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Management Plan for the Evening Grosbeak (*Coccothraustes vespertinus*) in Canada

Evening Grosbeak

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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: Male and female Evening Grosbeak © Fred Woodman

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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 SAR Public Registry.

The Minister of Environment and Climate Change and Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Evening Grosbeak 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, Province of Alberta, Province of Saskatchewan, Province of Manitoba, Province of Ontario, Province of Quebec, Province of New Brunswick, Province of Nova Scotia, Province of Prince Edward Island, Province of Newfoundland and Labrador, Northwest Territories, Yukon Territory, Wek'eezhii Renewable Resource Board and the Yukon Fish and Wildlife Management Board 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 or 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 Evening Grosbeak and Canadian society as a whole.

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

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

Acknowledgments

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Environment and Climate Change Canada would like to acknowledge the contribution of the thousands of volunteers who generously donate their time and expertise to bird monitoring programs throughout North America, including citizen-science based programs that have been extremely valuable in understanding Evening Grosbeak population status such as the Christmas Bird Count, the Breeding Bird Survey, Project FeederWatch and the Great Backyard Bird Count.

Executive Summary

The Evening Grosbeak (*Coccothraustes vespertinus*) is a stocky bird of the Finch family (Fringillidae), slightly smaller than an American Robin (*Turdus migratorius*). The species breeds in mature to old conifer and mixedwood forests across the boreal forest and western montane areas in North America. In Canada, the species breeds in all provinces and territories except Nunavut. The species winters throughout most of its breeding range in Canada and is well known for its fall and winter irruptions where it can be found in large numbers far outside its normal breeding range.

The species was assessed as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2016 and listed under Schedule 1 of the *Species at Risk Act* (S.C. 2002, c. 29) in 2019. The International Union for the Conservation of Nature (IUCN) ranks the Evening Grosbeak as Vulnerable. The Evening Grosbeak is protected under the *Migratory Birds Convention Act* in Canada and the *Migratory Bird Treaty Act* in the U.S.

Population estimates differ between sources. Partners in Flight estimates the North American population size of Evening Grosbeaks at 3.8 million individuals of which 53% (2.0 million) occur in Canada. The Boreal Avian Modelling Project estimates the Canadian population size at 16.0 million individuals. In Canada, long-term trends based on the North American Breeding Bird Survey (BBS) indicate an 82% decline since 1970 while Christmas Bird Count (CBC) data indicate an 87% decline over a similar time period. Short-term trends in Canada from the BBS report a non-significant 0.6% increase per year between 2009 and 2019 and the CBC reports a non-significant 0.2% decrease per year for the same time period.

The causes for the decline in the Evening Grosbeak population are unclear. Threats identified for Evening Grosbeak include residential and commercial development (collisions with windows), transportation and service corridors (vehicular collisions) and biological resource use (forest harvesting). Threats with unknown impacts on the population that could potentially be important drivers of decline include other ecosystem modifications (Spruce Budworm control), invasive and other problematic species (various diseases and infections) and pollution (road salts). Threats deemed to have negligible impact on the population include agriculture and aquaculture (clearing of forest for crops and livestock), energy production and mining (oil/gas and mining/quarrying development, wind turbine collisions) and climate change (habitat shifting).

The short-term management objective for the Evening Grosbeak is to achieve a stable (or increasing) 30-yr population trend by 2036. After 2036, the long-term objective is to maintain, at a minimum, a stable 30-yr population trend. The distribution objective is to maintain the current extent of occurrence of the species in Canada. The Breeding Bird Survey provides reliable population trends, both nationally and regionally, that will be used to measure progress towards the management objective. Christmas Bird Count results will also be used to measure progress.

The high priority broad strategies outlined in this management plan aim to fill important knowledge gaps related to the Evening Grosbeak's life history and ecology, and to conduct research to understand the causes of the species' decline. These broad strategies are intended to be short-term means to obtain the relevant information required to develop long-term conservation measures.

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1. COSEWIC* Species Assessment Information

Date of Assessment: November 2016

Common Name (population): Evening Grosbeak

Scientific Name: *Coccothraustes vespertinus*

COSEWIC Status: Special Concern

Reason for Designation: This large finch is widely distributed across Canada's forests, but has exhibited significant long-term declines (77-90%) over most of its range, since 1970. Over the past decades, some data suggest a further decline of nearly 40%, while other data indicate stabilization at a lower level. Threats to the species include reduced availability of mature and old-growth mixed wood and conifer forests, collisions with windows, and mortality associated with feeding on grit and salt along roads in winter.

Canadian Occurrence: Yukon, Northwest Territories, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland and Labrador

COSEWIC Status History: Designated Special Concern in November 2016

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

2. Species Status Information

Evening Grosbeak (*Coccothraustes vespertinus*) was assessed by COSEWIC as Special Concern in 2016 and listed on Schedule 1 of the *Species at Risk Act* (SARA) in 2019. The species is listed as Special Concern in Ontario and Vulnerable in Nova Scotia under their respective *Endangered Species Act*s. The species is not currently listed under formal legislation for species at risk in any of the other provinces or territories where it occurs. The IUCN Red List of Threatened Species classifies Evening Grosbeak as Vulnerable (Birdlife International 2018). NatureServe conservation status ranks are provided in Table 1. Approximately 53% of the global population (Partners in Flight 2020) and 64% of the global range occurs in Canada.

Table 1. Conservation status ranks for Evening Grosbeak (NatureServe 2020).

Global (G) Rank[a]	National (N) Rank	Subnational (S) Rank[b]
G5[c]	Canada N4B, N4N, NUM	British Columbia S5 Alberta S4 Yukon S2B Northwest Territories S4 Saskatchewan S4 Manitoba S2S3 Ontario S4B Quebec S4 New Brunswick S3B, S3S4N, SUM Nova Scotia S3S4B, S3N Prince Edward Island S1S2B, S2S3N Newfoundland Island S4 Labrador (SNA)

[a] Conservation Status Ranks: 1 – Critically imperiled; 2 – Imperiled; 3 – Vulnerable to extirpation or extinction; 4 – Apparently secure; 5 – Secure; U – Unrankable; NA – Not applicable. S#S# or N#N#: range rank indicating range of uncertainty.

[b] Breeding Status Qualifiers: B - Conservation status refers to the breeding population of the species in the nation or state/province/territory; M - Migrant species occurring regularly on migration at particular staging areas or concentration spots; conservation status refers to the aggregating transient population of the species in the nation or state/province/territory; N - Conservation status refers to the non-breeding population of the species in the nation or state/province.

[c] Global status was last reviewed July 2016.

3. Species Information

3.1. Species Description

The Evening Grosbeak is a distinctive stocky bird of the Finch family (Fringillidae), slightly smaller than an American Robin (*Turdus migratorius*). Its large, triangular bill and distinct plumage set it apart from other species (Gillihan and Byers 2020). Adult males are brightly-coloured, having a brown head with a bold yellow forehead, bright yellow belly and black wings with conspicuous white patches. Adult females are duller, generally greyish-brown with a yellowish wash on the sides of the neck. Juveniles resemble adult females in appearance.

3.2. Species Population and Distribution

Distribution

The Evening Grosbeak breeds in Canada, United States and Mexico; the species' breeding range in North America corresponds to the boreal and other conifer-dominated forests (Figure 1) (COSEWIC 2016). Evening Grosbeaks are believed to breed in all provinces and territories except Nunavut (COSEWIC 2016). Breeding has not been confirmed in Yukon, though regular observations of both males and females in summer in the extreme southeast is suggestive of breeding (Eckert 2003).

In the United States, the species breeds in northern New England and in the western states (Figure 1). Evening Grosbeak is considered scarce in Mexico, restricted to areas of higher elevation.

Evening Grosbeaks are considered irruptive migrants, undertaking seasonal movements to and from breeding areas, and occasionally moving long distances in large numbers (i.e., irrupt[3]) during the fall and winter (Gillihan and Byers 2020). They overwinter within most of their Canadian breeding range, where local resident birds mix with winter visitors, as well as in areas south of the breeding range (Figure 1) (Brewer et al. 2018). The species exhibits both north-south movement, as well as east-west movement, to and from breeding and wintering areas (Brewer et al. 2018, Hannah et al. 2020). Males tend to overwinter further north than females (Prescott 1991). Long distance irruptive movements that occur in some years may be in response to poor or failed cone crops in the fall, or exhausted cone crops in late-winter (Bolgiano 2004, Gillihan and Byers 2020). In some years, individuals irrupt as far south as Texas and Louisiana (Figure 1). Evening Grosbeaks are often found in urban and suburban areas at backyard feeders in fall and winter.

Prior to the late 1800s, Evening Grosbeaks occurred primarily west of the Rocky Mountains and were considered a rare visitor to the eastern provinces in Canada (Gillihan and Byers 2020). Several hypotheses have been raised to explain the expansion across the Canadian range including: widespread planting of Manitoba Maple (*Acer negundo*) as ornamentals in eastern cities and as windbreaks in the Prairies, wild Pin Cherry (*Prunus pensylvanica*) establishment after large forest fires, and Spruce Budworm (*Choristoneura fumiferana*) outbreaks (Brunton 1994, COSEWIC 2016, Gillihan and Byers 2020). The most accepted explanation for the range expansion is the increase in intensity and size of Spruce Budworm (*C. fumiferana*) outbreaks in eastern Canada during the first decades of the 1900s (Ouellet 1974, Bolgiano 2004). The first breeding records for the species in Ontario are from 1920 (Godfrey 1986), in 1940 for Quebec and New Brunswick, in 1939 for Nova Scotia and in the late-1960s/early-1970s for Prince Edward Island (Sabine 2010).

Population Size

Population estimates differ considerably between sources. Partners in Flight (2020) estimate the population of Evening Grosbeak in Canada to be approximately 2.0 million birds (95% confidence interval [CI] 1.4 to 2.7 million), which is based on North American Breeding Bird Survey (BBS) data from 2006 to 2015 (Will et al. 2020). According to these estimates, the majority of Evening Grosbeaks in Canada occur in British Columbia (48%), followed by Quebec (18%), Ontario (8%), Alberta (7%) and Saskatchewan (7%). The remaining provinces and territories each support <5% of

[3] Irruptions are characterized as the broad-scale movement of large numbers of individuals to areas outside their normal range (Strong et al. 2015).

Canadian breeding population. The global population size is estimated at 3.8 million birds (95% CI 3.0 to 4.8 million) (Partners in Flight 2020).

