COSEWIC
Assessment and Status Report

on the

Western Silvery Aster
Symphyotrichum sericeum

in Canada

THREATENED
2021

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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

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Previous report(s):

COSEWIC 2000. COSEWIC assessment and update status report on western silvery aster *Symphyotrichum sericeum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 15 pp.

Punter, C.E., and B.A. Ford. 2000. Update COSEWIC status report on the western silvery aster *Symphyotrichum sericeum* in Canada, *in* COSEWIC assessment and update status report on western silvery aster *Symphyotrichum sericeum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 15 pp.

Wallis, C., and C. Bradley. 1987. COSEWIC status report on the western silver-leaf aster *Virgulus sericeus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 28 pp.

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COSEWIC would like to acknowledge Karin Newman for writing the status report on Western Silvery Aster (*Symphyotrichum sericeum*), in Canada, prepared under contract with Environment and Climate Change Canada. This report was overseen and edited by Del Meidinger, Co-chair of the COSEWIC Vascular Plants Specialist Subcommittee.

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Western Silvery Aster — Photo: © K. Newman. Western Silvery Aster, Birds Hill Provincial Park, Manitoba.

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COSEWIC
Assessment Summary

Assessment Summary – April 2021

Common name
Western Silvery Aster

Scientific name
Symphyotrichum sericeum

Status
Threatened

Reason for designation
This species is a beautiful, purple-flowered perennial with silky silvery leaves, that is restricted to isolated remnant xeric tall-grass prairie and oak savannah in southern Manitoba and northwestern Ontario. This species was designated Threatened at the last assessment because of the small number of known individuals. Subsequent search effort has resulted in the discovery of new sites and partnerships with public and private land managers have increased the population at some sites. However, there have been declines in abundance and area of occupancy elsewhere and threats to this species remain very high, primarily from aggregate extraction and habitat degradation. A population decline of greater than 30 percent is suspected within the next 20-30 years based on potential threat impacts. The species is limited by low seed viability coupled with low seed set indicating that current declines could continue.

Occurrence
Manitoba, Ontario

Status history
Designated Special Concern in 1988. Status re-examined and designated Threatened in May 2000. Status re-examined and confirmed in May 2021.

COSEWIC
Executive Summary

Western Silvery Aster
Symphyotrichum sericeum

Wildlife Species Description and Significance

Western Silvery Aster is an herbaceous perennial that produces 1-5 sparsely branched upright stems, 30 to 70 cm tall. Leaves have dense silky hairs that give the plant a silvery appearance. Leaves on the stem are lance-shaped, and those at the base of the stem are oblanceolate and wither by the time of flowering. Flowers are arranged in an open, branched array of up to five daisy-like heads. Ray florets are typically rose-purple.

Its showy flowers may serve to encourage public appreciation of native prairie habitat and may encourage landowners to engage in beneficial habitat stewardship practices.

Distribution

Western Silvery Aster is widely distributed in the United States, found in 14 states from North Dakota to Oklahoma, east to Michigan and Indiana, with isolated occurrences in Texas. In Canada, 20 extant subpopulations are known within southeast Manitoba extending from Birds Hill Provincial Park south to the U.S. border, and east to Richer. Three extant subpopulations are known from Rainy River District and on islands in Lake of the Woods, Kenora District, Ontario.

Habitat

Western Silvery Aster is a plant of remnant tall-grass and dry prairies, bur oak savannah, open dry upland sites, dry banks, and sometimes open woods.

Biology

Western Silvery Aster is a perennial herb that develops from a corm-like rootstock and can spread vegetatively by rhizome to produce clonal patches. The species is pollinated by a wide variety of insects including bumblebees, halictid bees, and syrphid and bee flies.

Population Sizes and Trends

Recent estimates from 23 extant subpopulations of Western Silvery Aster suggest the Canadian population comprises roughly 16,600+ individuals, with most sites having hundreds of individuals but several sites numbering in the thousands. Four long-lived

subpopulations occur in Birds Hill Provincial Park, Manitoba (known since 1970 and two since 1996), and Rainy River District, Ontario (known since 1981). Additional historical (presumed extirpated) or extirpated subpopulations are recorded in Manitoba (four subpopulations) and Ontario (two subpopulations).

Threats and Limiting Factors

Western Silvery Aster is limited by the isolated distribution of its native grassland habitat, by low seed production, and is possibly limited by seed dispersal. Likely causes of low seed production include a weevil seed predator, early pollen competition, poor-quality pollination, and low rainfall in late summer. Habitat loss and alteration by human activities including aggregate extraction, development, and maintenance of roadsides and rights-of-way are the most significant threats to plants. Many subpopulations are small, and those along roadsides are particularly vulnerable to maintenance operations.

Protection, Status and Ranks

Western Silvery Aster is currently designated as Threatened on Schedule 1 of the federal *Species at Risk Act* (SARA), as Endangered under Ontario's *Endangered Species Act* in June 2007, and as Threatened under Manitoba's *Endangered Species and Ecosystems Act* in February 1998. It was assessed by COSEWIC as Threatened in May 2000 and previously as Special Concern in April 1988.

TECHNICAL SUMMARY

Symphyotrichum sericeum

Western Silvery Aster

Aster soyeux

Range of occurrence in Canada: Manitoba, Ontario

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines (2011) is being used).	Unknown, but estimated at 7-10 years. Possibly 3+ years for a seed to germinate and reach maturity based on Crooked-stem Aster.
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Yes, inferred from the impacts of ongoing threats. The overall population size has increased since 2000 due to increased search effort and landowner stewardship. However, declines occurred at many sites known from last assessment (COSEWIC 2000)
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations].	Unknown.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Unknown.
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Suspected decline of > 30% based on impact of threats.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Suspected decline of > 30% based on impact of threats.
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	a. Yes, at some sites b. Yes, at some sites c. No
Are there extreme fluctuations in number of mature individuals?	No.

Extent and Occupancy Information

Estimated extent of occurrence (EOO)	14 678 km²
Index of area of occupancy (IAO)	172 km²
Is the population “severely fragmented” i.e., is >50% of its total area of occupancy in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?	a. No. b. Yes. Most subpopulations are separated from other subpopulations by distances larger than the species can be expected to disperse. Areas of potentially suitable habitat exist outside the currently known area of occupancy and within the extent of occurrence.

Number of "locations"* (use plausible range to reflect uncertainty if appropriate)	At least 23 locations, which corresponds to the number of subpopulations. Some subpopulations may represent more than one location due to multiple threats and land tenures.
Is there an [observed, inferred, or projected] decline in extent of occurrence?	No.
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	No.
Is there an [observed, inferred, or projected] decline in number of subpopulations?	No. No new subpopulations have become historical or extirpated since the last assessment. However, portions of at least three extant subpopulations are historical or extirpated in Manitoba.
Is there an [observed, inferred, or projected] decline in number of "locations"*?	No.
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat?	Yes, declines in area and quality of habitat are observed in Manitoba and declines are inferred from the impact of ongoing threats.
Are there extreme fluctuations in number of subpopulations?	No.
Are there extreme fluctuations in number of "locations"*?	No.
Are there extreme fluctuations in extent of occurrence?	No.
Are there extreme fluctuations in index of area of occupancy?	No.

Number of Mature Individuals (in each subpopulation)

EO id[1]	Subpopulation	N Individuals[2]
12747	Ingolf, ON	Extirpated
92789	Rainy Lake, ON	Historical
5620	Birds Hill/ Pine Ridge, MB	Historical
2117	Stony Mountain, MB	Historical
630	St. James Prairie, MB	Historical
5619	Birds Hill, MB	Historical
12741	Budreau's Beach, ON	>2,200 [2018]
66158	Cliff Island, ON	>109 [2014]◊
-	French Portage Narrows, ON	>50 [2017]
2189	Birds Hill, MB	>200 [2009]
2793	Birds Hill, MB	>785 [2016]◊§
3755	Birds Hill, MB	>376 [2016]◊

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

78	East Hazelglen, MB	>2,265 [2013][◊]
4501	East Hazelglen, MB	>50 [2013]
4895	Richer, MB	>3,410 [2015][◊§]
165	Carlowrie, MB	>544 [2008][◊§]
3917	Carlowrie, MB	>2,405 [2008][◊§]
4894	Carlowrie, MB	Present, not counted [2016][◊§]
744	N Gardenton, MB	>150 [2008][◊]
984	N Gardenton, MB	~30 [2006][◊]
4893	N Gardenton, MB	~40 [2008][◊]
1270	W Gardenton, MB	>250 [2015]
3242	W Gardenton, MB	3,255 [2015][◊]
5210	E Gardenton, MB	>350 [2010]
1502	Grunthal, MB	~50 [2001]
3578	N Pansy, MB	3 [2001]
5188	Woodmore, MB	Unknown [2008]
5189	Woodmore, MB	>100 [2016]
7576	Woodmore, MB	Unknown [2009]
Total Individuals		**>16,622**

[1] EO = Element Occurrence, the jurisdiction's unique identification number for an occurrence record, generally corresponding to a COSEWIC subpopulation.
[2] All estimates are based on the [last year] of survey. Counts may be underestimated due to partial surveys in many subpopulations in the given year (◊), and one or more qualitative estimates within subpopulations (§)**.** The best available information includes estimates from the last year observed, which assume that the subpopulation is still extant, and that the numbers have not changed over time.

Quantitative Analysis

Is the probability of extinction in the wild at least?	Data not available.

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

Was a threats calculator completed for this species? Yes: 2019, October 15, included (see Appendix 1). The calculated and assigned threat impact is Very High.

i. Mining & quarrying (high impact)
ii. Roads & railroads (medium impact)
iii. Other ecosystem modifications (medium impact)
iv. Invasive non-native species (medium impact)
v. Agriculture & forestry effluents (medium-low impact)
vi. Livestock farming & ranching (medium-low impact)
vii. Annual & perennial non-timber crops (low impact)
viii. Housing & urban areas (low impact)
ix. Commercial & industrial areas (low impact)
x. Tourism & recreation areas (low impact)
xi. Utility & service lines (low impact)
xii. Recreational activities (low impact)
xiii. Fire suppression (unknown impact)
xiv. Droughts (unknown impact)

What additional limiting factors are relevant?
Western Silvery Aster has low seed viability (61% of seeds produced were not viable) coupled with low seed set (37% of viable seed heads are depredated by a weevil) (Robson 2010b).

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	The closest confirmed occurrence is 29 km from the Canadian border, in Minnesota (S4).
Is immigration known or possible?	Not known. Closest confirmed occurrences to Manitoba are 29 km from the Canadian border (in Minnesota) and 200 km (in North Dakota). Ontario subpopulations are separated by >125 km from closest confirmed occurrences in Minnesota.
Would immigrants be adapted to survive in Canada?	Yes.
Is there sufficient habitat for immigrants in Canada?	Yes.
Are conditions deteriorating in Canada?	Yes. Habitat alteration and loss are ongoing. Portions of at least three extant subpopulations are historical or extirpated in Manitoba.
Are conditions for the source (i.e., outside) population deteriorating?	Yes. Prairie remnants where subpopulations occur are isolated, and prairie habitats are subject to loss and increased fragmentation throughout the global range.
Is the Canadian population considered to be a sink?	No.
Is rescue from outside populations likely?	Unknown. Unlikely from known US occurrences, but distribution in Minnesota near MB border is poorly documented.

Data Sensitive Species

Is this a data sensitive species?	No.

Status History

COSEWIC: Designated Special Concern in 1988. Status re-examined and designated Threatened in May 2000. Status re-examined and confirmed in May 2021.

Status and Reasons for Designation:

Status:	**Alpha-numeric codes:**
Threatened	A3c+4ac
Reasons for designation: This species is a beautiful, purple-flowered perennial with silky silvery leaves, that is restricted to isolated remnant xeric tall-grass prairie and oak savannah in southern Manitoba and northwestern Ontario. This species was designated Threatened at the last assessment because of the small number of known individuals. Subsequent search effort has resulted in the discovery of new sites and partnerships with public and private land managers have increased the population at some sites. However, there have been declines in abundance and area of occupancy elsewhere and threats to this species remain very high, primarily from aggregate extraction and habitat degradation. A population decline of greater than 30 percent is suspected within the next 20-30 years based on potential threat impacts. The species is limited by low seed viability coupled with low seed set indicating that current declines could continue.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Meets Threatened, A3c. A decline in number of mature individuals exceeding 30% is suspected within the next three generations (20-30 years), based on potential threat impacts causing a decline in quality of habitat (c) and limiting factors in seed production that restrict seed production and recovery. Meets Threatened, A4ac. A decline in number of mature individuals exceeding 30% over three generations (20-30 years) spanning past and future, based on observed declines at seven subpopulations (a) and a suspected decline in quality of habitat (c).
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable. EOO of 14,678 km^2 is below the threshold for Threatened and IAO of 172 km^2 is below the threshold for Endangered, but population is not severely fragmented, occurs at >10 locations, and does not experience extreme fluctuations although there is continuing decline in habitat quality.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. Although there is uncertainty in the number of mature individuals, the population, at > 16,000, exceeds thresholds.
Criterion D (Very Small or Restricted Population): Not applicable. Estimate of greater than 16,000 mature individuals is above thresholds for D1. D2 not met as population is not vulnerable to rapid and substantial decline.
Criterion E (Quantitative Analysis): Not applicable. Analysis not conducted.

