBDEs) have been reported to be increasing exponentially in Pacific Great Blue Heron tissues in British Columbia and might be close to toxicologically significant levels (Elliott et al. 2005).

The overall impact of this threat is currently unknown but could be significant, especially around the Strait of Georgia (Elliott et al. 2005).

5. Management Objective

To ensure that all conservation regions across coastal British Columbia have stable or locally increasing numbers of Pacific Great Blue Herons.

Rationale for Management Objective

The historical population size is difficult to confirm due to a lack of sufficient monitoring data prior to the 1980s, but it likely would have been larger than at present due to the subsequent impact of various threats; therefore, stability or local increase in numbers is an appropriate objective. Until more rigorous Conservation Region-specific numbers can be established (through planned enhancements to the monitoring program), the 2008 population size of 4715 nesting adults (COSEWIC 2008) should be viewed as the baseline from which population dynamics are measured.

Stability for each Great Blue Heron Conservation Region is defined as sufficient nesting success/productivity to ensure a stable population persists over the long-term without relying on immigration from more productive Conservation Regions (noting that in some regions, numbers may be naturally limited). Population data is lacking from Haida Gwaii and the Mainland Coast (including associated islands), but, in the south, it appears that only the Lower Fraser River Valley currently is producing enough young to maintain a stable population (COSEWIC 2008).

In the short-term (five years), numbers within each Conservation Region should be determined and managed to remain stable (or increasing). Over the longer term (ten years), the enhanced monitoring data should be used to identify numerical targets for each Conservation Region to ensure populations remain viable (see Broad Strategies and Conservation Measures below).

6. Broad Strategies and Conservation Measures

6.1 Actions Already Completed or Currently Underway

Habitat Protection and Threat Mitigation:

- Adult birds and their nests, eggs and nestlings are protected under the *Migratory Birds Convention Act* (MBCA) and BC *Wildlife Act*. Unlike other species protected under the MBCA, Pacific Great Blue Herons nests (and thus their nest trees) are protected year round by section 34 of the *Wildlife Act*.
- Develop with Care factsheets (Ministry of Forests, Lands and Natural Resource Operations 2014) have been published to set environmental guidelines for urban and rural land development in British Columbia. These factsheets outline legal

protection[4] for Pacific Great Blue Herons and their colonies and recommend best practices for development for landowners and land managers.
- Many of the large colonies are under various levels of protection including municipal and regional parks, while others remain unprotected. For a list of both nesting and foraging areas with some existing protection please see the COSEWIC status report (COSEWIC 2008).

Habitat Mapping and Research to Fill Knowledge Gaps:

- There has been a long term nesting success and productivity study program on Vancouver Island and the south coast. This program has been supported by the Province of BC, Environment and Climate Change Canada, Parks Canada, the Habitat Conservation Trust Fund, and volunteers. The program tracks active colonies, maps location of nesting habitat, and reports on colony numbers and productivity.
- Contaminant sampling in Pacific Great Blue Herons has been carried out by Environment and Climate Change Canada scientists (Elliott et al. 2005).

6.2 Broad Strategies

The following broad strategies will guide conservation of the Pacific Great Blue Heron in Canada.

1. Habitat mapping – The location of nesting (woodland) and foraging habitat (eelgrass beds, freshwater and estuarine marshes, grassy habitats, ditches, and riversides) needs to be mapped to support its conservation by responsible jurisdictions and landowners. Mapping also needs to be done to identify habitat that should be set aside for future nesting (alternate habitat is required because Pacific Great Blue Heron colonies move locations from time to time).

2. Habitat conservation – Those habitats considered necessary for conservation of the species, including existing and alternate habitat, need to be conserved. Since many Pacific Great Blue Heron colonies are on private land, a program of incentives (such as Natural Areas Protection Tax Exemption Program and Ecological Gifts Program) could provide landowners with the impetus to protect nesting trees and buffers. Land stewardship agreements and both provincial and federal protection should be pursued for nesting and foraging grounds (e.g., via mechanisms such as Wildlife Habitat Areas and Wildlife Management Areas (WMAs).