The Boreal Avian Modelling (BAM) Project provides population estimates for Canada based on models of species density in relation to environmental variables. They estimate the Canadian population of Evening Grosbeak at 16.0 million individuals[4] (95% CI 13.9 to 18.6 million) (Boreal Avian Modelling Project 2020). According to these estimates, the majority of Evening Grosbeaks in Canada occur in Quebec (32%) and Ontario (21%), followed by British Columbia (17%) and Newfoundland and Labrador (12%). The remaining provinces and territories each support <5% of Canadian breeding population. Based on the BAM model, the highest densities of the species can be found in southcentral British Columbia, the Gaspé Peninsula of Quebec, the Maritime Provinces and the island of Newfoundland (Boreal Avian Modelling Project 2020). For the Evening Grosbeak, the PIF population estimate is likely low, as the forest habitats in which the species is most abundant are typically under-represented in BBS roadside surveys (Sólymos et al. 2020). In addition, the BAM population estimate model accounts for the low detection rate of Evening Grosbeaks during the BBS roadside counts, as the species doesn't have an elaborate song.

[4] The BAM population estimate model assumes that only breeding males are being counted during surveys, and hence provide estimates as number of males. The PIF population estimates incorporate an adjustment factor to account for the undetected member of the breeding pair (Stanton et al. 2019). Therefore, a pair adjustment factor of 1.75 for Evening Grosbeak was applied to the BAM population estimate to allow comparison of both estimates in number of individuals.

Figure 1. Global distribution of the Evening Grosbeak. The species is found year-round in the orange-shaded areas and during the winter in the purple-shaded area. Evening Grosbeaks can winter irregularly in areas between the dotted lines (adapted from COSEWIC 2016, Gillihan and Byers 2020, and Government of the Northwest Territories 2020).

Population Trends

Because Evening Grosbeaks are present in Canada year-round and display irruptive behaviour, it is important to look at sources of information from different times and geographic areas during the seasonal cycle (e.g., breeding and wintering) to understand population trends. The BBS is conducted during the summer breeding period and primarily covers the southern portion of the species' range, while the Christmas Bird Count (CBC) provides samples from across the range during the overwintering period. Considered together they provide a more complete picture of Evening Grosbeak population status and distribution. Additional information from backyard feeder programs also contribute to a broader understanding of the species, as well as data from citizen science programs like eBird that are now being used to estimate trends and annual indices of abundance. The BBS and CBC are considered the best sources of information for assessing this species' population trends and distribution across its Canadian range (COSEWIC 2016), and are discussed first.

Breeding Bird Survey Results

In Canada, trend results based on BBS data (breeding season) indicate a significant long-term (1970-2019) decline of 3.4% per year (95% credible limit[5] [CL] -5.8% to -1.4%) and a non-significant short-term (2009-2019) increase of 0.6% per year (95% CL -6.5% to +5.9%) (Smith et al. 2020). The long-term annual change indicates that the population declined by approximately 81% between 1970 and 2019 and increased by 6% between 2009 and 2019. Long- and short-term trends in the United States are relatively stable (-1.1% per year [95% CL -2.5% to +5.4%] between 1970 and 2019 and +1.9% per year [95% CL -2.2% to +6.7%] between 2009 and 2019 (Smith et al. 2020). The long-term annual change indicates that the population declined by approximately 42% between 1970 and 2019 and increased by 21% between 2009 and 2019.

The Evening Grosbeak's irruptive nature and unpredictable movement patterns can result in high inter-annual variation in counts. Long-term trends measured over broad spatial scales may be more meaningful than trends reported over shorter periods at smaller spatial scales (COSEWIC 2016). However, attempting to infer a rate of change over a time period that spans multiple fluctuations can also be problematic. The most recent methods of analyzing the BBS data are designed to account for annual fluctuations in the trend estimations (Figure 2). The 10-yr interval represents the three generation time period COSEWIC uses for status assessment. A 30-yr interval is also presented that reflects the long-term response to landscape processes associated with Evening Grosbeak population cycles (Figure 3).

[5] A confidence interval (CI) is a range of values around a number that is believed to contain the true value of the number. In this case, there is a 95% probability that the true trend falls between -5.8% and 1.4%. The credible limit (CL) has a similar interpretation.

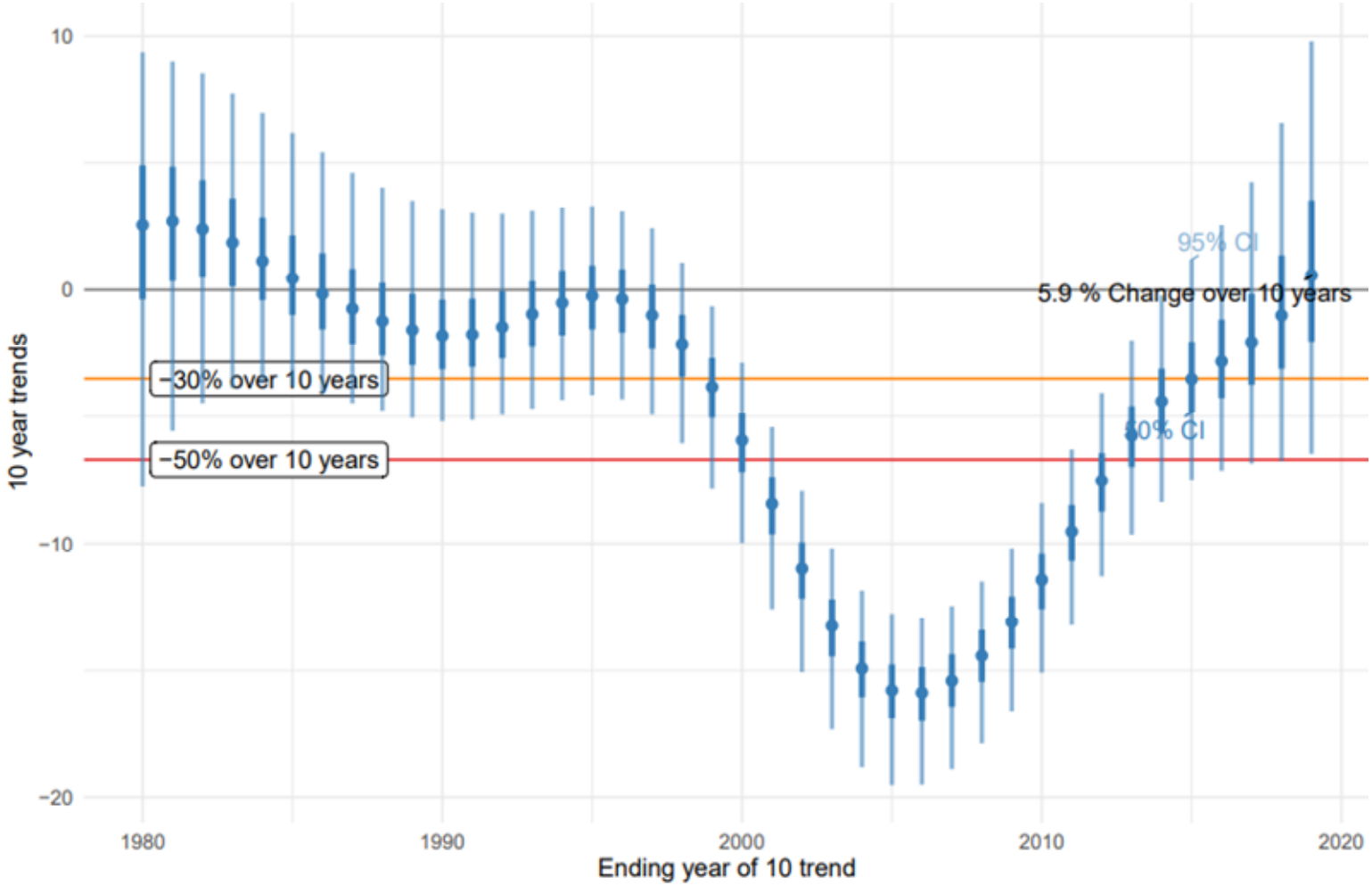

Figure 2. Trends averaged over rolling 10-yr intervals from the BBS for Evening Grosbeak in Canada (Smith and Edwards 2020, for methods see Smith et al. 2020). The orange and red lines indicate the COSEWIC 30% and 50% decline thresholds for Threatened and Endangered, respectively. Each point represents the trend estimate from the previous 10-year period. Points below the grey line represent declining trend estimates while points above the line represent increasing trend estimates. The dark blue lines represent the 50% credible limits and the light blue lines represent the 95% credible limits. If the line crosses the grey line (i.e., 0) the trend is considered not statistically significant. The 5.9% change refers to the 2009-2019 time period.