PREFACE

Since the last assessment (2000), thirteen new subpopulations have been documented: two in Ontario from islands in Lake of the Woods (within a conservation reserve and a provincial park); and eleven in Manitoba. Continued search effort has greatly expanded the known extent of four subpopulations in southeast Manitoba, and two subpopulations in Birds Hill Provincial Park. The number of historical and extirpated subpopulations is unchanged since the last assessment; however, portions of three subpopulations are now considered historical or extirpated. The age of subpopulation data, along with partial surveys and qualitative estimates, precludes accurate estimates of the Canadian population. However, best available estimates from the last year of observation suggest that the Western Silvery Aster population may number ca. 16,600+ individuals.

Protection for Western Silvery Aster under the *Endangered Species Act* (ESA) was granted in Ontario (2007) and in Manitoba (1998). A provincial regulation was enacted under the Ontario ESA in February 2010 to further protect habitat of Western Silvery Aster at two subpopulations (Budreau's Beach and Cliff Island). The third subpopulation (French Portage Narrows) is protected under the *Provincial Park and Conservation Reserves Act* (2006).

Much of the current Canadian Western Silvery Aster population occurs on private lands and rights-of-way. To help mitigate threats associated with road maintenance activities and mowing, the Manitoba Conservation Data Centre prepared road allowance maps highlighting localities of Western Silvery Aster for the rural municipalities of Franklin and Stuartburn. The density and distribution of Western Silvery Aster at Budreau's Beach has increased since 2002 and been stable since 2012, due to stewardship actions by the landowner (Environment and Climate Change Canada 2017).

The distribution of Western Silvery Aster in the US has been clarified. Conflicting reports of occurrence in at least five other states from numerous literature sources, particularly for eastern disjuncts, was caused by the largely allopatric distribution of a closely related and morphologically similar species, Barrens Silky Aster (*Symphyotrichum pratense*), which is taxonomically distinct (Jones *et al.* 2008) and does not occur in Canada.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2021)

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

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

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

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

Environment and Climate Change Canada
Canadian Wildlife Service
Environnement et Changement climatique Canada
Service canadien de la faune
Canada

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

COSEWIC Status Report

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Symphyotrichum sericeum

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific Name: *Symphyotrichum sericeum* (Ventenat) G.L. Nesom

Synonyms: *Virgulus sericeus* (Vent.) Reveal & Keener (1981, Taxon 30:649);
Lasallea sericea (Vent.) Greene (1903, Leaflets of Botanical Observation and Criticism 1:5);
Aster sericeus Vent. (1800, Hort. Cels. t.33).

English Common Name: Western Silvery Aster

French Common Name: Aster Soyeux

Family: Asteraceae (Aster Family)

Major Plant Group: Angiosperms, Dicot

Symphyotrichum sericeum belongs to a morphologically and cytologically distinct group of aster species variously recognized as a distinct genus, *Virgulus* Raf. (Semple 1987; Semple and Heard 1987) or subgenus, *Virgulus* (Raf.) A.G. Jones (Semple *et al.* 1996; Xiang and Semple 1996) within *Symphyotrichum* – subgenus *Virgulus.* Western Silvery Aster was previously recognized by COSEWIC (1988) under the name *Virgulus sericeus* as treated by Semple and Heard (1987).

Morphological Description

Western Silvery Aster is an herbaceous perennial that produces 1-5 sparsely branched upright ascending or sprawling stems, 30 to 70 cm tall, from a corm-like rootstock, with short rhizomes. Its alternately arranged lance-shaped leaves have distinctive silvery-silky hairs and are reduced in size ascending the stem. Leaves at the base of the stem are oblanceolate and wither by the time of flowering. The open branched inflorescence also bears dense silvery-silky hairs on the reduced bract-like leaves below the flower heads. Flower heads are daisy-like, composed of two flower types: strap-shaped ray florets ring the outer margin and are rose-purple to deep purple (rarely white); the central disc is formed of yellow tubular florets (Figure 1). Flower heads are arranged in arching, open arrays, 1-5 per branch. Each flower produces an obovoid single-seeded cypsela (dry fruit), 2–3 mm long, with a whitish or tawny pappus (tuft of hairs) about 6-7 mm long.

Figure 1. Left: Western Silvery Aster flowering head. Right: Branched stem with linear lanceolate leaves, with dense silvery-silky hairs. Photos © Candace Neufeld.

Population Spatial Structure and Variability

No genetic or morphological studies have been undertaken on the variability or spatial structure of its subpopulations. Western Silvery Aster has no infraspecific taxa (subspecies or varieties) in Canada. The putative varietal *Symphyotrichum sericeum* (Vent.) G.L. Nesom var. *microphyllum* (DC) Wunderlin and B.F. Hansen has been synonymized with *Symphyotrichum pratense* (Raf.) G.L. Nesom, which occurs in the southeastern United Sates (primarily Texas, Louisiana and Arkansas), (Brouillet *et al.* 2006; Jones *et al.* 2008).

Manitoba subpopulations[1] of Western Silvery Aster are primarily situated in the Interlake Plain ecoregion of the Boreal Plains ecozone, while Ontario subpopulations are found in the Lake of the Woods ecoregion of the Boreal Shield ecozone (Smith *et al.* 1998). Subpopulations in Ontario are separated from those in Manitoba by over 125 km, including 40 km of open water. While several subpopulations in Manitoba are relatively close together (2-3 km), other subpopulations in Manitoba are separated by 20-66 km. The considerable distances between most subpopulations and lack of suitable habitats in between likely preclude genetic exchange between most subpopulations. Historical occurrences and some present day disjuncts across the North American range suggest a

[1] The use of the term subpopulation follows the NatureServe (2002) guidelines for an Element Occurrence (EO), a provincial designation for occurrences that are *typically separated from each other by barriers to movement or dispersal, or by specific distances*. This definition also aligns with the COSEWIC (2017) subpopulation definition (*geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange*).

more expansive distribution in the past. Current fragmentation of the suitable habitat throughout its range is likely primarily due to human disturbance.

Designatable Units

The Canadian population of Western Silvery Aster is considered a single designatable unit. No genetic and morphological characteristics, dispersal history or pre-settlement distributional evidence exists to characterize any subpopulation as being discrete or evolutionarily significant (as per guidelines for recognizing designatable units; COSEWIC 2017).

Special Significance

Western Silvery Aster is a species with a restricted Canadian range, associated with threatened prairie habitats. Western Silvery Aster occasionally can be locally abundant, especially when found in relatively undisturbed native prairie habitat (Reimer and Hamel 2002). Its showy flowers may serve to encourage public appreciation of native prairie habitat and may encourage landowners to engage in beneficial habitat stewardship practices.

Western Silvery Aster is a pollinated by a wide variety of insects including bumblebees (*Bombus* spp.), sweat bees (Halictidae), and syrphid (Syrphidae) and bee flies (Bombyliidae) (Jones 1978; Semple *et al.* 1996; Robson 2010a). Most frequent pollinators observed in Birds Hill Provincial Park, Manitoba are the Two-form Bumblebee (*Bombus bifarius*) and a bee fly (*Anastoechus* sp.) (Robson 2010a).

There are no known medicinal uses or Indigenous Traditional Knowledge associated with this species (Davis pers. comm. 2018). However, Western Silvery Aster, like all species, is important to Indigenous peoples who recognize all interrelationships within an ecosystem.

DISTRIBUTION

Global Range

Western Silvery Aster is native to central North America and is known in Canada from southeast Manitoba to northwest Ontario. In the United States, Western Silvery Aster is confirmed in 14 states from North Dakota south to Arkansas and Oklahoma, east to Michigan and Indiana, with isolated occurrences in central Texas (Jones *et al.* 2008), (Figure 2).

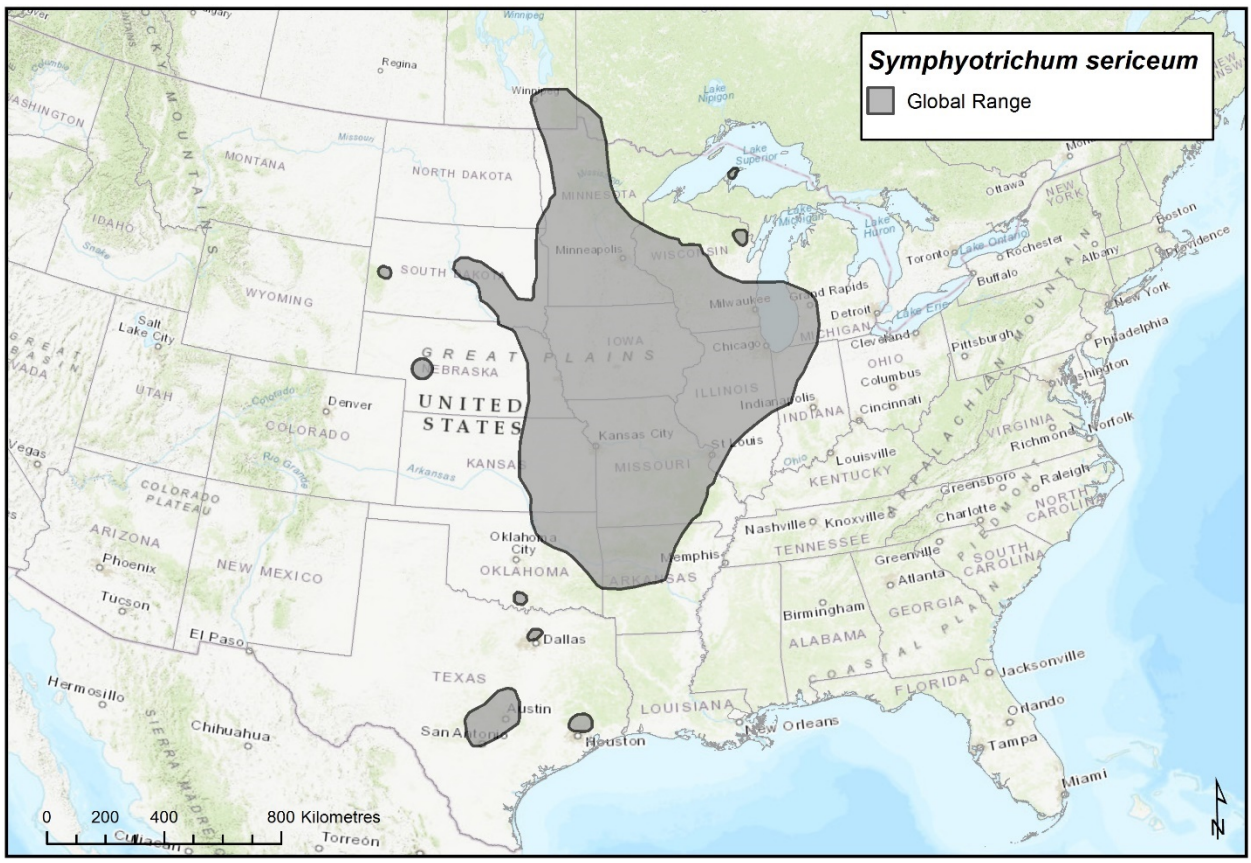

Figure 2. North American distribution of Western Silvery Aster adapted from Kartesz (2015).

In the United States, Western Silvery Aster has been variously and previously indicated to occur in Georgia, Ohio, Tennessee, and Virginia (e.g., Semple and Brouillet 1980; Brooks *et al.* 1986; Gleason and Cronquist 1991; Brouillet *et al.* 2006; Kartesz 2015; NatureServe 2019; USDA 2018). However, in a thorough taxonomic and distributional review Jones *et al.* (2008) found no substantiation of the occurrence of Western Silvery Aster in Georgia, Ohio, or Tennessee. All reports of the species east of the Mississippi River and south of the Ohio River are now understood to be based on a taxonomically broader application of a separate, largely allopatric species, Barrens Silky Aster (*S. pratense*) (Jones *et al.* 2008; Weakley 2015).