3. Habitat stewardship and education – Outreach with individual landowners (to inform them of the species' needs and encourage them to adjust landscaping and other activities) is needed to reduce disturbance and habitat loss for birds that nest on/adjacent to private land. Interpretive signage and community meetings also will build

[4] "protection" in this document should not be confused with the legal protection afforded to the critical habitat of threatened and endangered species under SARA.

awareness of the negative effects of human recreation on foraging Pacific Great Blue Herons.

4. Research and monitoring to fill knowledge gaps – The current monitoring program must be continued and enhancements made to ensure that reliable population estimates can be generated and appropriate management targets established for all Conservation Regions. Research is required to assess potential methods for mitigation of threats from human disturbance and Bald Eagle predation (CDC 2014), as well as the importance of emerging industrial contaminants (such as PBDEs; COSEWIC 2008). The threat from Bald Eagle predation is not well understood currently, so, until further research is conducted, it is not clear what appropriate mitigation options (if any) can be employed. Population modeling is required to better understand the metapopulation dynamics between Haida Gwaii, Mainland Coast, Vancouver Island, and Lower Fraser River Valley and the numbers required for viability in each of these Conservation Regions. Juvenile herons from wildlife rescues might be able to increase recruitment in some populations; however, more research into this technique is required. Attaching radio or satellite tags onto rehabilitated juveniles could provide valuable information about heron movement patterns.

5. Habitat restoration – The restoration of marine (e.g., eelgrass enhancement, spartina removal) and upland (e.g., planting old field and grassy cover that promote small mammal populations) foraging habitats in the more heavily-developed areas of the coast (especially in the Lower Fraser River Valley), as well as selected habitats by planting alders or other beneficial vegetation, will help to ensure that priority nesting and foraging locations remain as functional as possible. This may help to reduce the risk of colonies frequently relocating and provide mature trees for nesting in the future.

6.3 Conservation Measures

Table 3. Conservation Measures and Implementation Schedule.

Conservation Measure	Priority[a]	Threats	Timeline
Broad Strategy 1: Habitat mapping			
Map the location of all known nesting locations including buffer areas required for management. Ensure maps are accessible to landowners and managers.	Medium	– 1.1 Housing and Urban Areas – 1.2 Commercial & Industrial Areas – 4.1 Roads & Railroads – 4.2 Utility & Service Lines – 6.1 Recreational Activities	Five years after final posting of the management plan
Map the location and extent of all priority foraging locations (all that are < 10km from important nesting locations) and ground-truth data.	Medium	– 1.2 Commercial & Industrial Areas – 2.1 Annual & Perennial Non-timber Crops – 6.1 Recreational Activities	Five years after final posting of the management plan

Conservation Measure	Priority[a]	Threats	Timeline
In regions with potentially limiting nesting habitat, map suitable woodlands for identification as potential alternate nesting locations (for future use).	Low	– 1.1 Housing and Urban Areas – 1.2 Commercial & Industrial Areas – 4.1 Roads & Railroads – 4.2 Utility & Service Lines – 6.1 Recreational Activities	Five years after final posting of the management plan
Complete the Heron Working Group's online atlas (currently housed at the Community Mapping Network) as a centralized warehouse of habitat mapping for responsible jurisdictions and landowners.	Low	– 1.1 Housing and Urban Areas – 1.2 Commercial & Industrial Areas – 2.1 Annual & Perennial Non-timber Crops – 4.1 Roads & Railroads – 4.2 Utility & Service Lines – 6.1 Recreational Activities	Five years after final posting of the management plan
Broad Strategy 2: Habitat conservation			
Work with responsible jurisdictions and landowners towards the effective conservation of all known nesting and foraging locations and alternate habitat: – Implement Wildlife Habitat Areas and Wildlife Management Areas where feasible and appropriate. – Institute Natural Areas Protection Incentive Program to gain private landowner support and adopt bylaws in official community plans to protect Great Blue Heron nest sites such as those in the Comox Valley and Cowichan Valley Regional Districts. – Protect nesting birds from nest predators.	Medium	– 1.1 Housing and Urban Areas – 1.2 Commercial & Industrial Areas – 2.1 Annual & Perennial Non-timber Crops – 4.1 Roads & Railroads – 4.2 Utility & Service Lines – 6.1 Recreational Activities	Five years after final posting of the management plan