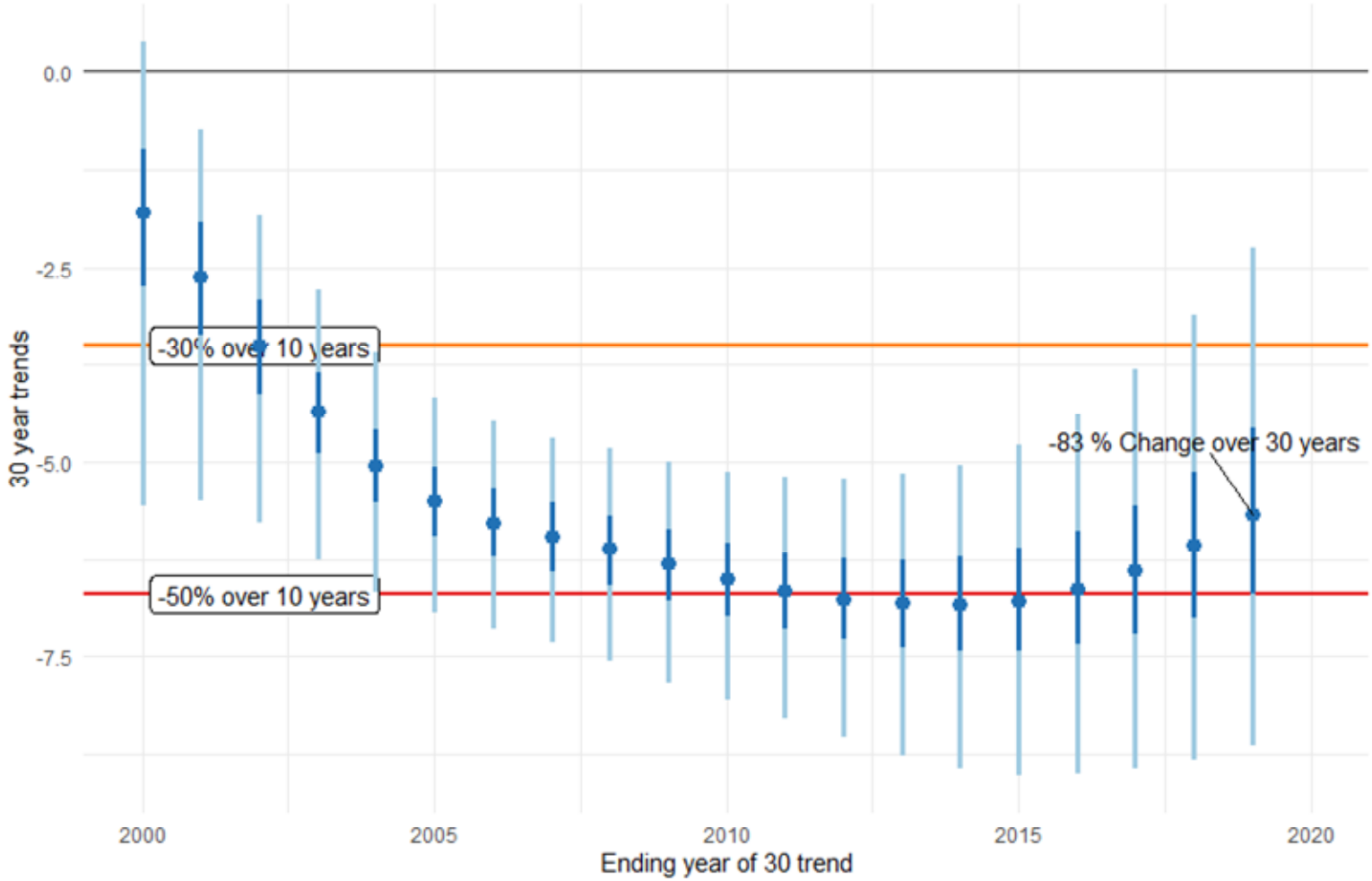

Figure 3. Trends averaged over rolling 30-yr intervals from the BBS for Evening Grosbeak in Canada (Smith and Edwards 2020, for methods see Smith et al. 2020). The orange and red lines indicate the COSEWIC 30% and 50% decline thresholds for Threatened and Endangered, respectively. Each point represents the trend estimate from the previous 30-year period. Points below the grey line represent declining trend estimates while points above the line represent increasing trend estimates. The dark blue lines represent the 50% credible limits and the light blue lines represent the 95% credible limits. If the line crosses the grey line (i.e., 0) the trend is considered not statistically significant. The 83% change refers to the 1989-2019 time period.

Trends by province vary both over the long-term and short-term (Figure 4); it is unclear what is driving regional differences in the trend estimates though the current Spruce Budworm outbreak in Quebec is likely influencing the positive short-term trend in that province (B. Drolet, pers. comm.).

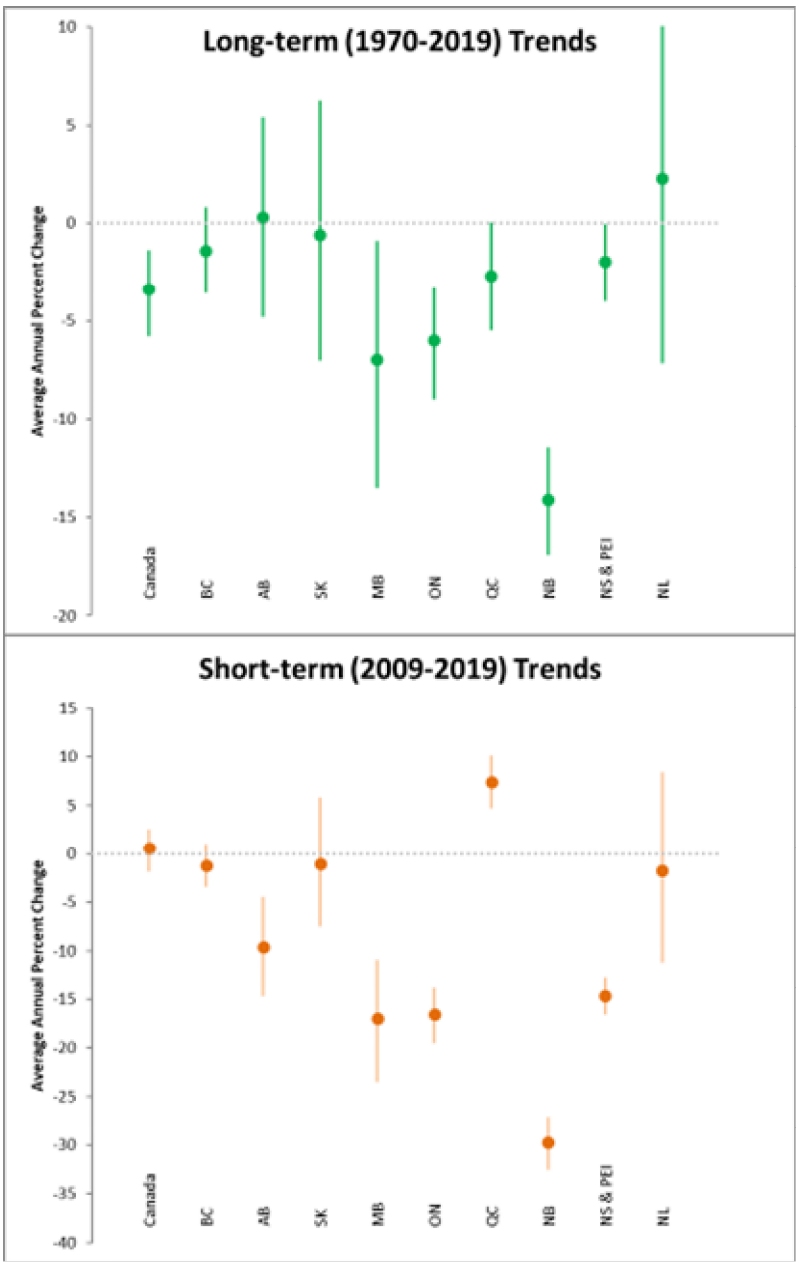

Figure 4. Short- and long-term population trends for the Evening Grosbeak by province based on the BBS. Points below the grey dotted line represent declining trend estimates while points above the line represent increasing trend estimates. Lines represent in the upper and lower credible limits around the estimate. If the line crosses the grey dotted line (i.e., 0) the trend is considered not statistically significant. Due to small sample size, Nova Scotia and Prince Edward Island are grouped together. Note that trends are not available for the Northwest Territories and Yukon.

Annual indices of abundance based on the BBS show a mean count of 4.2 birds per route between 1970 and 2019 and 0.9 birds per route between 2009 and 2019 in Canada (Figure 5). Plots for each province show the change in the mean count over the duration of the BBS (Figure 6). While the Canadian trend is showing increases approaching historical peaks (Figure 2), the population remains at reduced abundance in Canada and in most provinces (Figures 5 & 6).

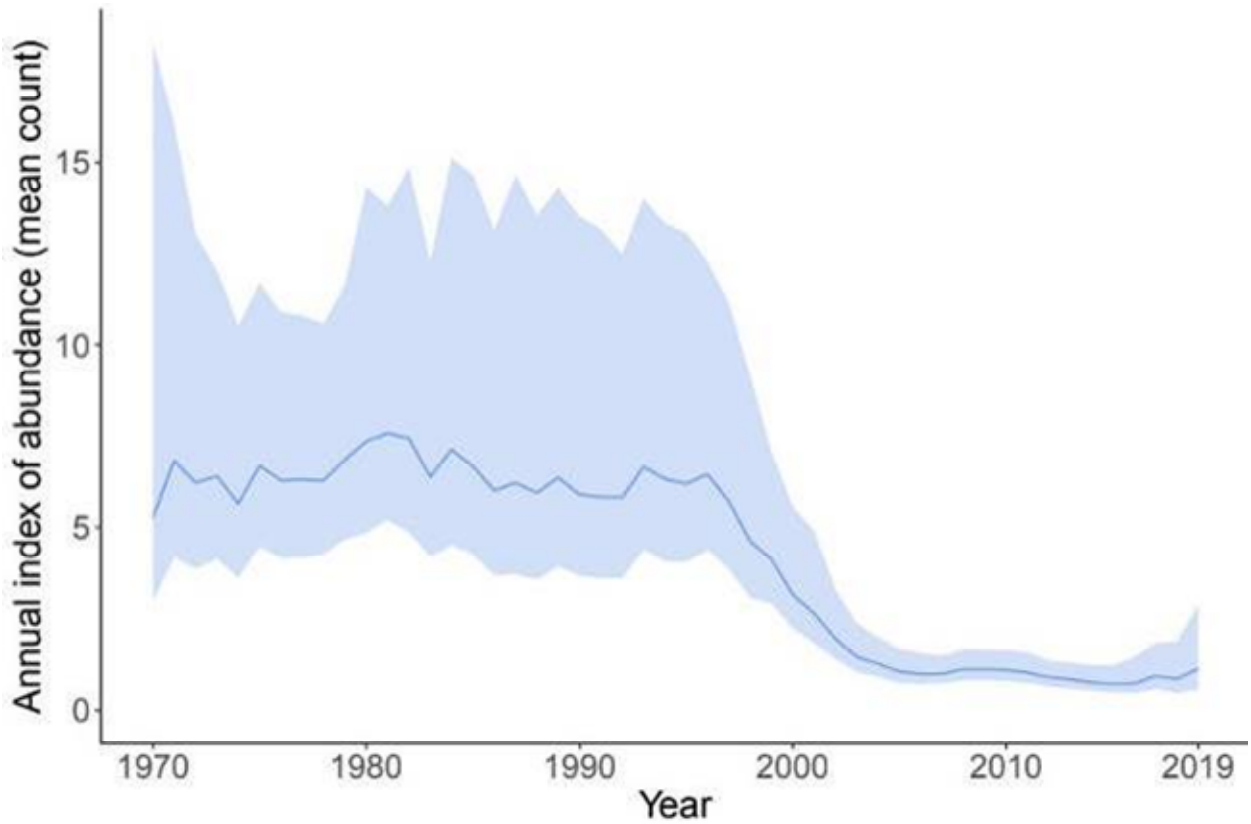

Figure 5. Annual index of abundance (mean count of birds per BBS route) for the Evening Grosbeak in Canada from the BBS (Smith, unpubl. data). Blue shading represents the upper and lower 95% credible limits.