Canadian Range

In Canada, the Western Silvery Aster population presently consists of 23 subpopulations concentrated in southeast Manitoba and scattered into northwest Ontario (Figure 3, Table 1).

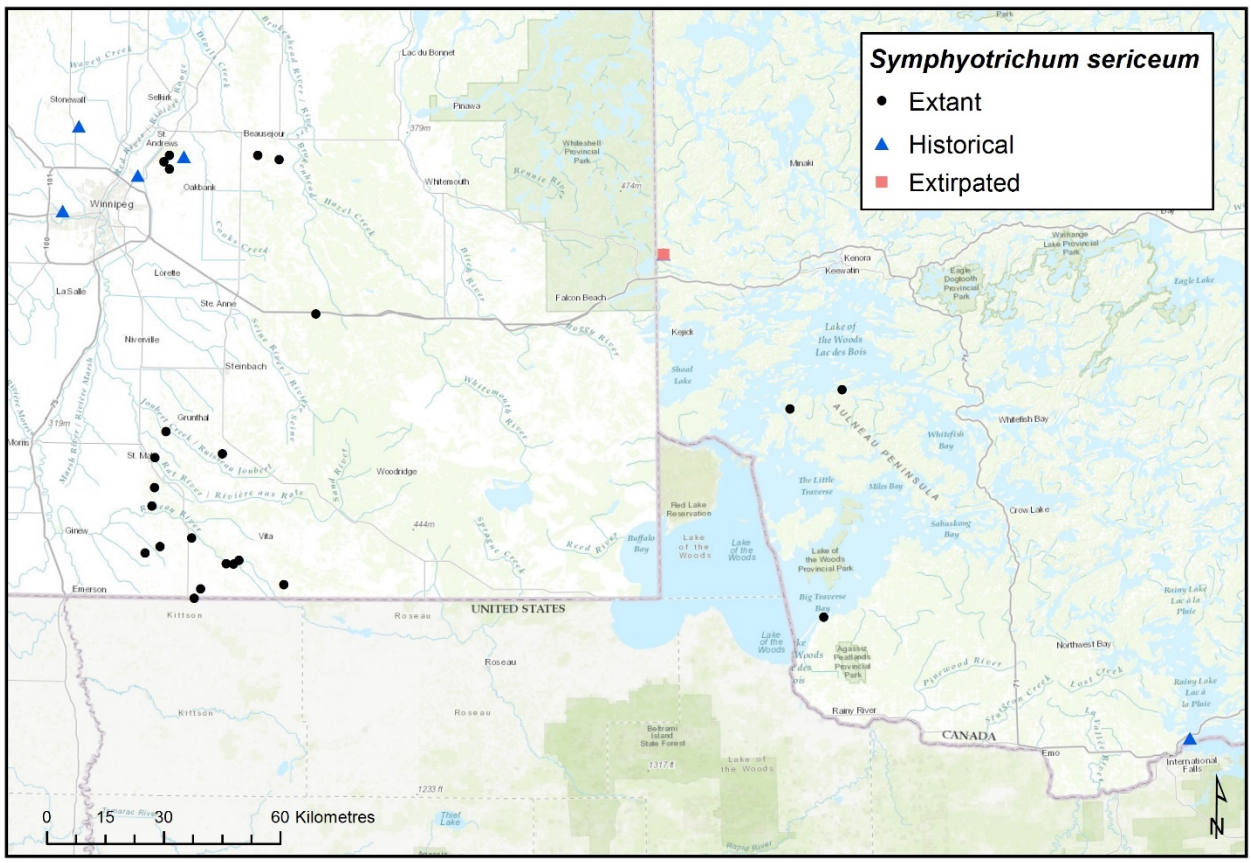

Figure 3. The Canadian distribution of Western Silvery Aster with extant, historical, and extirpated subpopulations from Manitoba and Ontario.

Table 1. Summary of twenty-three extant subpopulations of Western Silvery Aster, with land tenure, observation year, abundance, and threats by jurisdiction.

Subpopulation [EO identification] [1]	Land Tenure	First Year	Last Year	Last Estimate	High Estimate(s) [Year]	IUCN Threats
Manitoba						
Birds Hill [2189]	Provincial Park	1996	2009	>200	>1,000 [1998]; >200 [2001]	1.3, 4.1, 7.1, 7.3
Birds Hill [2793][2]	Provincial Park, Municipal, RoW	1996	2016	>785◊§	>2,300 [1998]◊	1.1, 1.3, 2.3, 3.2, 4.1, 4.2, 6.1, 7.1, 7.3, 8.1, 9.3
Birds Hill [3755]	Provincial Park, RoW	1970	2016	>376◊	>2,040 [1998]◊	1.3, 3.2, 4.1, 6.1, 7.1, 7.3, 8.1
East Hazelglen [78]	Private, RoW	2000	2013	>2,265◊	>20,000 [2005]◊§	1.1, 2.1, 3.2, 4.1, 7.1, 7.3, 8.1, 9.3
East Hazelglen [4501]	Private	1999	2013	>50	>150 [2005]	2.1, 7.3, 8.1, 9.3
Richer [4895][3]	Private, RoW	2006	2015	>3,410◊§	>3,410 [2015]◊; >1,409 [2006]◊	1.2, 3.2, 4.1, 4.2, 6.1, 7.1, 7.3, 8.1, 9.3

Subpopulation [EO identification] [1]	Land Tenure	First Year	Last Year	Last Estimate	High Estimate(s) [Year]	IUCN Threats
Carlowrie [165][4,5]	Private, RoW	1997	2008	>544◊§	>800 [1998]◊; >106 [2004]◊	2.3, 3.2, 4.1, 7.3, 8.1
Carlowrie [3917][5,6]	Roseau Rapids 2A	1953	2008	>2,405◊§	>1,300 [1998]◊; >900 [2004]◊§	2.3, 3.2, 4.1, 4.2, 7.3, 8.1, 9.3, 9.4
Carlowrie [4894][5]	Provincial Park, RoW, Private	2006	2016	Present, not counted	>239 [2015]◊	1.3, 4.1, 9.3
N Gardenton [744][5]	Private	2001	2008	>150◊	>150 [2008]◊; 103 [2001]◊	3.2, 4.1
N Gardenton [984][5]	Private	2001	2006	>30◊	>1,000 [2003]	3.2, 7.1, 8.1
N Gardenton [4893][5]	RoW	2006	2008	>40◊	>40 [2008]◊; 7 [2006]◊	4.1
W Gardenton [1270]	Private	1998	2015	>250	>1,000 [2006]◊	3.2, 4.1
W Gardenton [3242][5]	Private, RoW	1998	2015	>3,255◊	>3,255 [2015]◊ >400 [2006]◊	2.3, 3.2, 4.1, 7.1, 8.1, 9.3, 9.4
E Gardenton [5210][5]	RoW	2008	2010	>350	>350 [2010]; >300 [2008]	4.1
Grunthal [1502][4]	Private	1998	2001	>50	>50 [1998]	3.2, 4.1
N Pansy [3578][5]	Private	1998	2001	3	6 [1998]	3.2, 4.1, 8.1, 9.3
Woodmore [5188][5]	RoW	2008	2008	No data	No data	4.1
Woodmore [5189][5]	RoW	2008	2016	>100	>100 [2016]	2.1, 4.1
Woodmore [7576][5]	RoW, Private	2009	2009	Present, not counted	No data	2.1, 4.1
Ontario						
Budreau's Beach [12741][7]	Private	1981	2018	>2,200	>2,200 [2012]	1.1, 4.1, 6.1, 8.1
Cliff Island [66158][5]	Conservation Reserve	2001	2014	109◊	>300 [2001]◊	6.1, 7.1, 7.3, 11.4
French Portage Narrows[5]	Provincial Park	2014	2017	>50	127 [2014]	6.1, 7.1, 7.3, 11.4
Total Population:				**>16,622**		

Notes:

◊ Incomplete survey: not all patches in subpopulation surveyed in the given year.

§ Estimates in one or more patches in subpopulation are qualitative.

[1] EO = Element Occurrence, the jurisdiction's unique identification number for a subpopulation.

[2] Plant observations at five patches are historical (>20 years without observation), and all plants in four patches were destroyed (one) or damaged (three) in 2013 for this subpopulation.

[3] The current status of plants in one third of this subpopulation is unknown and questionable, due to recent land use changes, described in the Habitat Trends section.

[4] All plant observations from one patch in subpopulation are historical.

[5] Data available for this subpopulation represents 3 or fewer survey years.

[6] Plant observations at four patches in subpopulation are historical, including all those surveyed in 1998.

[7] The years of last and highest observation follow NHIC Ontario (2018), while the estimates represent the range of 2,200 to 2,799 individuals documented in Environment and Climate Change Canada (2017).

Canada holds roughly 3% of the species' global range, as calculated from Figure 2 and similarly documented by Harris *et al.* (2005). The Canadian range of Western Silvery Aster has receded slightly at its western and northwestern edges due to declines in several subpopulations, resulting from rural and urban development, recreational use, aggregate extraction, fire suppression, and certain agricultural practices (Semple 1987; Harris *et al.* 2005). However, the documented extent of its eastern Canadian range has increased in the past ten years, due to increased search effort (likely not actual range expansion). New searches of suitable habitat adjacent to known subpopulations have also greatly expanded the geographical extent of subpopulations in Manitoba during this time (see **Fluctuations and Trends,** and **Abundance**).

While horticultural garden plantings by the public are not tracked, there is no indication that manipulated populations are affecting known extant subpopulations of Western Silvery Aster (Friesen pers. comm. 2019). Western Silvery Aster has been available in the past through multiple specialized nurseries dealing in native prairie plants; it is generally sold to the public in small quantities as seed or as individual transplant plugs (e.g., Prairie Originals 2018) for use in private gardens. There is no indication of wide-scale sale or use of seeds in Manitoba (Leask pers. comm. 2018). In the absence of large habitat restoration projects within the natural range of Western Silvery Aster, horticultural plantings are not included in the assessment of conservation status.

Manitoba

Twenty extant subpopulations occur from north and east of Winnipeg and south to the international border (Table 1; Figure 3). Within the Birds Hill gravel esker complex and an associated provincial park, there are three subpopulations. Two subpopulations are found near East Hazelglen. One subpopulation is found near the town of Richer. In southeast Manitoba, there are fourteen subpopulations clustered east of the Red River, near Carlowrie (three), Gardenton (six), Woodmore (three), and single subpopulations occur near Grunthal and Pansy.

In Manitoba, four subpopulations are considered historical from St. James Prairie, Stony Mountain, Birds Hill, and near Pine Ridge (Table 2). These occurrences may be extirpated due to aggregate extraction and/or urban development, as described below.

Two specimens were collected from the St. James prairie (now Living Prairie Museum) in August 1970 (Ralston s.n. WIN, MMMN[2]). The original area has largely been developed and no plants have been discovered despite repeated searches (COSEWIC 2000). Similarly, Western Silvery Aster was collected from the vicinity of Stony Mountain (27 August 1939, MacDonald s.n. MMMN), and reported there by Garton in 1946 (Scoggan 1957, 1978), but not subsequently observed (COSEWIC 2000). The earliest known

[2] Specimen references may include collector, date, accession number and herbarium acronym. GH – Gray Herbarium, Harvard University; WIN – University of Manitoba Vascular Plant Herbarium; MMMN – The Manitoba Museum, Steere Herbarium; CAN – National Herbarium of Canada, Canadian Museum of Nature; DAO – Agriculture and Agri-Food Canada Vascular Plant Herbarium; MICH – University of Michigan Herbarium.

Manitoba collections (1918, Lowe s.n. MMMN; and August 4, 1919 Lowe s.n. WIN) are presumed to be from near the community of Birds Hill, at East St. Paul (established 1915). This subpopulation has not been re-located. The area north of Pine Ridge and east of the Park boundary (16 August 1953, Löve & Löve 6197: CAN, DAO, GH, WIN) now has very few prairie openings and is partially surrounded by rural residential development. No Western Silvery Aster was found during subsequent searches of a disturbed prairie to the south of the Löve & Löve collection site in 1996 (Dyck and Kunec 1997) or 1998 (COSEWIC 2000).

Table 2. Summary of historical or extirpated subpopulations of Western Silvery Aster, with land tenure and first and last year of observation.