Conservation Measure	Priority[a]	Threats	Timeline
Broad Strategy 3: Habitat stewardship and education			
Educate those working near, and responsible for managing, heron habitats on how to avoid disturbance.	Medium	– 1.1 Housing and Urban Areas – 1.2 Commercial & Industrial Areas – 2.4 Marine & Freshwater Aquaculture – 4.1 Roads & Railroads – 4.2 Utility & Service Lines – 6.1 Recreational Activities	Five years after final posting of the management plan
Educate the general public on how to avoid disturbance of herons.	Low	– 1.1 Housing and Urban Areas – 6.1 Recreational Activities	Five years after final posting of the management plan
Broad Strategy 4: Research and monitoring to fill knowledge gaps			
Conduct ongoing colony monitoring (with enhancements to address gaps within some Conservation Regions) to track numbers and assess efficacy of management activities.	Medium	– All	ongoing
Determine effective methods for mitigating the impact of Bald Eagles.	High	– 8.2 Problematic Native Species	Five years after final posting of the management plan
Conduct population modelling to understand metapopulation dynamics, define population viability, and set population targets.	Medium	– All	Five years after final posting of the management plan
Engage wildlife rescues to foster and release nestlings and track yearlings upon release to investigate metapopulation dynamics.	Medium	– All	ongoing
Work with toxicologists to ensure further understanding and monitoring of contaminants.	Medium	– 9.2 Pollution	ongoing
Broad Strategy 5: Habitat restoration			
Where opportunities exist, restore forested nesting habitat in areas where habitat is currently limiting or will be in the future.	Low	– 1.1 Housing & Urban areas – 1.2 Commercial & Industrial areas – 4.1 Roads & Railroads	ongoing

Conservation Measure	Priority[a]	Threats	Timeline
		– 4.2 Utility & Service Lines – 5.3 Logging and Wood Harvesting	
Where opportunities exist, restore marine and upland foraging habitat in areas where habitat is likely to be limiting in the future, and map habitat likely to be restored.	Low	– 1.1 Housing & Urban Areas – 1.2 Commercial & Industrial Areas – 2.1 Annual & Perennial Non-timber Crops – 4.1 Roads & Railroads	ongoing

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

7. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the management objective. Every five years, success of this management plan implementation will be measured against the following performance indicators:

- Research has been conducted to better understand and manage disturbance by Bald Eagles and humans and threats from pollutants.
- Nesting and foraging habitats have been mapped.
- In areas where nesting habitat may be limiting, unoccupied woodlands have been identified for alternate nesting habitat.
- Ongoing colony monitoring has improved tracking of numbers, breeding success, and measures of the efficacy of management activities.
- Information regarding Pacific Great Blue Heron colonies and habitat has been integrated into a centralized data warehouse.
- Landowners and land managers have received proper guidance and education to effectively manage lands with priority nesting and foraging habitats and habitat protection measures, such as WMAs, have been explored.
- Population modeling has been conducted to better assess numbers, viability, and set targets.
- Habitat restoration projects have been identified and completed in areas where habitat may be limiting.
- Ensure Pacific Great Blue Heron numbers persist in all currently occupied Conservation Regions of coastal British Columbia.

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Appendix A: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*[5]. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[6] (FSDS) goals and targets.

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

Conservation and management of foraging habitat for Pacific Great Blue Heron may have indirect benefits for intertidal ecosystems and the species associated with them, including salmon, eel grass beds, and migrating shorebirds. Conservation and management of nesting habitat in the Coastal Douglas-fir Biogeoclimatic Zone may provide indirect benefits for over 100 species including breeding passerine birds. By conserving Pacific Great Blue Heron habitat, a multitude of species that rely on the same habitats will also benefit. There are no known negative impacts to other species at risk from the implementation of the management plan.

[5] www.canada.ca/en/impact-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html
[6] https://www.fsds-sfdd.ca/index.html#/en/goals/