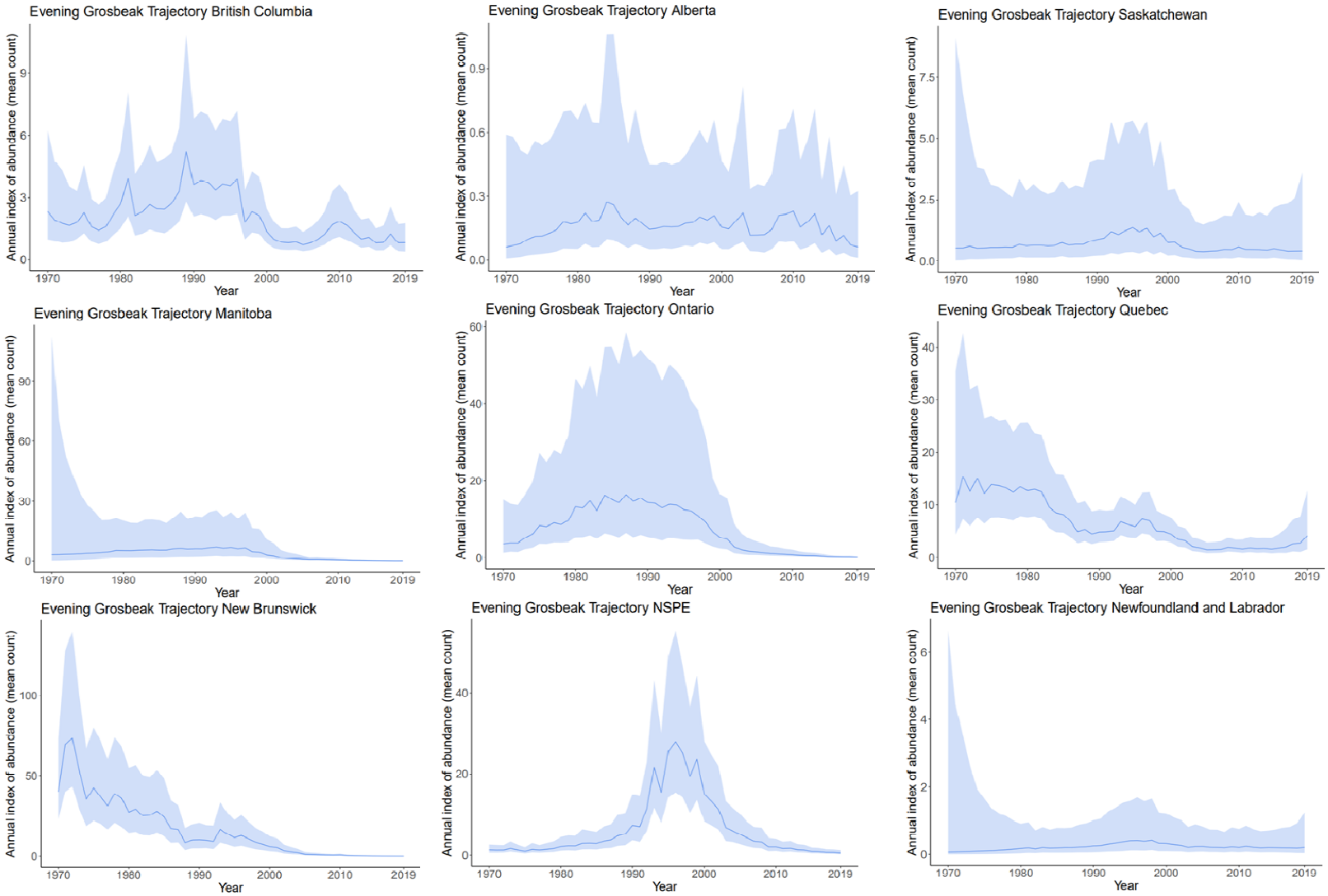

Figure 6. Annual index of abundance (mean count of birds per BBS route) for Evening Grosbeak across provinces from the BBS (Smith et al. 2020). Blue shading represents the upper and lower 95% credible limits. Note that the scale of the y-axis (mean count) differs between plots. Indices are not available for the Northwest Territories and Yukon. NSPE – Nova Scotia and Prince Edward Island.

Christmas Bird Count Results

In Canada, trend results based on CBC surveys (overwintering season) indicate a significant long-term (1970-2019) decline of 4.2% per year (95% CI -7.4% to -2.0%) and a short-term (2009-2019) non-significant decline of 0.2% per year (95% CI -4.8% to 5.0%) (Meehan et al. 2018). The long-term annual change indicates that the population declined by approximately 87% between 1970 and 2019 in Canada. The CBC also reports a declining trend estimate of 3.46% per year (95% CI -5.59% to -0.94%) for the 25-yr period between 1993 and 2019 in Canada (Meehan et al. 2018). Long- and short-term trends across Canada by province and territory are presented in Figure 7. Annual indices of abundance based on the CBC between 1966 and 2017 for Canada are presented in Figure 8.

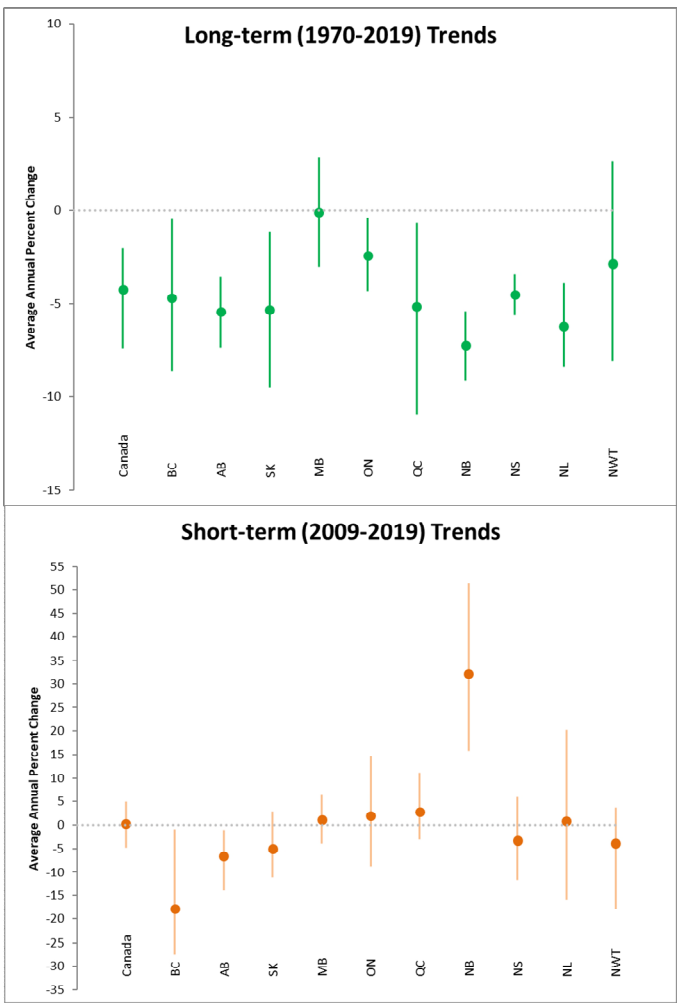

Figure 7. Long- and short-term trends for the Evening Grosbeak by province/territory based on CBC data. Points below the grey dotted line represent declining trend estimates while points above the line represent increasing trend estimates. Lines represent the upper and lower 95% credible limits around the estimate. If the line crosses the grey dotted line (i.e., 0) the trend is considered not statistically significant. Note that trends are not available for Yukon or Prince Edward Island.

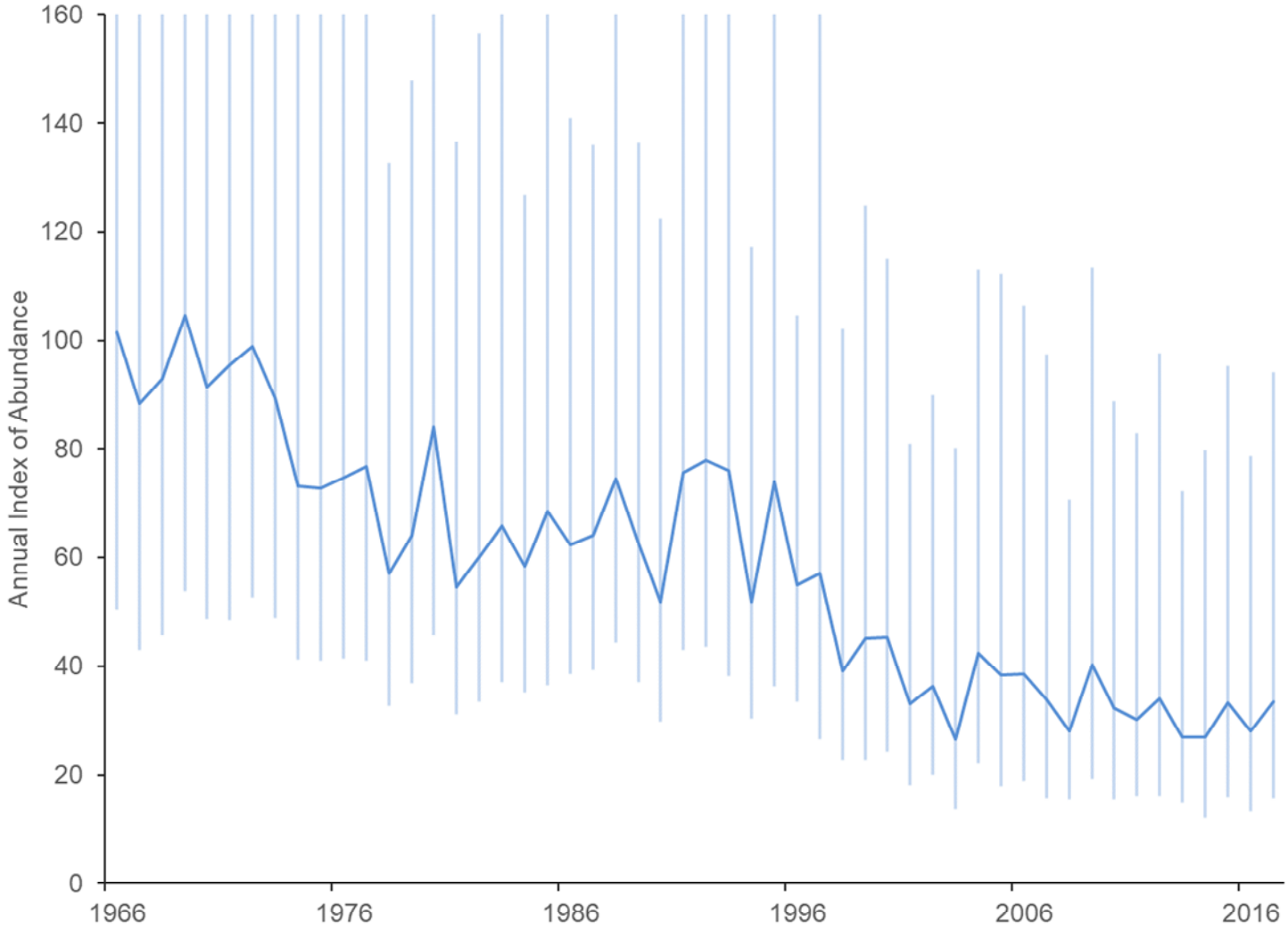

Figure 8. Annual index of abundance for the Evening Grosbeak in Canada from the CBC (Meehan et al. 2018). Abundance indices have been corrected for variable effort across space and time and are unitless reflections of relative abundance (i.e., they do not represent the number of birds seen at a particular count given a particular amount of effort). Light blue lines represent in the upper and lower 95% credible intervals around the estimate.