Subpopulation [EO identification]	Land Tenure	First Year	Last Year	Status
Manitoba				
Birds Hill [5619]	Private	1918	1919	Historical
Birds Hill/ Pine Ridge [5620]	Private	1953	1953	Historical
St. James Prairie [630]	Private, Municipal	1970	1970	Historical
Stony Mountain [2117]	Private	1939	1939	Historical
Ontario				
Ingolf [12747]	Unknown	1939	1939	Extirpated
Rainy Lake [92789]	Unknown	1827	1827	Historical

The precise locality of a collection (21 August 1986, Anderson s.n. MMMN) from a gravel ridge at Roseau Rapids 2A is unknown. The locality of a specimen collected by Clarke s.n. (DAO) in 1939 from Arnaud, in a sandy area, is uncertain as no sandy areas occur in the vicinity of the village. The nearest sandy area is found near the Roseau Rapids 2A Reserve.

Ontario

In Ontario, three known subpopulations are found in and around the Lake of the Woods. One subpopulation occurs on the southeastern shore in Rainy River District at Budreau's Beach, in Big Traverse Bay, and has been observed since 1981 (Brunton 2941 CAN). Two subpopulations are from islands in Kenora District, at Cliff Island (2001, Oldham 26763 MICH) and near French Portage Narrows (Table 1; Figure 3).

In Ontario, a 1939 collection site at Ingolf (Denike 850 CAN) has not been relocated despite repeated subsequent surveys, most recently in 2007 and in the wider vicinity in 2008 (Oldham pers. comm. 2018). This subpopulation is now considered extirpated. While possible introduction by railroad traffic has been suggested (Semple 1987), the presence of numerous other prairie plant species at this site and in the general area suggests a native occurrence at Ingolf (NHIC Ontario 2018).

The first known collection in Canada was made by John Richardson (s.n. Rainy Lake and River [Rainy River District Ontario, ca. 15 July 1827], 102465 CAN), although the precise locality of the original record is unknown (NHIC Ontario 2018). The Rainy Lake occurrence has not been rediscovered, and this subpopulation may be extirpated. Past sightings of the species recorded from the mouth of the Rainy River by John Macoun (1884) may refer to the 'mouth' of the river at its source (Lake of the Woods), near the subpopulation at Budreau's Beach. However, the mouth of Rainy River at its outlet (Rainy Lake) is over 100 km further east than current known occurrences, suggesting Western Silvery Aster may have once been more widespread in northwestern Ontario.

Extent of Occurrence and Area of Occupancy

Following COSEWIC (2017) guidelines, the extent of occurrence (EOO), measured using a convex polygon around extant subpopulations, in Canada is 14,678 km^2. The index of area of occupancy (IAO) derived from calculations based on a 2 x 2 km grid is 172 km^2, when limited to extant sites. The federal recovery strategy for Western Silvery Aster identified 28.26 km^2 and 0.14 km^2 of critical habitat in Manitoba and Ontario, respectively (Environment and Climate Change Canada 2017). These figures approximate estimated calculations for the biological area of occupancy, based on the areal extent occupied by all extant subpopulations, e.g., 33 km^2 and 0.15 km^2 in Manitoba Ontario, respectively (MB CDC 2018; NHIC 2018).

Since the last COSEWIC assessment, the size of the known EOO has increased due to the discovery of new subpopulations from Ontario (Cliff Island, 2001) and Manitoba (East Hazelglen, 1999). These subpopulations likely existed previously but were not known. The size of the IAO has also increased due to discoveries of eleven subpopulations in Manitoba and Ontario within the EOO (see **Fluctuations and Trends**).

Search Effort

No original field investigations were undertaken in the preparation of the current Status Report, which is based on available observation data from the Manitoba Conservation Data Centre (MB CDC; up to June 2018) and the Ontario Natural Heritage Information Centre (ON NHIC; up to November 2018) (Table 1). Since the last assessment, new subpopulations have been discovered in Manitoba (eleven) and Ontario (two) as a result of searches by the MB CDC, ON NHIC, MNRF Kenora District, various researchers, consultants, and interested individuals. However, search effort is not typically documented.

The MB CDC has conducted floristic and conservation work through targeted surveys and monitoring of known subpopulations, since the late 1990s to 2016 (e.g., Murray and Church 2015). This has amounted to approximately 75 survey days over 19 years, including 1996-2001, 2003-2006, and 2008-2016. While no new subpopulations of Western Silvery Aster have been uncovered in Manitoba since 2009 (MB CDC 2018), search effort appears to have gone towards searches in habitat adjacent to known subpopulations, with many new patches documented adjacent to seven known subpopulations since this time. Nevertheless, additional areas of potentially suitable habitat still exist outside of known subpopulations (Murray pers. comm. 2018).

In Ontario, prairie areas are extremely rare province-wide and found mostly as remnants in southern Ontario (Rodger 1998). However, the region encompassing Rainy Lake – Lake of the Woods – Ingolf is the most likely area to support unknown subpopulations of Western Silvery Aster in Ontario. This area has been the focus of floristic and conservation work (e.g., Bakowsky and Oldham 1998; Oldham *et al.* 2003; Harris *et al.* 2005; Oldham and Brinker 2009), along with the Rainy River area in 1979 and 1986 (Semple 1987; Oldham pers. comm. 2019). While the subpopulation of Western Silvery Aster from Budreau's Beach has been known since 1981, other prairie and savannah areas in Lake of the Woods in northwest Ontario have only recently been documented (Bakowsky and Oldham 1998) and new subpopulations from islands were discovered in 2001 and 2014 (NHIC 2018). However, more suitable habitat for Western Silvery Aster within this area remains to be examined by botanists (Oldham pers. comm. 2019).

In Ontario, targeted surveys have been conducted near known occurrences on 13 days between 1981 and 2018 (e.g., 1981, 1983, 1986, 1989, 2001, 2002, 2007, 2012, 2014, 2017, 2018). As a result, two new subpopulations were discovered at Cliff Island (2001) and at French Portage Narrows in 2014 (NHIC 2018). Negative data for Western Silvery Aster from general botanical surveys in and around the area of the historical occurrence at Ingolf covers six seasons between 1989 and 2008 (e.g., 1989, 1996-8, 2007-8) and along Rainy River and Rainy Lake in thirteen seasons between 1981 and 2008 (e.g., 1981, 1983-4, 1989, 1993, 1995, 1997-9, 2003, 2005, 2007-8) (Oldham pers. comm. 2018).

HABITAT

Habitat Requirements

Western Silvery Aster is typically associated with dry prairies, oak savannahs, fields, and occasionally open woods (e.g., Scoggan 1957, 1978; Jones 1978; Brooks *et al.* 1986; Gleason and Cronquist 1991; Semple *et al.* 1996; Brouillet *et al.* 2006; Reznicek *et al.* 2011). In Manitoba, it occurs in remnant tall-grass prairie sites or in openings in Bur Oak (*Quercus macrocarpa*) / Aspen (*Populus tremuloides*) woodlands (Foster and Hamel 2006). In Ontario it occurs in open or rocky Bur Oak, Jack Pine (*Pinus banksiana*) savannah or prairie remnants (Oldham *et al.* 2003; Harris *et al.* 2005) and is often associated with basic bedrock and south-facing slopes (Harris *et al.* 2005; MB CDC 2018; NHIC 2018).

In Manitoba, most Western Silvery Aster occurrences are located on the western edge of the Lake Terrace Plain physiographic region, a series of beach ridges and nearshore deposits of sands and gravels resulting from stationary lake levels of the last regression of Glacial Lake Agassiz (Matile and Conley 1979a,b). Well-drained near-surface gravel and limestone outcrops are discontinuous in southern Manitoba.

The Red River Lowlands physiographic region, comprised of lacustrine clays deposited by Glacial Lake Agassiz (Matile and Conley 1979a,b), is flanked to the south and east by the Lake Terrace Plain. Birds Hill Provincial Park is situated on part of an esker

complex of glaciofluvial and glaciolacustrine sand and gravel deposits (Manitoba Energy and Mines 1984). Stony Mountain, a limestone ridge originally covered by stony calcareous till and surrounded by beach deposits, also stands above the Red River Lowlands (Ehrlich *et al.* 1953). Soils developed from these sandy deposits are Dark Gray Chernozemic or Dark Gray Luvisolic sandy loams, rarely Black Chernozemic sandy loams (Canada Soil Inventory 1989). These soils are calcareous, well to moderately well drained, often with low water retention properties.

In Ontario, Western Silvery Aster occurs on the Canadian Shield, within the Great Lakes – St. Lawrence Forest region, in provincially rare dry Bur Oak savannah habitat (Oldham *et al.* 2003). Within this transitional region, between broad-leaved and coniferous forests, rare pockets of unique prairie vegetation communities can be found along lakes and river shores and less commonly at inland locations (Oldham *et al.* 2003). The site of an extensive Western Silvery Aster occurrence at Budreau's Beach overlies calcareous till and sandy silt, and bedrock ridges with a very thin veneer of lacustrine sands, silts, and clays in low areas, related to late glacial water level fluctuations in the Lake Agassiz basin (Bajc and Gray 1987). The two island occurrences in Lake of the Woods are found in an area of thin, discontinuous deposits of sandy till, overlying base-rich andesitic bedrock (Goebel *et al.* 1995), separated by forested slopes.

Habitat Trends

Western Silvery Aster is found in biologically-diverse prairie and savannah communities. Settlement of the prairies in Manitoba over 150 years has led to intense habitat modification through changes to natural processes, such as the fire regime and patterns of grazing by large mammals (Sampson and Knopf 1994). Temperate grasslands and savannahs are among the most highly converted land type yet are among the least protected of the world's terrestrial biomes (Hoekstra *et al.* 2005). In Manitoba, the geographic extent of native tall-grass and mixed-grass prairie has declined by 99.9% since settlement (Sampson and Knopf 1994). Declines in area and quality of native prairie are ongoing, in Manitoba and throughout its range (e.g., Koper *et al.* 2010; Hamel and Neufeld 2018; Ladwig *et al.* 2018). Prairie specialist species, such as the Western Silvery Aster, may be rare because the habitat is increasingly rare. While the Western Silvery Aster can occasionally be locally abundant, particularly in natural prairie sites (Reimer and Hamel 2002), many sites are small in area and numbers of individuals (Friesen and Murray 2010). Western Silvery Aster is associated with the coarse-textured, well-drained, calcareous soils that are in demand in Manitoba for aggregate extraction, the cause of habitat loss and extirpation of the species in several sites. Subpopulations, or portions thereof, in Manitoba have declined in the past as a result of both urban and rural residential development, recreational use in Birds Hill Provincial Park, fire suppression, pasture enhancement, and land conversion to agriculture.

The subpopulation near Richer, over a third of which is on private land, has undergone a recent land use change. Recent changes to this previously largely undisturbed landscape include expansion of a business with mechanical damage from vehicles and mowing, aggregate extraction, and storage of construction materials and equipment (MB CDC 2018). A formal survey of the area is required to determine whether or to what extent these activities may be impacting Western Silvery Aster plants.

The quality of remaining prairie where Western Silvery Aster is found is also in decline due to encroachment by shrubs and invasive plants. Non-native and invasive species, such as Smooth Brome (*Bromus inermis*), Leafy Spurge (*Euphorbia* virgata), sweet-clovers (*Melilotus albus* and *M. officinalis*), Kentucky Bluegrass (*Poa pratensis*), thistles (*Cirsium* spp.), and Reed Canarygrass (*Phalaris arundinacea*) (Foster and Hamel 2006; Environment and Climate Change Canada 2017; MB CDC 2018) are present, particularly in roadside sites in Manitoba. Many small remaining fragments, without active management practices to maintain land as prairie, will be lost by attrition through natural succession to forest (Koper *et al.* 2010). Western Silvery Aster is found often along roads and rights-of-way in Manitoba, where roadside maintenance activities (e.g., timing of mowing) may adversely affect the reproductive potential or persistence of the species. In Ontario, Common Tansy (*Tanacetum vulgare*) and Quackgrass (*Elymus repens*) were reported at the subpopulation at Budreau's Beach, largely restricted to the vicinity of the cabins and road (Oldham *et al.* 2003), while woody species encroachment is noted from Cliff Island (Environment and Climate Change Canada (2017).

Western Silvery Aster has been observed repeatedly in several sites over extended periods of time, suggesting the species can persist within habitats over long periods. Three long-lived subpopulations have been observed at Birds Hill Provincial Park (since 1970, and two since 1996), and the subpopulation at Budreau's Beach has been observed since 1981.