Project FeederWatch Results

Continent-wide trends based on the citizen-science program Project FeederWatch show a 50% reduction in the proportion of sites reporting the species between 1988 and 2006; a decline of 27% in mean flock size is also reported over the same time period (Bonter and Harvey 2008). In Canada, the declines in the proportion of sites reporting Evening Grosbeaks were greatest in British Columbia and in eastern Canada (Quebec to Nova Scotia, including Prince Edward Island), where declines exceeding 50% were observed (Bonter and Harvey 2008).

Breeding Bird Atlas Results

For provinces which have completed two atlas projects, allowing for calculation of trends, results generally show steeper declines in eastern Canada. In Alberta, Evening Grosbeak distribution did not change between the first (1987-1991) and second (2000-2005) atlases though relative abundance in the boreal forest and aspen parkland natural regions declined (FAN 2007). The probability of observing an Evening Grosbeak between the first (1981-1985) and second (2001-2005) breeding bird atlases in Ontario declined by 30% (Hoar 2007) though the number of occupied squares decreased by only 1% between the two periods. In Quebec, the probability of observing the species decreased across the entire sampled area with a 13% decrease in the number of occupied squares between the first (1984-1989) and the most recent (2010-2014) atlases (Robert et al. 2019). The first atlas was conducted at the same time as a major Spruce Budworm outbreak, while the second atlas was conducted at the beginning of a less intensive outbreak (Brunoni 2019). In the Maritimes, the probability of observing an Evening Grosbeak declined, most notably in New Brunswick (McCorquodale 2015), and a 28% decline in the number of occupied atlas squares was observed between the first (1986-1990) and second (2006-2010) atlases (Stewart et al. 2015). Additional statistical analysis, beyond the visual interpretations, would be required to better understand the atlas results in terms of population-level changes in the species. British Columbia, Manitoba and Saskatchewan have each completed a single atlas that doesn't allow for comparisons while Newfoundland and Labrador, Yukon and the Northwest Territories have not yet completed an atlas.

3.3. Needs of the Evening Grosbeak

Owing to the Evening Grosbeak's secretive behaviour, including courtship without elaborate song or display, comparatively little is known about its life history. Together with its irruptive behavior, unpredictable movement patterns and tendency to nest high in trees, make it a difficult subject of study (Gillihan and Byers 2020). Additionally, the nest is thin and flimsy, and easily overlooked (Gillihan and Byers 2020).

Breeding Habitat

Evening Grosbeaks are generally associated with conifer and mixedwood forests across their Canadian and US range. Presence and abundance of breeding birds can be

closely related to densities of Spruce Budworm (or number of hectares defoliated by Spruce Budworm), which comprises an important food source for the species (Langelier 1983, Walker and Taylor 2020). This is inclusive of several different species of Spruce Budworm that occur in Canada: namely the Eastern Spruce Budworm (*Choristoneura fumiferana*) but also the Western Spruce Budworm (*C. occidentalis),* the Two-year-cycle Budworm (*C. biennes)* and the Sugar Pine Tortix (*C. lambertiana)* that occur in western Canada.

Nesting habitat is large mature and old mixedwood stands with a high composition of fir (*Abies* spp.), spruce (*Picea* spp.), larch (*Larix* spp.), pine (*Pinus* spp.) and aspen (*Populus* spp.) (COSEWIC 2016). Similarly, Spruce Budworm primary hosts are Balsam Fir (*Abies balsamea*) and White Spruce (*Picea glauca*) (NRCan 2020).

In coastal and interior British Columbia, they are found in mixedwood forest dominated by Douglas Fir (*Pseudotsuga menziesii*), Ponderosa Pine (*Pinus ponderosa*) and spruce; understory and other species, such as Pin Cherry, Saskatoon (*Amelanchier alnifolia*), Chokecherry (*Prunus virginiana*) and Red-osier Dogwood (*Cornus stolonifera*) provide berries and seeds on which the Evening Grosbeak forages (Campbell et al. 2001). In Alberta, relative abundance is highest in White Spruce and mixedwood forests with increasing abundance associated with increasing age of the forest (ABMI 2019). In Yukon, Evening Grosbeaks are most common in structurally complex old-growth White Spruce forests (Eckert 2003). In Ontario, Quebec and the Maritimes, the species breeds in second-growth, mature and older coniferous (spruce-fir) woodland, and mixed forest (Peck and James 1987, Vincent 1996, McCorquodale 2015).

Nests are generally built in trees 5-35 m off the ground, usually within 60-80% of the tree's height (Bekoff et al. 1987); a variety of both conifer (predominantly) and deciduous tree species are used (Gillihan and Byers 2020).The nest is built from small twigs and roots, and is sometimes so thin that eggs can be seen through the bottom of the nest; only one brood is produced per year with two to five eggs laid (Gillihan and Byers 2020).

Overwintering Habitat

Winter habitat selection is less studied but seems to be associated with the availability of berries and seeds (Campbell et al. 2001). Evening Grosbeaks are nomadic during the winter and can range widely in search of food sources. Irruptions are likely in response to poor or failed cone crops in the fall, or exhausted cone crops in late-winter (Bolgiano 2004, Gillihan and Byers 2020). In urban and suburban areas, Evening Grosbeaks are attracted to trees that produce large, winged seeds, especially Manitoba Maple, as well as a wide variety of berry-producing ornamental plants. It is also a frequent visitor to bird feeders, especially those containing oiled black oil or hulled sunflower (*Helianthus* spp.) seeds (Bonter and Harvey 2008, Gillihan and Byers 2020, Project FeederWatch 2020).

Foraging Habitat

Foraging habitat for this species is defined by the availability of food resources, and the species will range widely in search of areas providing an adequate supply of invertebrates (in the summer) and seeds (in the winter) (see section 3.2 and Figure 1). The summer diet of Evening Grosbeak consists primarily of invertebrates. In one study from Quebec during a Spruce Budworm outbreak, Spruce Budworm larvae and pupae made up >80% of the diet (Blais and Parks 1964). Other defoliating insects are also consumed, including Forest Tent Caterpillars (*Malacosoma disstria*), Jack Pine Budworm (*C. pinus*), Larch Sawfly (*Pristiphora erichsonii*) and Large Aspen Tortix (*C. conflictana*) (Sutton and Tardif 2008, Government of Canada 2011). In the winter, a variety of seeds is consumed, including Pin Cherry, Manitoba Maple and sunflower seeds at feeders. The stomach contents of 88 birds examined by Gabrielson (1924) during the winter contained 40% fruit seeds, 38% winged seeds, 15% conifer seeds and 7% miscellaneous. Additionally, the species will ingest grit to aid in the digestion of seeds consumed.

4. Threats

4.1. Threat Assessment

The threat calculator assessment for Evening Grosbeak (Table 2) is taken directly from the species' COSEWIC status report (COSEWIC 2016). It is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership, version 2.0) unified threats classification system. Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational). Limiting factors are not considered during this assessment process. For purposes of threat assessment, only present and future threats are considered. Historical threats, indirect or cumulative effects of the threats, or any other relevant information that would help understand the nature of the threats are presented in the Description of Threats section.

Table 2. Threat calculator assessment.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]	Detailed threats
1	**Residential & commercial development**	**Low**	**Restricted - Small**	**Slight**	**High**	
1.1	Housing & urban areas	Low	Restricted - Small	Slight	High	Window collisions
1.2	Commercial & industrial areas	Negligible	Negligible	Negligible	High	Window collisions
2	**Agriculture & aquaculture**	**Negligible**	**Negligible**	**Extreme**	**High**	
2.1	Annual & perennial non-timber crops	Negligible	Negligible	Extreme	High	Fragmentation of habitat (southern limit of boreal only)
2.3	Livestock farming & ranching	Negligible	Negligible	Extreme	High	Fragmentation of habitat (southern limit of boreal only)
3	**Energy production & mining**	**Negligible**	**Negligible**	**Extreme**	**High**	
3.1	Oil & gas drilling	Negligible	Negligible	Extreme	High	Habitat loss, noise
3.2	Mining & quarrying	Negligible	Negligible	Extreme	High	Habitat loss, noise
3.3	Renewable energy	Negligible	Negligible	Negligible	High	Collisions with turbines
4	**Transportation & service corridors**	**Low**	**Restricted**	**Slight**	**High**	
4.1	Roads & railroads	Low	Restricted	Slight	High	Road salts (vehicular collision risk)

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]	Detailed threats
5	**Biological resource use**	**Low**	**Small**	**Serious – Moderate**	**High**	
5.3	Logging & wood harvesting	Low	Small	Serious – Moderate	High	Habitat loss and fragmentation
7	**Natural system modifications**	**Unknown**	**Unknown**	**Unknown**	**High**	
7.3	Other ecosystem modifications	Unknown	Unknown	Unknown	High	Spruce Budworm control (spraying, selective logging)
8	**Invasive & other problematic species & genes**	**Unknown**	**Restricted – Small**	**Unknown**	**High**	
8.1	Invasive non-native/alien species	Unknown	Restricted - Small	Unknown	High	Conjunctivitis, West Nile virus, scaly-leg, Trichomoniasis
9	**Pollution**	**Unknown**	**Small**	**Unknown**	**High**	
9.1	Household sewage & urban waste water	Unknown	Small	Unknown	High	Road salts (poisoning)
11	**Climate change & severe weather**	**Negligible**	**Negligible**	**Negligible**	**Unknown**	
11.1	Habitat shifting & alteration	Negligible	Negligible	Negligible	Unknown	Conifer forests shifting to deciduous (long-term)

[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 timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

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

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

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

4.2. Description of Threats

The overall Canada-wide threat impact for the species is Low[6]. The overall threat impact of Low equates to declines of ~3% (range 0-10%) which is consistent with the current trend estimate (i.e., stable). The overall threat impact considers the cumulative impacts of multiple threats. The primary threats to Evening Grosbeak are housing & urban areas, roads & railroads and logging & wood harvesting (Table 2). These three threats are assessed as having a low impact, while all other threats identified are assessed as negligible or unknown. Threats with unknown impacts on the population could potentially be important drivers of decline and include other ecosystem modifications (Spruce Budworm control), invasive and other problematic species (various diseases and infections) and pollution (road salts). Threats are discussed below in decreasing order of Level 1 threat impact.

Due to the large geographic range of the species in Canada and the differences in the spatial extent of the threats, the impacts on local populations vary across the country. Based on these factors, it may be of value for regions or jurisdictions to conduct a threat calculator at a more local scale to obtain a finer resolution on the threats for management purposes.

IUCN-CMP Level 1 Threat 1 – Residential & commercial development (Low)

1.1 Housing & urban areas (Low); 1.2 Commercial & industrial areas (Negligible)

The primary concern related to these two threat categories is collisions with windows. In Canada each year, it is estimated that about 25 million (range 16 – 42 million) birds (all species) are killed by colliding with windows (Machtans et al. 2013). Communication towers, transmission lines, lighted structures and wind turbines pose additional risks (Rioux et al. 2013, Loss et al. 2014). Collisions with structures are generally understood to impact neotropical migratory birds[7] to a greater extent, who are indeed at greater risk and suffer the greatest mortality (Longcore et al. 2013, Rioux et al. 2013). However, Evening Grosbeaks are also vulnerable to these types of collisions.

The propensity for Evening Grosbeaks to visit feeders makes them susceptible to collisions with nearby windows and within the urban landscape. Klem (1989) and Dunn (1993) both found Evening Grosbeak to be among the top ten species most frequently killed by residential window strikes, both studies using data from across Canada and the United States. Though not specific to Evening Grosbeaks, nearly twice as many window strikes occurred when a feeder was present than when absent, based on a study in Alberta (Kummer and Bayne 2015). While window strikes are a concern for commercial and industrial areas, the presence of feeders near houses presents a greater risk. It is

[6] The overall threat impact was calculated following Master et al. (2012) using the number of Level 1 Threats assigned to this species where Timing = High or Moderate.
[7] A neotropical migratory bird is a bird that breeds in North American temperate zones (in Canada and the United States) and migrates south of the continental United States in the nonbreeding season.

believed that a restricted/small proportion (1-30%) of the population is exposed to this threat, though it is acknowledged that the proportion of the population that visits feeders is unknown. Feeders may also have beneficial impacts by providing a supplementary food source during harsh winters, potentially offsetting some of the negative impacts of this threat.

IUCN-CMP Level 1 Threat 4 – Transportation & service corridors (Low)

4.1 Roads & railroads (Low)

Evening Grosbeaks are attracted to road salts and grit, exposing them to potential collisions with vehicles and salt toxicity (the latter discussed under threat 9). Evening Grosbeaks ingest grit to aid in the digestion of seeds and pits, which are primarily consumed outside of the breeding season (Mineau and Brownlee 2005). Salt intake may be influenced by a dietary need related to sodium deficiency. Mortality from vehicle collisions has been recorded for birds ingesting grit and salt on the sides of roads, though it is likely that most mortality events go undocumented. In British Columbia in the early 1980s, 2,000 Evening Grosbeaks were found dead along a 16 km stretch of highway (Wilson 1981); an additional 500 were found dead along the same stretch of highway in 1974 (Campbell et al. 2001). Both of these events coincided with large, regional Spruce Budworm outbreaks when the birds were likely at high densities. This threat is assessed as having a low impact as it is believed that a restricted proportion of birds are exposed and, of those exposed, the severity is assessed as slight. However, it is possible that this threat could be more important in localized areas throughout the range and during periods of Spruce Budworm outbreaks.

IUCN-CMP Level 1 Threat 5 – Biological resource use (Low)

5.3 Logging & wood harvesting (Low)

Evening Grosbeaks are forest-breeding birds that are associated with mature and older conifer and mixedwood forest stands. Removal of these stand types from forestry operations represents a source of habitat loss and fragmentation, though little study has been conducted to understand the impact of varying forest management practices across the range, and the species appears to be tolerant of some types of forestry practices. Short-rotation forestry practices, where the time between cuts (e.g., between 40 to 70 years) does not allow for mature forest to develop, would contribute to reduced availability of suitable habitat. Similarly, single-species silvicultural practices would also limit the availability of mixed and structurally diverse forests preferred by the species (Drapeau et al. 2000, Hobson and Bayne 2000). The practice of harvesting Balsam Fir and replanting with faster-growing species such as Black Spruce (*Picea mariana*) or Jack Pine (*Pinus banksiana*) in eastern Canada changes forest composition to tree species less preferred by Evening Grosbeaks, and additionally to tree species known to be less susceptible to Spruce Budworm outbreaks (Morin et al. 2008). In Alberta, among the different industrial sectors examined, forestry (measured as harvested area) had the strongest negative effect on Evening Grosbeaks; a 6.9% decrease in relative

abundance of Evening Grosbeaks at the regional scale was predicted in response to harvested area (ABMI 2019).

Silviculture practices exist that could increase the availability of suitable habitat for the species by promoting structural and species diversity (e.g., patchiness and hardwoods), though practices will vary with forest type and geographic region. In British Columbia, this could include pre-commercial thinning of young, homogenous Douglas Fir stands (Hagar et al. 1996, Hayes et al. 1997). When comparing Evening Grosbeak abundance between forests selectively logged (20 to 80 years prior) and unharvested forest (old-growth and mature second-growth) in Montana, no significant differences were found (Hoffland 1995).

Forest harvesting can also contribute to fragmentation. In Ontario, Evening Grosbeaks were among the top five species found to be sensitive to the amount of suitable habitat at the surrounding landscape (3.2 km radius around a point count location) and regional scales (12-24 km radius) (Desrochers et al. 2010). The relative impact of the effects of forest removal versus fragmentation has not been studied.

This threat is expected to impact a small proportion of the population over the next decade. Severity is serious to moderate within areas affected by forest harvesting (i.e., up to 70% reduction in the species population), though when combined with a small scope, the overall impact is considered to be low.

IUCN-CMP Level 1 Threat 7 – Natural system modifications (Unknown)

7.3 Other ecosystem modifications (Unknown)

This threat category includes ecosystem changes related to the indirect effects of other threats, such as the effects of invasive species on the species' habitat or reductions in food resources related to pesticide use. The direct effects of these threats on the species are covered under their corresponding threat categories (in this example, Threat 9 – Pollution or Threat 8 - Invasive & other problematic species & genes).

The Evening Grosbeak is an important predator of the Spruce Budworm, and breeding densities and home range sizes have been found to be closely linked to budworm densities (Langelier 1983, Venier et al. 2009). Studies have associated the fluctuation in regional, provincial and even North American Evening Grosbeak populations with fluctuations in Spruce Budworm density or defoliated areas (Bolgiano 2004, Venier et al. 2009, Walker and Taylor 2020). Fluctuations in Spruce Budworm populations, and therefore food availability during the breeding season, are likely the driving factors in the species long-term population trends (COSEWIC 2016). Indeed, using historical eBird data, Walker and Taylor (2020) showed that Evening Grosbeak historical population trajectories were positively correlated with the number of hectares of forest defoliated by Spruce Budworm. Canada-wide declines are believed, in part, to be related to improved control measures reducing the incidence and intensity of Spruce Budworm outbreaks (FAN 2007).

Spruce Budworm is considered an important forest pest in the context of forest economics, and its ecology in Canada has been well-studied (COSEWIC 2016). The periodicity of outbreaks varies geographically and outbreaks have a well-documented 25 to 40 year cycle in the eastern boreal forest (Royama 1984, Price et al. 2013) and every 26 years on average in British Columbia (Burleigh et al. 2002). Factors that are believed to lead to outbreaks include changes in the mortality rate of Spruce Budworm due to natural predation and disease, weather events, dispersal success of adults (i.e., moths) and reproductive success of females (Johns et al. 2019).

From the early 1950s to the 1980s, methods to control Spruce Budworm outbreaks included spraying of broad-spectrum pesticides (e.g., dichlorodiphenyltrichloroethane [DDT] beginning ca. 1950s and fenitrothion beginning ca. 1970s), including organophosphate (e.g., trichlorfon and carbonyl) pesticides (Blais and Parks 1964, Holmes 1998). Currently, biological (*Bacillus thuringiensis* [Bt]) pesticides and tebufenozide (belonging to a group of insect growth regulators) are most widely used in Canada (Van Frankenhuyzen 1993, Holmes 1998). Both of these pesticides are used against caterpillar pests and are specific to Lepidoptera[8] larvae; both are considered to have generally low toxicity to non-target organisms (outside of other Lepidoptera) and are non-toxic to vertebrates, including birds (Scriber 2001, COSEWIC 2016). Expected impacts to Evening Grosbeak are, therefore, indirectly linked to food availability and subsequent effects on reproduction through mechanisms such as adult fitness and chick development. However, studies looking at these impacts have shown minimal effect on bird populations (Rodenhouse and Holmes 1992, Nagy and Smith 1997, Holmes 1998, but see Cooper et al. 2005). Additionally, Spruce Budworm control measures may help to maintain large tracts of mature forest on the landscape post-outbreak that would otherwise be lost to the infestation, as well as support a continuous food supply if control methods prolong Spruce Budworm population collapse.

Other Spruce Budworm prevention methods, such as identifying forest stands most susceptible to defoliation and selectively logging or spraying those areas in advance of an outbreak or along the leading edge of an outbreak, can be expected to have implications related to habitat availability and quality (e.g., reduced insect prey) for Evening Grosbeaks. These early intervention, proactive strategies target population reduction of Spruce Budworm with the intention of preventing budworm outbreaks before they spread by controlling “hotspots” as they emerge, and are replacing traditional reactive methods that target foliage protection of high timber value stands (Johns et al. 2019, MacLean et al. 2019). In order to be successful, early intervention strategies operate over large regional scales (e.g., provinces) to suppress populations of Spruce Budworm and target all forest types susceptible to Spruce Budworm, not only commercially valuable forest types. This approach has been effectively applied in New Brunswick since 2014 (Johns et al. 2019, MacLean et al. 2019), and is currently being piloted in Newfoundland.

[8] Moths and butterflies

The proportion of the population that is presently exposed to this threat or could be exposed within the next 10 years is unknown. Additionally, the severity in terms of population-level effects is unknown. Given the species' ties to Spruce Budworm dynamics, this is an area where greater study is needed to address important knowledge gaps.

IUCN-CMP Level 1 Threat 8 – Invasive & other problematic species & genes (Unknown)

8.1 Invasive non-native/alien species (Unknown)

Though not scored in the threat assessment for the species in its COSEWIC status report, Evening Grosbeaks are affected by a number of diseases and infections that are commonly spread or exacerbated by unnatural congregations of birds at feeders (Mikaelian et al. 2001). Some of these include: conjunctivitis (*Mycoplasma gallisepticum conjunctivitis*), Trichomoniasis (*Trichomonas gallinae*), salmonellosis (*Salmonella enterica Typhimurium*), West Nile virus and a parasitic infection causing lesions to the feet and bill (scaly-leg) from the mite *Knemidokoptes jamaicensis* (Locke et al. 1973, Carothers et al. 1974, Daoust et al. 2000, Mikaelian et al. 2001, Komar et al. 2003, Bonter and Harvey 2008). These afflictions can cause mortality or contribute to other physiological effects that could affect survival and reproduction. Additionally, predation from house cats is probably the largest human-related source of bird mortality in North America (Blancher 2013, Calvert et al. 2013, Loss et al. 2013). Vulnerability to this threat is increased for species that inhabit human-dominated landscapes, including urban areas and bird feeders (Blancher 2013). Similar to window collisions in urban areas, it is unknown what proportion of the population visits feeders though it is believed to be low. Severity and population-level impacts are unknown and require further investigation.