BIOLOGY

Available information on Western Silvery Aster relates foremost to reproductive ecology, as a result of research in Birds Hill Provincial Park subpopulations.

Life Cycle and Reproduction

Western Silvery Aster is an herbaceous perennial that reproduces from seed. In Manitoba, flowering takes place from early August to mid-September, with seeds produced by early October (Robson 2010a). Individual plants average five or fewer stems, while each flowering stem produces between one and five heads (Brouillet *et al.* 2006). Plants at French Portage Narrows had five to 13 stems per clump (NHIC 2018). Many shoots do not produce flowers in a single year, as is the case for many herbaceous perennials (Crawley 2000). In occurrences from Birds Hill Provincial Park, 41% of stems produced flower heads, and on average there were 1.6 heads per flowering stem (Robson 2010b). Each head produces about 30 seeds (Newman 1999; Robson 2010b).

Vegetative reproduction in Western Silvery Aster can occur by the formation of new clones from horizontal rhizomes, produced by the shallow cormoid rootstock (Jones 1978; COSEWIC 2000). Next season shoots are produced by early September, with buds just below the soil surface. The minimum size or age at which a stem is likely to reproduce via rhizome spread is unknown. Propagation of plants by transplanting cormoid rootstock is possible with no special treatment; in some cormoid asters only a portion of the corm is required for propagation (Semple 1987). Hybridization has not been recorded in Western Silvery Aster from field observations or herbarium collections (Semple 1987).

The age at which plants reach maturity is unknown, although a seed could germinate and produce seed possibly at 3+ years (Semple pers. comm. 2019), as with other perennial asters, e.g., Crooked-stem Aster (*Symphyotrichum prenanthoides*) (COSEWIC 2012). The typical lifespan of individuals is also unknown. Individuals are likely long-lived, suggested by the production of the large, woody cormoid root base. It is likely that clonal patches are also long-lived, as plants have been repeatedly observed from certain occurrences for over >20 years (MB CDC 2018). The generation time is estimated at 7-10 years.

Longevity in the seed bank is unknown, although given that seeds germinate readily without scarification (Jones 1978; Newman 1999), they may be present in the seed bank only transiently, as with some other perennial asters (Chmielewski and Semple 2003). Despite the germinability of many aster species immediately after maturation, Jones (1978) planted various non-dormant aster seeds outdoors in October and found only spring germination. In the Canadian population of Western Silvery Aster, germination is expected to occur in spring, i.e., when temperature and light conditions are optimal.

In viable heads (i.e., exhibiting no insect depredation), only 39% of seeds produced were fully developed and presumably viable (Robson 2010b). A similarly low seed set is common in other related perennial asters, e.g., White Heath Aster, *Symphyotrichum ericoides* and New England Aster, *S. novae-angliae* (Chmielewski and Semple 2003). Poor pollination, limited soil resources, and moisture stress may all play a role in limiting seed production.

Physiology and Adaptability

Western Silvery Aster exhibits certain qualities of a stress tolerant plant (*sensu* Grime 2001), including the production of perennial corms and rhizomes, slow growth, and sparse litter production. It is known from generally nutrient-poor habitats, where soils are low in fertility and deficient in nitrogen, phosphorus, and potassium (Robson 2010b). While Western Silvery Aster tolerates low soil fertility and moisture stress, these factors also may limit seed production. A nitrogen fertilization experiment (Robson 2010b) reported a slight increase in the production of flowering heads but had no significant effects on vegetative growth or seed production compared to controls. The woody cormoid rootstock may have been an early adaptation enabling the species to tolerate normal seasonal ground fires or drought. It also may make individual plants more vulnerable to physical damage by compaction or erosion (e.g., livestock grazing, trails), as compared to plants with a more extensive underground rhizome system (Semple 1987).

Dispersal

Western Silvery Aster produces numerous small wind-dispersed seeds, facilitated by a bristle of hairs attached to the achene. No specific data were found regarding distance of seed dispersal, or other probable secondary (e.g., animal) dispersal mechanisms for the species. Studies on perennial asters in prairie habitats (e.g., Andersen 1992; Soons *et al.* 2004) suggest that release height, seed surface, surrounding vegetation structure, and wind speeds are partial determinants of distance, although the descent velocity may be the most important measure (Lacroix *et al.* 2007), with slower descent favouring more distant dispersal. Field experiments on Asteraceae with similar plant heights and seed morphology to Western Silvery Aster (e.g., Tansy Ragwort, *Jacobaea vulgaris* and Canada Goldenrod, *Solidago canadensis*) showed that most seeds dispersed short distances, with a maximum dispersal of 14 or 50 m from the parent plant (McEvoy and Cox 1978; Bakker *et al.* 1996). While storms may account for long distance dispersal on occasion, it is unknown whether current distribution represents remaining fragments of a once larger population, or whether isolated subpopulations may indicate potential dispersal distances.

Interspecific Interactions

Pollination biology of Western Silvery Aster in Manitoba was examined in detail by Robson (2010a,b, 2013) in Birds Hill Provincial Park. In a pollination comparison study, insect visitors to both Western Silvery Aster and the common, co-occurring Grey-stemmed Goldenrod (*Solidago nemoralis*) were collected, resulting in 22 insect taxa from three orders: Diptera (flies, 15 species in six families); Hymenoptera (bees and wasps, 15 species in eight families); and Lepidoptera (one butterfly). Western Silvery Aster plants observed in Birds Hill Provincial Park received a similar number of insect visitors compared to the co-occurring species. Further, when comparing only those insect visitors that transported larger amounts of pollen (e.g., due to insect size, hairiness, or specific pollen collecting behaviour) Western Silvery Aster had more potential pollen transfers by insect visitors than did the common co-occurring plant (Robson 2010a).

Competition for bumblebee pollinators may be a factor in low seed set in early blooming flower heads. In early flowering heads, hand pollination improved seed set to 56% of seeds per head, from 39% in controls, with no increase observed in later flowering heads (Robson 2010a).

Past and recent studies in Manitoba subpopulations have shown that pre-dispersal seed depredation is high in Western Silvery Aster. Seed predation by a weevil (*Anthonomus* sp.) that lays an egg at the base of the flower head, before or at bloom, occurs in 37% of heads (Robson 2010b). The growing larva consumes every developing seed in the affected head, drastically reducing the number of seeds available for germination. A previous study found similar depredation results from occurrences in Birds Hill Provincial Park and near Carlowrie (Newman 1999); no data are available for Ontario subpopulations. Pre-dispersal seed depredation likely has an important role in population dynamics by reducing seed production, recruitment of seedlings and flowering adults in the next generation (Fenner *et al.* 2002; Kolb *et al.* 2007).

Higher rates of flower production have been observed at certain sites with high cryptogamic cover composed of lichens (*Cladonia* spp. and *Peltigera* spp.) and Prairie Spike-moss (*Selaginella densa*) (Robson 2010b). The presence of *Nostoc*, a nitrogen-fixing blue-green algae, both free living and lichenized in *Peltigera*, may provide increased nitrogen into the soil substrate (Bellnap *et al.* 2001). In addition to improving soil fertility, some types of undisturbed cryptogamic crusts may improve water infiltration rates, particularly on sandy soils (Bellnap *et al.* 2001).

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

No fieldwork was undertaken specifically for this Status Report. Estimated counts from all subpopulations, where available, have been taken from data housed in the Manitoba Conservation Data Centre (last updated June 2018) and Ontario Natural Heritage Information Centre (last updated November 2018) unless otherwise noted (see Table 1). Since the last assessment, provincial botanists have continued to revisit known subpopulations, as well as to survey adjacent suitable habitat in Manitoba and Ontario regularly, but not annually.

Baseline estimates of abundance, and whole or partial counts of subpopulations, are available for some survey years for most extant occurrences. However, sampling effort is not consistent over time. In Manitoba, most subpopulations are made up of numerous patches of plants, which may be only partially surveyed in any given year. Greater abundance measured in some years may be attributable to a greater sampling effort within a subpopulation, particularly for those subpopulations in Manitoba with large extents. The number of individual plants may also be compounded by qualitative estimates (e.g., ‘scattered’, ‘small patch’) in all or portions of a subpopulation during certain years.

Abundance

The best available information to estimate population size includes partial surveys at most subpopulations, and qualitative estimates in one or more patches within some subpopulations, described above. Using data from the last year of observation in all extant subpopulations, the suggested population estimate is ca. 16,622+ individuals (Table 1). This estimate includes data from eleven seasons of surveys conducted over a span of 18 years (i.e., 2001, 2006, 2008-10, 2013-18) and assumes that early occurrences are still extant and for the purposes of deriving a population estimate, of the same size as their most recent measure. The most recent estimate for three small subpopulations could not be quantified, and therefore did not contribute to final population count.

Since the last assessment (COSEWIC 2000), two new subpopulations have been discovered in Ontario, both in the Lake of the Woods area: Cliff Island in 2001; and French Portage Narrows in 2014 (Table 1). The subpopulation at Budreau’s Beach has been

observed since 1981 and numbered between 2,200-2,799 individuals in 2012 and 2018 (Environment and Climate Change Canada 2017; NHIC 2018). A portion of the Cliff Island subpopulation comprised hundreds of individuals when it was first surveyed in 2001, while the most recent survey of a separate portion of this subpopulation in 2014 estimates over 100 individuals. The occurrence at French Portage Narrows comprises between 50-127 individuals, first found in 2014 and revisited in 2017.

In Manitoba, eleven new subpopulations have been discovered since the last assessment: one subpopulation near Richer (first documented in 2006, with new expanses recorded in 2008, 2013-15); and two subpopulations near East Hazelglen (first documented in 1999 and in 2000, with new expanses recorded in 2005, 2013). Between 2001 and 2009, eight new subpopulations were found from southeast Manitoba, while continued monitoring has greatly expanded the area from four previously known subpopulations (e.g., in 2004, 2008, 2015, 2016). Monitoring efforts between 2001 and 2016 have also greatly expanded the area of two previously known subpopulations in Birds Hill Provincial Park. In Manitoba, there are several large subpopulations of Western Silvery Aster. Three extant subpopulations within Birds Hill Provincial Park have been revisited over the past 23 and 49 years, with highest abundances estimated between 1,000+ to 2,000+ stems in all three subpopulations. A subpopulation near East Hazelglen (EO 78)[3], first recorded in the year 2000, was estimated at over 20,000 stems in 2005; subsequent surveys continue to estimate 'many thousands' of individuals in the subpopulation. There are insufficient data available to determine whether these qualitative estimates represent stability or decline for this subpopulation. In the southeast, another large occurrence (W Gardenton; EO 3242), was estimated at 3,200+ plants when surveyed in 2015. The fourth large occurrence near Richer, has been estimated at between 147 and 3,410 in years since it was first observed in 2006. The subpopulation's highest estimate was also its most recent survey (2015), although subsequent damage noted (MB CDC 2018) to a third of this subpopulation requires further investigation (see **Habitat Trends**).

The remaining subpopulations found in southeastern Manitoba (16 subpopulations) and at East Hazelglen (one subpopulation), are mostly smaller in area and in number of individuals, and generally occur along roadsides.

Fluctuations and Trends

There are no available quantitative analyses that estimate extinction probability based on known life history, habitat requirements, threats, and management options. Age of individuals is unknown, so no trends in change to mortality or recruitment rates over time are calculated.

The current Canadian population estimate of ca. 16,622+ individuals (Table 1) is an increase over the ca. 7,829+ individuals reported in the previous assessment (COSEWIC 2000; MBCDC 2018), due to the documentation of new subpopulations and new patches

[3] Subpopulations are named geographically and further distinguished with an Element Occurrence (EO) identification number, the jurisdiction's unique identifier for an occurrence record, refer to Table 1.

within known subpopulations. However, current estimates of only those patches known from the previous assessment now include only ca. 4,776+ individuals, a decline of almost 40 percent. While obscured by six qualitative estimates, this figure is dominated by the increases in abundance noted at Budreau's Beach, Ontario (46% of the estimate); therefore, the perceived loss since the previous assessment is attributed to declines in Manitoba. The Manitoba estimate for all patches known in 1998 numbered 7,529+ individuals (plus three qualitative estimates), while recent estimates for the same area total 2,576+ individuals (plus six qualitative estimates) (MB CDC 2018).

The perceived declines in Manitoba may be partially explained by historical losses to the extent of area documented at four subpopulations. A portion of the subpopulation at Birds Hill PP (EO 2793) is considered historical, as all plants in five patches within the subpopulation were last observed >20 years ago, and two patches that once numbered >1000 had no individuals present at last survey (MB CDC 2018). Another subpopulation in Birds Hill PP (EO 2189) was severely reduced with the construction of a paved road after the last assessment. Two subpopulations near Carlowrie (EOs: 165; 3917) each have historical components, as plants have not been observed in some patches for 20-65 years. Recently documented losses are also noted, including at Birds Hill PP (EO 2793), where all plants in four patches were destroyed or severely damaged when topsoil was removed with a bulldozer in 2013. Approximately a third of the subpopulation at Richer is currently of questionable status due to recent land use changes (see **Habitat Trends**).

Insufficient data are available to quantify trends in most subpopulations or provide firm insight on the range of natural variation of abundance for Western Silvery Aster in Canada. However, a single patch at W Gardenton (EO 3242), Manitoba showed steady increase in five surveys between 1998 (one individual) and 2015 (2000 individuals). In Ontario, estimates of the subpopulation size at Budreau's Beach have greatly increased since the last assessment, from several hundred to 2,200-2,799 individuals. The increase in the documented density and distribution of Western Silvery Aster at this locality between 2002 and 2012 has been attributed to stewardship actions by landowners (Environment and Climate Change Canada 2017). However, it is unclear to what extent the documented increase at this subpopulation may also be attributable to increased survey efforts over this time. The subpopulation at Budreau's Beach has since remained stable between the highest estimate year (2012) and the most recent year (2018) (NHIC 2018). Estimates of plant numbers at French Portage Narrows suggest some stability between the year of discovery (2014) and the most recent survey (2017). The estimates at Cliff Island are not directly comparable, as data from 2001 and 2014 measure different portions of the subpopulation.

Rescue Effect

The nearest occurrence of Western Silvery Aster in the United States is in Minnesota. subpopulations in Kittson County, which are 29 km from the international border (Anderson pers. comm. 2018) and the closest subpopulation in Manitoba. However, an historical record of an occurrence straddling the international boundary (COSEWIC 2000) suggests that Manitoba subpopulations may have been close or continuous with occurrences south

of the border. As no recent observation (Anderson pers. comm. 2018), nor further record was associated with this border occurrence in Minnesota (Bell Atlas 2018; Minnesota Natural Heritage Information System Relevé Database 2018), the likelihood of immigration success from Minnesota is unknown. The closest records of Western Silvery Aster from North Dakota are 200+ km from subpopulations at the Manitoba border (Shipunov 2018).

THREATS AND LIMITING FACTORS

Direct threats facing Western Silvery Aster assessed in this report were organized and evaluated based on the IUCN-CMP (International Union for Conservation of Nature – Conservation Measures Partnership) unified threats classification system (Master *et al.* 2012). Threats are defined as the proximate activities or processes that directly and negatively affect the population and result in population decline. Results on the impact, scope, severity, and timing of threats are presented in tabular form in Appendix 1. The overall calculated and assigned threat impact is Very High.

The following description of threats for the Western Silvery Aster is adapted from the federal recovery strategy (Environment and Climate Change Canada 2017). The numbers associated with the threats listed below correspond to IUCN threat numbers and the threat calculator completed for this species.

Threats

Housing and urban areas (1.1) [Low impact]

Residential development has contributed to the past loss of as many as four subpopulations in Manitoba. Other extant occurrences are found adjacent to residential development in both Manitoba and Ontario. Residential development can lead to the direct loss of plants through the housing development itself, and indirectly impact a subpopulation by altering the timing and frequency of disturbance events required to maintain suitable habitat conditions. Development can be accompanied by an introduction or spread of invasive species, changes to the hydrology and nutrients the habitat receives, and an increased amount of soil compaction (e.g., through recreational use of surrounding lands). Infrastructure and activities associated with development, such as installation and maintenance of utility lines, road expansion or alteration, and clearing and maintenance of ditches also threaten occurrences found along roadsides or rights-of-way (see threat 4.1, 4.2).

Plants at the subpopulation at Budreau's Beach were damaged in the past by a roadway (Ben-Oliel and Oldham 2000). Several cottages were constructed within the area occupied by Western Silvery Aster, while other lots were designated for cottage development (Oldham *et al.* 2003). During that time, less than 10% of the Western Silvery Aster plants occurred on developed lots, with about a third of the subpopulation on potential cottage lots and the remainder on inland sites not under immediate threat of development (Harris *et al.* 2005). While the mapping of critical habitat (Environment and Climate Change

Canada 2017) has identified key sites, existing human developments and infrastructure are excluded from critical habitat. Western Silvery Aster plants that occur on existing cottage lots may be threatened by the use or improvement of these previously developed lots.

Commercial and industrial areas (1.2) [Low impact]

Activities that alter ground cover have potential to threaten Western Silvery Aster. In Manitoba, one subpopulation (Richer, EO 4895) may be impacted by commercial activities on private land. Stored construction equipment and materials, as well as mechanical damage from vehicles, mowing, fencing, and aggregate extraction are apparent over approximately a third of this subpopulation (MB CDC 2018). The most recent survey estimate (2015) predates this land use change.

Tourism and recreation areas (1.3) [Low impact]

In Manitoba, three subpopulations at Birds Hill Provincial Park (EOs: 2189; 2793; 3755) are adjacent to two campgrounds, paved and unpaved trail networks and a road. Recreational expansion and increased use by visitors of habitat containing Western Silvery Aster could pose a threat to plant occurrences in the Park. One subpopulation (EO 2793) occurs adjacent to a golf course, which may have eliminated a portion of the original occurrence. Expansion of the golf course and the increased inputs (e.g., fertilizers, moisture) may pose further threat to remaining plants. A portion of the subpopulation at Carlowrie (EO 4894) occurs in a grassland opening near a beach.

Annual and perennial non-timber crops (2.1) [Low impact]

Many extant subpopulations occur in remnant strips of native prairie between cultivated fields and roadsides and may be further impacted by expansion of cultivated areas, by herbicide drift (threat 9.3) or encroachment of adventitious or invasive species from adjacent cultivated fields (threat 8.1). Land conversion in Manitoba is ongoing in many native grasslands, as native pastures continue to be converted to a non-prairie cover type, such as planting tame grasses for hay (Hamel and Neufeld 2018). At least four Manitoba subpopulations are adjacent to cultivated fields including East Hazelglen (EOs 78; 4501), Carlowrie (EO 3917), and Woodmore (EO 7576), or may be threatened by pasture improvement, e.g., planting to tame forage at Carlowrie (EO 3917).

Livestock farming and ranching (2.3) [Medium – Low impact]

The impacts of grazing frequency, scale, and intensity on Western Silvery Aster and its habitat is largely unknown. Several observations of reduced numbers of Western Silvery Aster plants at intensively grazed pastures, when compared to adjacent non-grazed areas, have been reported from four subpopulations in Manitoba (EOs: 2793; 165; 3917; and 3242) (MB CDC 2018). Soil compaction from intensive grazing may damage the woody corm just below the surface of the soil (Semple 1987). Grazing during flowering or seed set may result in reduced seed set, where reproductive parts are grazed or damaged. However, grazing with appropriate intensity, frequency and duration may not be detrimental

in a system that evolved under grazing pressure. Rather, some level of livestock grazing may be beneficial to native prairie plants by preventing succession and maintaining grassland structure (Biondini *et al.* 1998; Fuhlendorf and Engle 2001; Ranellucci *et al.* 2012). Such grazing levels have yet to be defined for Western Silvery Aster.

Mining and quarrying (3.2) [High impact]

In Manitoba, the glacial beach ridges, eskers, and aggregate lenses that support Western Silvery Aster also contain valuable aggregate deposits. More than half of the subpopulations of Western Silvery Aster in Manitoba are currently adjacent to or within active gravel pits, with still others found near disused pits. Aggregate extraction has resulted in reduced plant numbers at several extant subpopulations in Manitoba, including destruction of habitat and plants near Birds Hill Provincial Park. Aggregate extraction may have been a contributing factor in the extirpation of the Stony Mountain subpopulation in Manitoba. Aside from a direct loss of plants and habitat, aggregate extraction alters hydrology, further fragments remaining habitat, and increases the potential for invasive plant species to colonize disturbed areas. Twelve Manitoba subpopulations list aggregate mining and quarrying as a threat to plant occurrences. With the expected continued need for aggregate, additional subpopulations of Western Silvery Aster in Manitoba will likely be threatened by new aggregate extraction pits or the expansion of existing pits in future. In Ontario, aggregate extraction is not an apparent threat as no appreciable surficial deposits occur at known subpopulations.

Roads and railroads (4.1) [Medium impact]

Nineteen subpopulations in Manitoba, and one in Ontario (Budreau's Beach) are partially or entirely along roadsides and ditches, some of which are remnant strips of native prairie. Habitat and plants can be damaged or destroyed by road construction activities, such as road widening, ditch deepening, trenching, drainage projects, and realigning or improving the road. Habitat and plants can also be affected by incompatible or inappropriately timed road maintenance activities on shoulders and in ditches, such as grading, mowing for site lines. Mowing can be a beneficial management practice for many prairie species, as it can reduce litter and may control invasive alien plant species. However, inappropriately timed mowing can cause physical damage to Western Silvery Aster plants and reduce seed production through removal of floral parts prior to seed set or dispersal. Removal of flowers reduces nectar sources for pollinators of Western Silvery Aster. Repeated mowing during flowering or seed set, especially over time could have an impact on population dynamics or pollinator communities. Linear disturbances from roads also increase the potential for introduction and invasion by invasive alien species that may compete with Western Silvery Aster (threat 8.1).

Utility and service lines (4.2) [Low impact]

Three subpopulations in Manitoba have been affected in the past by construction and maintenance activities along energy or communications rights-of-way, at Birds Hill (EO 2793), Richer (EO 4895) and Carlowrie (EO 3917). The future installation, upgrading or

decommissioning could impact subpopulations that are adjacent to or within utility rights-of-way. Right-of-way maintenance generally includes periodic vegetation control, such as mowing (threat 7.3) and may include herbicide application to control invasive and/or tall woody species (threat 9.3). As with roadways, utility lines fragment habitat and can provide a corridor for the introduction or spread of invasive species. This is of particular concern in areas where invasive species are already established, such as in ditches or recreation areas.

Recreational activities (6.1) [Low impact]

Operation of off-road recreational vehicles, including all-terrain vehicles (ATV), in ditches and along trails can damage or destroy plants, compact or erode soil, and cause unnatural disturbance to habitat. Trail disturbance and the actual machines provide opportunities for dispersal and colonization of invasive alien plants, where seeds from invasive plants may be brought in on the vehicle from other areas. Off-road vehicle use was reported as a threat at four Western Silvery Aster subpopulations, at Birds Hill Provincial Park (BHPP) and Richer (MB CDC 2018). Other recreational activities can also damage plants, such as horse trails (BHPP) or hiking or biking trails (BHPP, Budreau's Beach), where heavy trail use overlaps with plant occurrences. Increased recreational use associated with existing and potential cottage developments and campgrounds may also threaten several subpopulations (threats 1.1 and 1.3). Intermittent activities, such as shore lunch sites, campsites, and hiking off designated trails has been identified as a low threat to the three extant subpopulations in Ontario (Environment and Climate Change Canada 2017).

Fire and fire suppression (7.1) [Unknown impact]

Fire suppression is a factor at every subpopulation of Western Silvery Aster, which occur near roads, human developments, or in provincial parks. Absence of natural fire disturbance can increase plant litter levels and woody vegetation encroachment, leading to a change in the grassland composition or succession to forest (Samson and Knopf 1994; Anderson 2006), and can allow invasive weed species to gain a foothold. While the relative cover of Western Silvery Aster increased after a prescribed burn in Kansas (Gibson and Hurlbert 1987), the long-term effects of frequency, intensity, and timing of fire on Western Silvery Aster in Canada is unknown. Higher Western Silvery Aster abundance has been associated with lichen and clubmoss cover (Robson 2010b), which is slow to recover after fire. Single sites in two subpopulations in BHPP (EOs: 3755; 2793) have been burnt in the past, although woody encroachment and/or thatch build-up (threat 7.3) due to fire suppression has since been noted from all BHPP subpopulations, as well as four other subpopulations in Manitoba and two from Ontario.