IUCN-CMP Level 1 Threat 9 – Pollution (Unknown)

9.1 Household sewage & urban waste water (Unknown)

This threat category deals with the direct toxicological effects of pollutants. Evening Grosbeaks are attracted to road salts that are used on paved roads to improve traction. The salts commonly used in Canada, sodium chloride and calcium chloride, are known to be toxic to birds when consumed in quantities that exceed the kidney's ability to remove them (Bollinger et al. 2005, Mineau and Brownlee 2005). In northern Ontario, Evening Grosbeaks were the most frequently observed bird at roadside pools contaminated with road salt; observations were made in June and early July (Fraser 1985). This behaviour, influenced by a dietary need related to sodium deficiency, exposes the birds to increased vulnerability to vehicular collisions (discussed under Threat 4) as well as physiological effects and direct mortality. Studies on the House Sparrow (*Passer domesticus*) have shown that consumption of excess sodium chloride could result in reduced vigilance and motor function (Bollinger et al. 2005). Most known

cases of mortality have occurred within a group of birds commonly referred to as “winter finches”, a group that includes Evening Grosbeak (Mineau and Brownlee 2005). While the scope of this threat is considered to be small, the population-level effects are unknown. Mineau and Brownlee (2005) conclude that mortality from road salt may be underestimated and this area of research requires further study.

IUCN-CMP Level 1 Threat 2 – Aquaculture & agriculture (Negligible)

2.1 Annual & perennial non-timber crops (Negligible), 2.3 Livestock farming & ranching Negligible)

Conversion of forest to agricultural land-use contributes to the loss and fragmentation of forested areas used by the species. In some areas, loss of forest to agriculture has been extensive. In Saskatchewan, 73% of the boreal transition zone has been lost since European settlement with a more recent (~1970 to 2000) annual deforestation rate of 0.89%, a rate approximately three times the global average at the time (Hobson et al. 2002). Similar rates of loss occurred in Alberta at 0.82% per year between 1977 and 1998 (Young et al. 2006). However, offsetting gains in some areas from regeneration of low quality agricultural lands resulted in an overall deforestation rate of 0.27% per year (Young et al. 2006). Deforestation rates in Canada are around 0.02% per year, and as of 2010, 41% was due to conversion to agriculture (NRCan 2016). Some of the earlier deforestation at the time of European settlement would have occurred prior to Evening Grosbeak establishment east of the Rocky Mountains.

The impacts of this threat discussed above are largely considered to have occurred in the past, and as such, do not influence the scores in the assessment. However, this threat does continue to occur, particularly at the southern edge of the species’ range in Canada along the southern limit of the boreal forest. It is considered negligible in scope (presently and within the next 10 years). Where it is occurring, the severity is considered extreme as it results in direct removal of suitable habitat. Overall, the impact is considered negligible.

IUCN-CMP Level 1 Threat 3 – Energy production & mining (Negligible)

3.1 Mining & quarrying (Negligible), 3.2 Oil & gas drilling (Negligible), 3.3 Renewable energy (Negligible)

Threats related to energy production and mining can impact Evening Grosbeaks in a number of ways, including direct habitat loss, habitat/landscape fragmentation, noise, and direct mortality from collisions with infrastructure (e.g., wind turbines). The energy sector in Alberta is predicted to have very small population-level effect on Evening Grosbeak at the regional scale (ABMI 2019). The scope of mining and oil and gas activities is negligible across the species’ Canadian range though the severity in areas where it is occurring is extreme. There is little information available on collision rates of Evening Grosbeaks at wind turbines. The overall impact of the threat of energy production and mining is considered negligible.

IUCN-CMP Level 1 Threat 11 – Climate change & severe weather (Negligible)

11.1 Habitat shifting & alteration (Negligible)

Over the next several decades, the climate in Canadian forests will shift northward at a rate that will likely exceed the ability of individual tree species to migrate (Johnston et al. 2009). Climate change is predicted to cause changes in forest composition, including shifts to the spatial distribution of forest types, as well as influence Spruce Budworm population dynamics. Strong decreases in the biomass of dominant boreal species, and especially mid- to late-successional conifers, are expected in the southern boreal forests of Canada (Boulanger et al. 2017). Western boreal forests bordering the Prairies are most at risk due to the lack of tree species adapted to warmer climates, and due to major increases in burned areas expected under climate change scenarios (Boulanger et al. 2017). Near extirpation of Evening Grosbeak is expected in the northeastern United States due to northward shifting of Balsam Fir forests, a preferred habitat for the species and Spruce Budworm (Matthews et al. 2004). By 2100, Balsam Fir is likely to disappear from Nova Scotia and most of New Brunswick, and shift north into northeastern Quebec and Labrador (Johnston et al. 2009).

Other studies have found that Evening Grosbeak abundance will increase by 93% by 2100 in the northernmost areas of Canada (Stralberg et al. 2015b). However, there is a lag time before vegetation is expected to respond to the changing climatic conditions of an area. When a 30-yr lag is considered, it is predicted that climatically-appropriate areas that could support Evening Grosbeak suitable habitat will increase by 45% between 2071 and 2100, with a corresponding increase to predicted density in northwestern British Columbia and Alaska (Stralberg et al. 2015a).

Outbreaks of Spruce Budworm are complex and multiple factors that include the affected tree species, the specific ecoregion and regional climate conditions are at play (Navarro et al. 2018). Climate change is expected to modify forest pest outbreak characteristics, particularly in the boreal forest (Boulanger et al. 2016). Boulanger et al. (2016) found that as climate change scenarios intensify, Spruce Budworm outbreaks are projected to shift northward and decrease in duration. Factors that trigger outbreaks include consecutive dry summers, or spring and autumn droughts (Ives 1974), and therefore may be exacerbated under rising global temperatures.

While impacts related to climate change over the long-term might be considerable they are difficult to predict and studies vary in their findings; overall impacts to the species over the short-term (i.e., next 10 years) are expected to be negligible.

5. Management Objective

The management objective for the Evening Grosbeak in Canada is to:

- in the short-term (by 2036), achieve a stable (or increasing) 30-yr population trend,

- in the long-term (after 2036), maintain, at a minimum, a stable 30-yr population trend, and
- maintain the current extent of occurrence (the area that encompasses the geographic distribution of the population) of the species in Canada (Figure 1).

This management objective addresses the species' long- and short-term declines, which were the reasons for its designation as Special Concern (COSEWIC 2016). The population components of the objective will be measured by the BBS over consecutive 30-year periods (i.e., 1992-2022, 1993-2023 and onwards), and corroborated by the 25-yr period CBC results. This management objective recognizes that there is currently an adequate number of individuals (2 million or 16 million depending on source) and an increasing population trend (based on short-term BBS results) in Canada to ensure continuing reproductive output that will support achieving the objectives, and prevent the species from becoming threatened or endangered.

The 30-year timeframe was deemed an appropriate temporal scale to measure and assess population changes in the Evening Grosbeak population. This period was selected as Evening Grosbeak population trends are highly variable over the short-term due to their irruptive nature and are expected to naturally fluctuate over the long-term in response to landscape scale processes related to Spruce Budworm outbreaks which cycle every 25 to 40 years (NRCan 2020). An objective based on the population trend was selected over population size as trend estimates are more reliable.

Given the uncertainty of human impacts, including climate change, and uncertainty in our understanding of the reasons for the decline in the species, it is considered appropriate to maintain the current extent of occurrence across the known range in Canada, to the extent possible, while these knowledge gaps are addressed.

6. Broad Strategies and Conservation Measures

6.1. Actions Already Completed or Currently Underway

In Canada, little direct work targeting Evening Grosbeak has been completed or is underway. The following list thus largely includes activities that address Evening Grosbeak indirectly and is intended to give context to the broad strategies outlined in section 6.2. Actions completed or underway are listed below.

A project currently underway by ECCC is examining historical changes in breeding/natal origins of Evening Grosbeaks wintering in Ontario based on stable isotope analysis of feathers from Canadian Museum of Nature collections.

International forest certification systems applied in Canada that require addressing threats to species at risk include:

- Canadian Standards Association (CSA)

- Forest Stewardship Council (FSC),
- Sustainable Forestry Initiative (SFI).

Several citizen-science and conservation-oriented research and monitoring projects have been implemented in Canada and the United States that include Evening Grosbeak. These include the following groups and/or projects:

- North American Breeding Bird Survey (BBS): https://www.canada.ca/en/environment-climate-change/services/bird-surveys/landbird/north-american-breeding/overview.html
- Breeding Bird Atlases (and associated rare species reports): https://www.bsc-eoc.org/volunteer/atlas/
- Christmas Bird Count: https://www.birdscanada.org/bird-science/christmas-bird-count/
- Project FeederWatch: https://feederwatch.org/
- Canadian Migration Monitoring Network: https://www.birdscanada.org/bird-science/canadian-migration-monitoring-network-cmmn/
- Boreal Avian Monitoring Strategy (see example of regional implementation in Van Wilgenburg et al. 2020)
- The Great Backyard Bird Count: https://www.audubon.org/menu/great-backyard-bird-count
- The Boreal Avian Modelling Project (BAM): https://borealbirds.ualberta.ca/
- The Ontario Forest Bird Monitoring Program: https://www.bsc-eoc.org/nabm/index.jsp?lang=EN&proj=77
- eBird: https://ebird.org/home

Canada Target 1 is one of the 2020 Biodiversity Goals and Targets for Canada. It states that by 2020, at least 17% of terrestrial areas and inland water, and 10% of marine and coastal areas of Canada are conserved through networks of protected areas and other effective area-based measures. Collaborative efforts between the federal, provincial, territorial and local governments, and Indigenous Peoples has resulted in the establishment of protected and conserved areas across the Evening Grosbeak's Canadian range. These areas will provide protection to the species' habitat and allow for natural cycles of Spruce Budworm to operate. Pathway to Target 1: https://www.conservation2020canada.ca/home

Several national parks run breeding bird monitoring projects, either as part of their environmental impact assessment programs, as additional ongoing monitoring efforts, or as one-off research projects.

6.2. Broad Strategies

Based on the threat assessment, there are no human-related threats of high (or even medium) impact identified. There are, however, several threats with unknown impacts as well as threats that may have important impacts at regional scales. Our understanding of the threats is hampered by a lack of basic life history information about the species. The mechanisms contributing to range-wide population declines remain unclear and investigation of the factors driving these declines is a high priority (Bonter and Harvey 2008). The broad strategies to guide conservation are thus designed to fill knowledge gaps related to the species' ecology, threats, life history and understanding the species' full life-cycle. These strategies are short-term means to inform the development of long-term conservation measures; the latter of which will directly contribute to reaching the management objectives. Strategies fall under the following broad categories[9]:

- Research & Monitoring
- Conservation Designation & Planning
- Awareness Raising
- Institutional Development
- Livelihood, Economic & Moral Incentives

[9] The broad strategy categories were selected from the International Union for Conservation of Nature – Conservation Measures Partnership (IUCN-CMP) Conservation Actions Classification v 2.0 (http://cmp-openstandards.org/tools/threats-and-actions-taxonomies/).