Other ecosystem modifications (7.3) [Medium impact]

The disruption of the natural disturbance regime, including changes to fire and grazing frequency and intensity, leads to encroachment of woody vegetation in prairie areas (Anderson 2006; Koper *et al.* 2010). Woody or weedy encroachment and thatch build-up

can result in decreased recruitment through increased competition by limiting availability of suitable microsites for establishment and altering light, moisture and temperature levels. Succession of woody species has been reported for eight subpopulations (EOs: 78; 165; 984; 2793; 3242; 3755; 3917; and 4895) in Manitoba (MB CDC 2018), as well as two Ontario subpopulations, French Portage Narrows and Cliff Island (Environment and Climate Change Canada 2017; NHIC 2018).

Inappropriately timed landscape grooming (e.g., mowing) may be an issue at the privately owned portion of one subpopulation (Richer, EO 4895).

Invasive non-native/alien species (8.1) [Medium impact]

Invasive and non-native alien species grow under a wide range of climatic and soil conditions. They often produce abundant and easily disseminated seeds, which may be long lived in the soil seed bank. Invasive species are persistent, often have vigorous growth and can produce seeds under conditions adverse for other plants. All or any of these factors can lead non-native and invasive species to outcompete native species, shifting the vegetation composition and community where they occur (e.g., Wilson 1989; Wilson and Belcher 1989; Reader *et al.* 1994; Dillemuth *et al.* 2009). Agricultural land, roadside ditches and residential or recreation areas surround most Manitoba subpopulations of Western Silvery Aster, where the risk of spread of non-native and invasive plants is high. Primary invasive or non-native plant species co-occurring with Western Silvery Aster in Manitoba include Smooth Brome, Leafy Spurge, Sweet-clovers, Kentucky Bluegrass, thistles, and Reed Canarygrass (Foster and Hamel 2006; Environment and Climate Change Canada 2017; MB CDC 2018). Siberian Elm (*Ulmus pumila*) and Scots Pine (*Pinus sylvestris*) have invaded sites in Birds Hill PP, Manitoba. In Ontario, Common Tansy and Quackgrass were reported at the subpopulation at Budreau's Beach, largely restricted to the vicinity of the cabins and road (Oldham *et al.* 2003).

Agriculture and forestry effluents (9.3) [Medium – Low impact]

The indiscriminate or inappropriate use of chemicals intended to control undesirable plants (e.g., broad-leaf herbicide) or insect pests (directly through insecticide; indirectly through herbicide) in rights-of-way, ditches or adjacent fields may affect Western Silvery Aster plants and pollinators. The potential for chemical drift was reported from at least four subpopulations, including Birds Hills Provincial Park (EO 2793), East Hazelglen (EOs: 78; 4501) and Carlowrie (EO 4894) (MB CDC 2018). In Ontario, herbicide spray drift from forestry harvest operations on Crown lands has been identified as a potential threat to Western Silvery Aster. Although prescriptions on timing, method, and distance of herbicide use from aster plants were under development in Ontario during 2017 (Snyder pers. comm. 2019), at present it is unclear if and to what extent these prescriptions may be adopted and implemented through forestry management guidelines. Targeted applications of herbicide to control invasive species in areas where Western Silvery Aster occurs risks the mortality of all plants, which could negatively impact the reproduction of the Western Silvery Aster.

Neonicotinoids are the most widely used insecticides worldwide (Goulson 2013) and include many of the systemic insecticides registered in Canada. Because of their broad-spectrum range, widespread use, accumulation and persistence, neonicotinoid insecticides used systemically are not as environmentally safe as once thought (Goulson 2013). Sublethal exposure to this insecticide can cause acute and chronic effects in pollinating species, including bumblebees (Godfray *et al.* 2015; Stanley and Raine 2016). Chronic exposure to sublethal doses of neonicotinoids can alter bumblebee behaviour by changing forager preferences for flower types, impairing forager performance (e.g., fewer foraging bouts, and smaller pollen loads), and impairing bee learning performance (Gill and Raine 2014).

Western Silvery Aster relies on insect pollinators to ensure successful fertilization and subsequent seed production (Robson 2010b, 2013; see **Limiting Factors**). Bumblebees are the main pollinators of Western Silvery Aster, and at least four subpopulations in Manitoba are adjacent to cultivated fields where agricultural chemical use may commonly occur. It is unknown whether interactions exist between a change in pollinator behaviour, and other factors, such as early temporal competition for pollinators, or poor-quality pollination as described in Robson (2010a,b). Another main pollinator of Western Silvery Aster is the syrphid fly, a predator of small insect larvae, which could be indirectly affected by a lack of insect prey due to insecticide use. The impact of this activity on pollinators of Western Silvery Aster is unknown. Threat 9.3 was evaluated on the basis of potential herbicide use.

Droughts (11.2) [Unknown impact]

Although Western Silvery Aster exhibits stress-tolerant characteristics that make it capable of growing in gravelly, well-drained, low-nutrient soils, moisture may also be a limiting factor in reproductive output of Western Silvery Aster (Robson 2010b). Periods of late season drought may reduce seed production in Manitoba subpopulations (COSEWIC 2000). Many of the subpopulations in Manitoba are on well-drained soils, in areas where plants regularly experience moisture stress, where the effect of increased drought is unknown.

Limiting Factors

Occurrences of Western Silvery Aster in Canada are restricted to a small geographical area in Canada. Observations from several areas in Manitoba suggest that the reproductive potential of Western Silvery Aster is low, due in part to low seed production. Observations of plants' failure to produce mature flowering heads or set seed have been made from at least five subpopulations during field surveys (MB CDC 2018). Upon examination of viable flower heads from Birds Hill Provincial Park, over 60% of seeds produced were not viable, based on their thin and translucent nature (Robson 2010b). Suggested causes of low seed production are moisture stress, particularly late season drought and low soil fertility. Early temporal pollen competition may also affect seed set. Hand pollination increased seed set for early flowering heads, suggesting that at certain times the Western Silvery Aster may be pollen, as well as resource limited (Robson 2010b). Low quality of pollination, due to

possible heterospecific pollen transfer, may also be a factor in low seed production, although this has not yet been examined in Western Silvery Aster (as discussed in **Interspecific Interactions**).

While pre-dispersal seed depredation by a weevil (*Anthonomus* sp.) in Manitoba subpopulations of Western Silvery Aster was found to be high, it may be within the range of natural variation. Similar levels of pre-dispersal seed depredation have been found in other perennial asters (e.g., Louda *et al.* 1990; Fenner *et al.* 2002), and can be higher than 90% in some plant species (Crawley 2000). Pre-dispersal seed depredation in Western Silvery Aster was found in 37% of viable heads (Robson 2010b), which may affect population dynamics by reducing seed production, recruitment of seedlings and flowering adults in the next generation (Fenner *et al.* 2002; Kolb *et al.* 2007). Spatial and temporal variation in the intensity of pre-dispersal seed depredation, and its influence on plant population dynamics have not been examined in Western Silvery Aster.

Number of Locations

The term location defines a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the species present (IUCN Standards and Petitions Subcommittee 2017). Every subpopulation of Western Silvery Aster is under one or more threats, most threats are ongoing and several threats are considered high both in impact and severity (Appendix 1).

The most significant threats to Western Silvery Aster are human activities that cause disturbance and permanent alterations to soils and/or habitats. Twelve subpopulations in Manitoba occur at or adjacent to aggregate extraction operations and are at risk from continued extraction activities (MB CDC 2018). Roadside occurrences are at risk from right-of-way maintenance activities at up to 19 subpopulations. Woody encroachment into prairie openings (vegetation succession), and invasion of exotic plant species, threatens Western Silvery Aster (Krause Danielson and Friesen 2009; Environment and Climate Change Canada 2017) in at least 14 subpopulations. Increased recreational use and development continue to pose a significant threat in at least six subpopulations, including those at Birds Hill Provincial Park and the cottage development near Budreau's Beach (Ben-Oliel and Oldham 2000; Harris *et al.* 2005; MB CDC 2018).

Most subpopulations occur on private land and will be uniquely influenced by individual landowner activities and decisions. Furthermore, at least nine subpopulations have multiple land tenures, and as such each may represent more than one location. Therefore, the number of locations is at least 23 (i.e., the number of subpopulations), but given the age of available subpopulation data and the absence of up-to-date information on threats, the exact number of locations is uncertain.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

Western Silvery Aster is currently designated as Threatened on Schedule 1 of the federal *Species at Risk Act* (SARA), with a federal recovery strategy posted in 2017 (Environment and Climate Change Canada 2017). The species is listed as Endangered under Ontario's *Endangered Species Act* (June 30, 2007) and Threatened under Manitoba's *Endangered Species and Ecosystems Act* (February 26, 1998). It was assessed by COSEWIC as Threatened in May 2000, and previously as Special Concern in April 1988.

The habitat of Western Silvery Aster is legally protected in Ontario, since 2010, through a provincial regulation enacted under the Ontario *Endangered Species Act* (ESA) at two subpopulations (Cliff Island and Budreau's Beach). The subpopulation at French Portage Narrows is protected within the Lake of the Woods Provincial Park, under the *Provincial Park Conservation Reserves Act* since regulation in 2006 (Environment and Climate Change Canada 2017), although it does not receive habitat protection under the Ontario ESA. Western Silvery Aster's tall-grass prairie habitat is listed as Endangered under Manitoba's *Endangered Species and Ecosystems Act*, since April 22, 2013.

The federal Recovery Strategy has identified critical habitat at all 23 extant populations of Western Silvery Aster in Canada, totaling ca. 2,826 hectares (28.26 km²) in Manitoba and 14 hectares (0.14 km²) in Ontario (Environment and Climate Change Canada 2017). Calculations used best available subpopulation data up to September 2013 (Manitoba) and January 2015 (Ontario). Since the calculation of critical habitat, three known subpopulations in Manitoba have been expanded as additional patches have been newly documented (i.e. from November 2013 to 2016).

In the United States, Western Silvery Aster does not receive legal protection under the federal US *Endangered Species Act*; however, it is state listed as Threatened in Indiana and Michigan (Indiana Department of Natural Resources 2019; Michigan Natural Features Inventory 2009).

Non-Legal Status and Ranks

In Canada, Western Silvery Aster is nationally ranked Imperilled to Vulnerable (N2N3), and tentatively Secure (N5?) in the United States. It is globally Secure (G5), as of last review in 2002 (NatureServe 2019), and not included in the IUCN red list.

Western Silvery Aster is Critically Imperilled (S1) in Ontario (NHIC 2018), and Imperilled to Vulnerable (S2S3) in Manitoba (MB CDC 2018). In the US, Western Silvery Aster is Critically Imperilled (S1) in Oklahoma, Imperilled (S2) in Arkansas, Indiana, Michigan, and North Dakota, Apparently Secure (S4) in Iowa, Minnesota, Wisconsin and (S4S5) in Nebraska, and Secure (S5) in Kansas. Updated ranks from Kansas, Minnesota, Nebraska, Oklahoma and Wisconsin were obtained from botanists in corresponding jurisdictions (Freeman-KS, Anderson-MN, Simpson-NE, Buthod-OK and Doyle-WI, pers. comm. 2018). In the remaining US states, the species remains unranked.

Habitat Protection and Ownership

Close to two-thirds of the Canadian Western Silvery Aster population occurs on private lands[4], with twelve subpopulations primarily privately owned. An additional single subpopulation is primarily municipally owned and leased to aggregate extractors. Stewardship actions by private landowners have led to the increase in density and distribution of Western Silvery Aster at two subpopulations, including Budreau's Beach, Ontario (Environment and Climate Change Canada 2017), and East Hazelglen (EO 78), Manitoba (MB CDC 2018). A privately owned portion of the subpopulation near Richer, Manitoba has undergone a recent land use change, although the extent of impact on plants is currently unknown (see **Habitat Trends**).

Close to one fifth of plants in the Canadian population occur on rights-of-way, with twenty subpopulations found partially or entirely along roads and rights-of-way. To help mitigate threats associated with road maintenance activities and mowing, the Manitoba Conservation Data Centre has prepared maps of road allowances highlighting localities of Western Silvery Aster for the rural municipalities of Franklin and Stuartburn in Manitoba (Foster and Reimer 2007; Friesen and Murray 2010).

While a total of six subpopulations occur in three provincial parks and a conservation reserve, designation within these areas does not ensure permanent habitat protection. Cliff Island is included in the Lake of the Woods Conservation Reserve, where intensive land uses, such as aggregate extraction, mineral exploration, logging, and cottage development are prohibited since regulation in 2005 (Harris *et al.* 2005). However, the development and maintenance of new or existing roads and utility rights-of-way, and the disposition of Crown lands for commercial and private use are permitted under specific guidelines (OMNR 2006, 2009). Cliff Island has been identified as an area of interest in an ongoing Treaty Land Entitlement Claim, Animakee Wa Zhing #37 (Schlag pers. comm. 2019).