6.3. Conservation Measures

Table 3. Conservation Measures and Implementation Schedule

Conservation Measure	Priority[e]	Threats or Concerns Addressed	Timeline
Broad Strategy: Research & Monitoring			
Basic Research & Status Monitoring • Undertake basic life history and ecology studies (e.g., habitat requirements and use across life stages) • Develop a full life-cycle population model to determine where (i.e., geographically) and when (i.e., life stage) populations are most limited.	High	Knowledge gaps	2022-2027
Basic Research & Status Monitoring • Undertake studies to understand the population-level effects of the various threats, particularly threats assessed as unknown (e.g., diseases and pathogens and road salts) and threats that might be of high regional importance (e.g., forestry).	High	Knowledge gaps; all threats	2022-2037
Basic Research & Status Monitoring • Undertake studies to understand the relationship with Spruce Budworm, including impacts of Spruce Budworm control measures, on key demographic parameters (e.g., nesting success and recruitment, age-specific survival, population growth) and habitat use/plasticity.	High	Knowledge gaps; 5.3 Biological resource use; 7.3 Other ecosystem modifications	2022-2027
Basic Research & Status Monitoring • Improve data collection (e.g., develop appropriate protocols) for geographic areas and seasonal periods not well covered by other programs (e.g., BBS, CBC), and explore other approaches (e.g., landscape simulation studies) to better understand movement patterns and population trends.	Low	Knowledge gaps	2022-2027

Conservation Measure	Priority[e]	Threats or Concerns Addressed	Timeline
Broad Strategy: Conservation Designation & Planning			
Protected Area Designation &/or Acquisition • Support the establishment of protected areas, including Indigenous Protected and Conserved Areas, to conserve large, intact forested landscapes that allow for natural landscape processes, such as Spruce Budworm outbreaks, to take place.	Medium	All threats	2030
Broad Strategy: Awareness Raising			
Outreach & Communications • Encourage public reporting of sightings and promote participation in citizen-science programs (e.g., Great Backyard Bird Count, Project FeederWatch, eBird, iNaturalist). • Promote responsible feeder use and placement to reduce the incidence of diseases/infections and window strikes. • Promote window applications and other methods to reduce strikes. • Use signage to promote awareness and reduce speed limits along roads with high mortality from vehicular collisions, during periods when collisions are most frequent.	Medium	1.1 Housing & urban areas; 4.1 Roads & railroads; 8.1 Invasive non-native/alien species	2022-2024 (to develop materials and communication strategy), then Ongoing
Broad Strategy: Institutional Development			
Alliance & Partnership Development • Foster cooperative relationships with industry (e.g., forestry), Indigenous groups, land owners/managers, municipalities and others to better understand and mitigate threats to the species and its habitat in Canada.	Medium	Knowledge gaps; all threats	Ongoing

Conservation Measure	Priority[e]	Threats or Concerns Addressed	Timeline
Alliance & Partnership Development • Promote international cooperation and collaboration with conservation groups and others across the species' range to fill knowledge gaps, mitigate threats and promote ecosystem conservation.	Low	Knowledge gaps; all threats	Ongoing
Broad Strategy: Livelihood, Economic & Moral Incentives			
Market-based Incentives • Work with the forest industry through provincial/territorial regulators to support the development and/or expansion/adoption of stewardship programs (e.g., forest certification) and forest management approaches to conserve, maintain and enhance suitable habitat, including maintaining natural landscape processes such as Spruce Budworm outbreaks.	Medium	5.3 Biological resource use	2022-2025
Better Products & Management Practices • Support the development and promote the use of affordable and effective window designs and/or applications to reduce mortality from bird strikes.	Low	1.1 Housing & urban areas; 1.2 Commercial and industrial areas	Ongoing
Better Products & Management Practices • Support the development and promote the use of environmentally- and bird-friendly alternatives to currently used road salt products.	Low	4.1 Roads & railroads; 9.1 Household sewage & urban waste water	Ongoing

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

6.4. Narrative to Support Conservation Measures and Implementation Schedule

Management of the Evening Grosbeak in Canada to achieve the objectives will require commitment, collaboration and cooperation among international, federal, provincial and territorial jurisdictions, wildlife management boards, Indigenous people, local communities, landowners, industry and other interested parties. Owing to the Evening Grosbeak's large geographic range, it will be important to monitor habitat conditions and population trends throughout the species' range so that the effectiveness of the management efforts can be evaluated and adjusted as necessary. It is also important to recognize that the responsibility for forest management lies with provinces/territories and they will be important contributors to achieving the objectives of this management plan.

Research & Monitoring

High priority conservation measures relate to filling knowledge gaps about the species' basic life history characteristics, including breeding biology and reproductive success. Information relating to key demographic parameters and developing a full life-cycle population model is needed to better understand patterns and drivers of decline. Conservation efforts are most effective when complete demographic information is available for a species of concern. Understanding the threats, specifically impacts of Spruce Budworm control measures, and their relative contribution to observed declines is also important to develop informed and effective conservation measures.

Evening Grosbeaks are widespread and exhibit ecological adaptations (e.g., irruptive and resource-tracking behaviour) that make it difficult to monitor populations, predict movement patterns and obtain reliable population trends. The fact that they do not advertise territory through song during the breeding season, like most passerine species, adds to this. Novel approaches (e.g., simulations) are required to better understand Evening Grosbeak movement and population trends, as well as other species that exhibit similar characteristics and appear to respond to broad-scale landscape processes (e.g., Spruce Budworm outbreaks, conifer cone crop production).

Conservation Designation & Planning

The Government of Canada set a new target to address climate change and biodiversity loss by aiming to conserve 25% of our lands and oceans by 2025, and 30% by 2030 (Government of Canada 2021). This initiative recognizes the important role the boreal forest plays in addressing climate change. Collaborative efforts between multiple levels of government and Indigenous peoples to establish networks of protected areas and other effective area-based measures will also support the conservation of the Evening Grosbeak, its habitat and the natural processes that support it.

Awareness Raising

Evening Grosbeaks are frequent visitors to backyard feeders during the winter. This provides a valuable opportunity to engage homeowners in citizen-science based monitoring programs (e.g., Project FeederWatch, Great Backyard Bird Count, eBird, iNaturalist) and to provide information on the safe feeding of birds. The opportunity to provide homeowners with information on window applications, feeder placement and disease transmission should be taken advantage of.

Institutional Development

Evening Grosbeaks are found in every province and territory in Canada except Nunavut, with approximately 53% of the global population found within the country. The remaining portion of the population occurs in the United States (approximately 47%) and Mexico (less than 1%). Partnerships among provincial/territorial and international organizations, Indigenous communities, industry, municipalities and private landowners should be built so these groups can work together to achieve the management objectives for the species. Partnerships allow for the sharing of information and pooling of resources, for example on threats or habitat management, to inform positive conservation approaches for the species.

Livelihood, Economic & Moral Incentives

Evening Grosbeaks depend on mature to old structurally diverse forest habitats for breeding, and populations cycle closely with Spruce Budworm outbreaks. Certification programs that incorporate their habitat needs in forest harvesting practices provide an opportunity for voluntary-based conservation. In addition, these programs encourage multi-species approaches and overall biodiversity benefits. The management of Evening Grosbeak populations requires maintaining landscape level processes that allow for natural fluctuations in their populations.

Window designs and applications that reduce bird collisions have been the topic of research and development for a number of years. Cost-effective designs and their wide-scale adoption can reduce mortality from window strikes with extending benefits to many species over large geographic areas. Development of cost-effective and environmentally friendly alternatives to road salts for use in road maintenance during the winter has been receiving more attention in recent years (e.g., beet juice, cheese brine, pickle juice). Adoption of these products has the potential to effectively mitigate the toxicological impacts related to the consumption of road salts and mortality due to vehicular collisions (i.e., if the alternative products do not attract birds).

7. Measuring Progress

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

- In the short-term (by 2036), the population trend of the Evening Grosbeak in Canada is stable[10] (or increasing), as measured by the BBS over the previous 30-year period (i.e., 2006-2036), and corroborated with CBC results over 25-yr intervals[11],
- In the long-term (after 2036), the population trend of the Evening Grosbeak in Canada is stable (or increasing), as measured by the BBS over each previous 30-year interval (i.e., 2006-2036, 2007-2037, etc.), and corroborated with CBC results over 25-yr intervals, and
- The extent of occurrence (the area that encompasses the geographic distribution of the population) of the Evening Grosbeak in Canada is maintained (as depicted in Figure 1).

[10] A trend would be considered stable when the confidence intervals or credible intervals include zero.
[11] Should the BBS and CBC show conflicting results, other sources of information (e.g., Project FeederWatch, Canadian Migration Monitoring Network, PIF and BAM population estimates, etc.) will be used to assess progress. Should no obvious pattern emerge through such an exercise, the BBS will be considered to provide the clearest and most important signal, acknowledging its limitations for this species. Additionally, decisions made regarding the use of particular data sources during subsequent status re-assessments conducted by COSEWIC will be followed.

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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*[12]. 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[13] (FSDS) goals and targets.

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

This federal management plan will clearly benefit the environment by promoting the conservation of the Evening Grosbeak and promoting sustainable boreal forest management. Several other species at risk occur in the boreal forests of Canada, including: several caribou designatable units[14] (*Rangifer* spp.), Canada Warbler (*Cardellina canadensis*), Olive-sided Flycatcher (*Contopus cooperi*) and Common Nighthawk (*Chordeiles minor*).

The potential for this management plan to inadvertently lead to adverse effects on other species was considered. At this time, conservation measures for the Evening Grosbeak focus on filling knowledge gaps related to the species' ecology and reasons for decline, outreach and awareness raising, partnership building and incentives. These activities have little potential to lead to adverse effects on other species that may share the habitat or range of the Evening Grosbeak.

Consequently, the SEA concluded that this management plan will clearly benefit the environment and will not entail significant adverse effects. For further details, the reader should refer to the following sections of the document in particular: Needs of the Evening Grosbeak (Section 3.3), Conservation Measures (Section 6.3) and Narrative to Support Conservation Measures and Implementation Schedule (Section 6.4).

[12] www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html
[13] www.fsds-sfdd.ca/index.html#/en/goals/
[14] Designatable units are discrete and evolutionarily significant units below the species level (e.g., Boreal population or Pacific population).