[4] To estimate the proportion of land ownership in the Canadian population, each subpopulation was categorized by ownership type (private, RoW, First Nation, municipal, or provincial park/ conservation reserve). In Manitoba, where subpopulations have multiple land tenures, rural municipality maps were used to determine ownership of all mapped patches of plants within subpopulations. Ontario subpopulations are categorized by a single ownership type. Up to 64% of the plants in the Canadian population occur on privately owned land, while 18% of plants occur on RoWs. Remaining land ownership in the Canadian population is represented by First Nations (7%), municipal (5%), and provincial park/ conservation reserve (4%).

In Birds Hill Provincial Park, Manitoba, one subpopulation (EO 2189) and portions of two others (EOs: 2793; 3755) occur within a Recreational Development land use category, which is unprotected. Plants within portions of all three subpopulations at Birds Hill Provincial Park have been affected by development or expansion of recreational activities (e.g., campgrounds, roads and trails). All such activities have caused a reduction in subpopulation numbers and extent in and around Birds Hill Provincial Park in the past. It is unclear whether unprotected portions of subpopulations within Park boundaries will continue to decline in the future. The subpopulation in and adjacent to the provincial park (EO 2793) is primarily municipally owned and leased to aggregate extractors[5].

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Friesen, Chris. Coordinator, Manitoba Conservation Data Centre, Sustainable Development, Winnipeg, MB.

[5] Roughly 75% of plants observed from EO 2793 occur on municipal land leased to aggregate extractors, 18% of plants occur on the RoW, while just 7% of plants occur on land within the provincial park.

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BIOGRAPHICAL SUMMARY OF REPORT WRITER(S)

Karin Newman is a consultant botanist, ecologist and writer. She has conducted botanical inventories and rare and invasive plant surveys for the past 15 years for environmental impact, monitoring, and habitat stewardship projects through contract with private industry, municipal, provincial and federal organizations. She has worked throughout Manitoba, often in sensitive sites from prairie, boreal and wetland habitats. Karin completed an M.Sc. Botany from the University of Manitoba, and a B.Sc. (Honours) Biology (Botany Major, Geography Minor) from the University of Winnipeg. Prior to graduating, she spent eight field seasons assisting in university, government and NGO initiated biological research projects in Alberta, NWT, Nunavut, and Manitoba.

COLLECTIONS EXAMINED

A thorough review of specimen collections prior to 1999 was documented in the previous assessments (Semple 1987; Punter and Ford 1999) from numerous herbaria including: CAN, DAO, MMMN, MT, NY, UAC, UWPG, WAT, WIN, DFB, and JCS personal herbarium.

On-line collections (CAN; TEX-LL; Minnesota Bell Atlas), specimen enquiry (CAN; DAO) and specimens from herbaria in Winnipeg (MMMN, WIN, UWG) were consulted by K. Newman. No new localities were indicated for any specimens. Specimen information from DAO was not available during the preparation of this report.

Appendix 1. Threat calculator for Western Silvery Aster.

Species or Ecosystem Scientific Name	Western Silvery Aster - *Symphyotrichum sericeum*
Element ID	**Elcode**
Date:	15/10/2019
Assessor(s):	Del Meidinger (facilitator, co-chair), Bruce Bennett, Cary Hamel, Colin Jones, Chris Friesen, Colin Murray, Diana Robson, Karin Newman, Candace Neufeld
References:	

Overall Threat Impact Calculation Help:		**Level 1 Threat Impact Counts**	
Threat Impact		**high range**	**low range**
A	Very High	0	0
B	High	1	1
C	Medium	6	3
D	Low	1	4
Calculated Overall Threat Impact:		Very High	Very High

Assigned Overall Threat Impact:	**A = Very High**
Impact Adjustment Reasons:	
Overall Threat Comments	Generation time not specific in report but likely 7-10 years, so three generations would be 20-30 years. Most of population under some level of threat and threats are mostly cumulative. It seems possible that more than 50% of the population could decline over three generations due to threats in next 10 years. Note that the population decreased by over 50% in set of subpopulations with abundance data over approximately 20 years from 1998 to present--the data trend is complicated as data are not available for all subpopulations and abundance methods varied. Many threats assessed where scope is at high end of range.

Threat		**Impact (calculated)**		**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
1	Residential & commercial development	CD	Low	Restricted (1-30%)	Extreme (71-100%)	High (Continuing)	
1.1	Housing & urban areas	D	Low	Small (1-10%)	Extreme - Serious (31-100%)	High (Continuing)	Extant occurrences near residential developments (EO 78); shoreline and/or cottage development at Budreau's Beach. Housing development south of Birds Hill PP and East Hazelglen included. Cottage development at Budreau's Beach has less impact than housing development.
1.2	Commercial & industrial areas	D	Low	Small (1-10%)	Extreme (71-100%)	High (Continuing)	Business storage of equipment, materials, mechanical damage from vehicles, landscape grooming (threat 7.3) at Richer (EO 4895) affecting a third of the subpopulation. Effects of development on site of old gas station are unknown: equipment etc. observed from roadside.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
1.3	Tourism & recreation areas	D	Low	Small (1-10%)	Serious – Slight (1-70%)	Moderate (Possibly in the short term, < 10 yrs/3 gen)	One subpopulation at St Malo PP (EO 4894); three subpopulations at Birds Hill PP, MB are adjacent to two campgrounds, paved and unpaved trail networks and a road. Campground and parking lot expansion or increase in recreation facilities in adjacent areas; golf course expansion. Although plants are protected in MB, park areas zoned as Recreational Land Use are considered unprotected.
2	Agriculture & aquaculture	CD	Medium – Low	Restricted (11-30%)	Extreme – Moderate (11-100%)	High (Continuing)	
2.1	Annual & perennial non-timber crops	D	Low	Small (1-10%)	Extreme (71-100%)	High (Continuing)	Portions of at least four extant subpopulations (EOs: 78; 4501; 7576; 3917) occur in remnant strips of native prairie between cultivated fields and roadsides and may be further impacted by cultivation of the remaining strips, herbicide/ pesticide drift (threat 9.3) or encroachment of invasive or adventitious species from adjacent cultivated fields (threat 8.1).
2.2	Wood and pulp plantations						
2.3	Livestock farming & ranching	CD	Medium – Low	Restricted (11-30%)	Extreme - Moderate (11-100%)	High (Continuing)	Several observations of reduced numbers of Western Silvery Aster plants at intensively grazed pastures, when compared to adjacent non-grazed areas, have been reported from four subpopulations in Manitoba (EOs: 165; 2793; 3242; 3917). Grazing with appropriate intensity, frequency and duration may not be detrimental in a system that evolved under grazing pressure. Overgrazing is the concern. 42% of the population is subject to grazing, but 13% to heavier grazing. Large range in severity as there are differences in “overgrazing” intensity and the potential impact is unknown. Some evidence of more severe impact at one site from horse grazing.
2.4	Marine & freshwater aquaculture						
3	Energy production & mining	B	High	Large (31-70%)	Extreme (71-100%)	High (Continuing)	
3.1	Oil & gas drilling						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3.2	Mining & quarrying	B	High	Large (31-70%)	Extreme (71-100%)	High (Continuing)	Twelve extant subpopulations in Manitoba are currently adjacent to or within active gravel pits; expansion or creation of new pits is of concern.
3.3	Renewable energy						
4	Transportation & service corridors	C	Medium	Restricted (11-30%)	Extreme (71-100%)	High (Continuing)	
4.1	Roads & railroads	C	Medium	Restricted (11-30%)	Extreme (71-100%)	High (Continuing)	Nineteen subpopulations (eighteen in Manitoba) are partially or entirely on remnant pieces of native prairie along roadsides and ditches or are otherwise traversed by a road. Habitat and plants can be damaged or destroyed by road construction activities such as road widening, ditch deepening, trenching, drainage projects, and realigning or improving the road. Road maintenance activities. Mowing for improving site lines and herbicide spraying to reduce vegetation along road are included here.
4.2	Utility & service lines	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	Transmission line right of way maintenance and construction; hydro line rights-of-way are found in three subpopulations (EOs: 2793; 3917; 4895) in Manitoba. RoW maintenance may include herbicide application on RoW to control invasive and/or tall woody species.
4.3	Shipping lanes						
4.4	Flight paths						
5	Biological resource use						
5.1	Hunting & collecting terrestrial animals						
5.2	Gathering terrestrial plants						
5.3	Logging & wood harvesting						
5.4	Fishing & harvesting aquatic resources						
6	Human intrusions & disturbance	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	
6.1	Recreational activities	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	In Birds Hill PP, and St Malo PP subpopulations, off-road all-terrain vehicle (ATV) use in ditches and along trails can damage or destroy plants, compact or erode soil, and cause unnatural disturbance to habitat. Activities along horse trails; hiking/biking on trails and off dedicated trails; shore lunch sites; temporary campsites can also impact on plants and habitat in Ontario subpopulations.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
6.2	War, civil unrest & military activities						
6.3	Work & other activities						
7	Natural system modifications	C	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)	
7.1	Fire & fire suppression	U	Unknown	Large (31-70%)	Unknown	High (Continuing)	Fire suppression is leading to woody encroachment: forest and shrubs becoming established in absence of fire. Lichen and clubmoss cover are associated with higher Western Silvery Aster abundance, but these are slow to recover after fire. Park Managers would like to introduce fires but problematic due to human use. Positive and negative effects, so severity scored as 'unknown'. Woody encroachment and thatch build up due to fire suppression scored under 7.3. Past fire noted at single site within each of two subpopulations at Birds Hill (EOs: 2793; 3755).
7.2	Dams & water management/use						
7.3	Other ecosystem modifications	C	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)	Disruption of the natural disturbance regime has allowed encroachment of woody vegetation and thatch build-up at several Manitoba sites. Mowing at inappropriate times is also a potential issue (e.g., Richer EO 4895).
8	Invasive & other problematic species & genes	C	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)	
8.1	Invasive non-native/alien species/diseases	C	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)	Invasive alien plant species. Smooth Brome (*Bromus inermis*), Leafy Spurge (*Euphorbia virgata*), Sweet-clovers (*Melilotus albus* and *M. officinalis*), Kentucky Bluegrass (*Poa pratensis*), thistles (*Cirsium* spp.) and Reed Canarygrass (*Phalaris arundinacea*) co-occur with Western Silvery Aster in Manitoba. Common Tansy (*Tanacetum vulgare*) and Quackgrass (*Elymus repens*) were reported at the subpopulation at Budreau's Beach, ON. Invasive grasses such as Smooth Brome and Reed Canarygrass may pose a threat to subpopulations occupying ditches. Siberian Elm (*Ulmus pumila*) and Scots Pine (*Pinus sylvestris*) also invading sites in Birds Hill PP, MB.
8.2	Problematic native species/diseases						
8.3	Introduced genetic material						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
8.4	Problematic species/diseases of unknown origin						
8.5	Viral/prion-induced diseases						
8.6	Diseases of unknown cause						
9	Pollution	CD	Medium - Low	Restricted (11-30%)	Serious – Slight (1-70%)	High (Continuing)	
9.1	Domestic & urban waste water						
9.2	Industrial & military effluents						
9.3	Agricultural & forestry effluents	CD	Medium – Low	Restricted (11-30%)	Serious - Slight (1-70%)	High (Continuing)	Non-specific pesticide and neonicotinoid use and the potential for chemical drift was reported from at least four subpopulations, (EOs: 2793; 78; 4501; and 4894), and from forestry harvest areas from Crown lands in Ontario. In addition to drift or inadvertent application, there are also impacts on pollinators both on site and in adjacent agricultural land.
9.4	Garbage & solid waste		Negligible	Negligible (<1%)	Slight (1-10%)	High (Continuing)	Garbage Dumping at Carlowrie (EO 3719) and W Gardenton (EO 3242), mechanical damage from vehicles and materials dumping, possible pollution effects in case of hazardous materials.
9.5	Air-borne pollutants						
9.6	Excess energy						
10	Geological events						
10.1	Volcanoes						
10.2	Earthquakes/tsunamis						
10.3	Avalanches/landslides						
11	Climate change & severe weather	U	Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	
11.1	Habitat shifting & alteration						
11.2	Droughts	U	Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	Although species exhibits stress-tolerant characteristics that make it capable of growing in gravelly, well-drained, low-nutrient soils, moisture may be a limiting factor in reproductive output throughout Manitoba subpopulations.
11.3	Temperature extremes						
11.4	Storms & flooding						
11.5	Other impacts						

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