PROPOSED

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Western Silvery Aster (*Symphyotrichum sericeum*) in Canada

Western Silvery Aster

2016

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

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[1] http://www.registrelep-sararegistry.gc.ca

Preface

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

The Minister of the Environment is the competent minister under SARA for the Western Silvery Aster and has prepared this strategy, as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the Government of Ontario and the Government of Manitoba.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Environment Canada, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Western Silvery Aster and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by Environment Canada and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When the recovery strategy identifies critical habitat, there may be future regulatory implications, depending on where the critical habitat is identified. SARA requires that critical habitat identified within federal protected areas be described in the *Canada Gazette*, after which prohibitions against its destruction will apply. For critical habitat located on federal lands outside of federal protected areas, the Minister of the Environment must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies. For critical habitat located on non-federal lands, if the Minister of the Environment forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament, and not effectively protected by the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to extend the prohibition against destruction of critical habitat to that portion. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

[2] http://registrelep-sararegistry.gc.ca/default.asp?lang=en&n=6B319869-1#2

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The Manitoba Conservation Data Centre and Ontario Natural Heritage Information Centre provided updated element occurrences and Chris Friesen provided valuable insight on the species occurrences and habitat requirements in Manitoba. Acknowledgement and thanks is given to all other parties that provided advice and input used to help inform the development of this recovery strategy including various Aboriginal organizations and individuals, landowners, citizens and stakeholders who provided input and/or participated in consultation meetings. The co-operation of all the landowners, lessees and land managers who granted access to their land to do surveys and who continue to provide habitat for species at risk is greatly appreciated.

Executive Summary

The Western Silvery Aster (*Symphyotrichum sericeum*) is a perennial wildflower, producing 30-70 cm tall sparsely branched upright stems from a corm-like rootstock, with purplish aster flowers, and silky-hairy leaves. Western Silvery Aster flowers from early August to mid-September. Plants inhabit prairies, oak savannahs, fields and open woods. Preferred substrates are coarse, calcareous sands and gravel with little loam, sandy pockets and cracks in sandstone and limestone outcrops, and thin loamy soil over Canadian Shield. In Ontario, Western Silvery Aster is often associated with basic bedrock.

Western Silvery Aster is widespread in central North America from Texas, through the midwestern United States to Manitoba and Ontario in Canada. In Canada, as of 2014, there were 20 extant populations in Manitoba, and 3 extant populations in Ontario, with a further 5 extirpated populations in Manitoba and Ontario and 1 historic population in Ontario.

The most significant threat to Western Silvery Aster is continued habitat loss, fragmentation and/or degradation through gravel extraction, road construction/maintenance, shoreline development, invasive alien species and agriculture effluent (non-specific pesticide use). Other threats include off-road vehicle use, residential areas, tourism and recreation areas, annual and perennial non-timber crops (cultivation), overgrazing, utility and service lines, inappropriately timed mowing, fire suppression, encroachment of woody growth, and drought.

Recovery is considered feasible for this species. The population and distribution objectives are to maintain the population size and distribution, within the natural range of variation, at all extant populations as well as any newly discovered or reconfirmed populations to ensure the long-term persistence, and where feasible, the natural expansion of Western Silvery Aster in Canada. Broad strategies to be taken to address the threats to the survival and recovery of Western Silvery Aster are presented in the section on Strategic Direction for Recovery.

Critical habitat for Western Silvery Aster is fully identified in this recovery strategy for all extant populations in Canada. In Manitoba, critical habitat is the extent of suitable habitat occupied by the species and all natural biophysical attributes within a 300 metre critical function zone extending from the outer boundary of the occupied suitable habitat. In Ontario, critical habitat is the extent of suitable habitat occupied by the species, plus a 50 metre critical function zone around the plants where they occur near the edge of suitable habitat.

One or more action plans for Western Silvery Aster will be posted on the Species at Risk Public Registry by 2022.

Recovery Feasibility Summary

Based on the following four criteria that Environment Canada uses to establish recovery feasibility, recovery of the Western Silvery Aster, as defined by the population and distribution objective set for the species by Environment Canada, has been deemed feasible.

1. Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.

Yes. There are several thousand plants in 23 extant populations capable of reproduction. Three populations are within protected areas, with an estimated 1000 plants at Cliff Island in Lake of the Woods Islands Conservation Reserve, an estimated 127 stems at French Portage Narrows in Lake of the Woods Provincial Park, and portions of the largest population in Manitoba occurring within Bird's Hill Provincial Park (estimated several thousand plants). Western Silvery Aster colonies may slowly expand through the creation of new clumps along underground rhizomes. Flower and seed production have also been observed in extant populations, although low seed set and high seed predation may limit seed availability. Limiting factors, such as loss of genetic diversity in peripheral populations, species specific pollination biology, and the growth characteristics of stress tolerant plants may influence the species ability to sustain the population or improve its abundance. Knowledge gaps associated with the species limiting factors should be addressed in recovery planning.

2. Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.

Yes. Western Silvery Aster is found in a range of open habitats such as prairie, fields, oak savannah and open woodlands on suitable soils, and appears to be tolerant of some disturbance. While suitable habitat makes up a relatively small proportion of the landscape in southeastern Manitoba and northwestern Ontario, unoccupied yet suitable habitat still exists within these areas. In Ontario, suitable habitat is often isolated due to the fact that it occurs on islands. In Manitoba, suitable habitat is often fragmented due to woody vegetation encroachment. Best management practices, such as the use of fire to reduce woody vegetation within and between suitable habitat, may benefit Western Silvery Aster by decreasing habitat fragmentation and increasing the amount of suitable habitat that is available. Since habitat loss and degradation are the most significant threats to Western Silvery Aster, recovery actions that protect, enhance and manage suitable habitat within and adjacent to occupied habitat patches are anticipated to support the species and allow for its natural expansion.

3. The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.

Yes. The primary threats to Western Silvery Aster relate to habitat loss and degradation, both of which may be mitigated through the protection and management of habitat.

Three populations are within protected areas (Cliff Island in Lake of the Woods Islands Conservation Reserve, French Portage Narrows in Lake of the Woods Provincial Park, and Bird's Hill Provincial Park). Threats to these three populations primarily relate to fire suppression and recreational use. Mitigation strategies are available or can be developed to manage these threats. Many populations in Manitoba are on privately-owned land or provincial and municipal road allowances maintained by the province and rural municipalities. Often, populations adjacent to those in roadside strips have been destroyed or damaged by ploughing, grazing or gravel extraction. Inappropriate management of road right-of -ways threatens these populations. The development and adoption of best management practices for road right-of-way management is anticipated to protect these populations. Factors that may limit Western Silvery Aster's ability to sustain the population in the future can be addressed in recovery planning. Research testing preliminary management practices to address the pollination biology of the species has been conducted and an indirect threat to Western Silvery Aster may be the use of neonicotinoids and other insecticides on the plant's pollinators. While Western Silvery Aster occurs at the northern limit of its range in Canada, making it vulnerable to stochastic events and genetic inbreeding, it is more common in adjacent Minnesota where individuals from larger populations may be available to support Canadian populations.

4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.

Yes. Further loss of habitat or extant populations can be avoided through legislation and conservation easements/agreements, municipal planning mechanisms and stewardship agreements with landholders. Habitat degradation can be prevented through stewardship using the development of best management practices to provide an appropriate level of site disturbance to maintain open habitat conditions, while preventing the invasion of invasive plants or woody vegetation. Best management practices (such as mowing, prescribed burns, grazing intensity, etc) are currently unavailable, but are anticipated to be developed within a reasonable time frame. If populations continue to decrease and rescue effort is required, Western Silvery Aster is more common in adjacent Minnesota, and it may be possible to transplant individuals, if necessary into existing populations. Western Silvery Aster is readily transplanted (Semple 1988) and individuals from the larger colonies in Canada or in Minnesota may be available for enhancing smaller populations. Stock grown from seed collected in Manitoba is also available through several local native plant/seed suppliers. If this is the case, it would benefit from further study (e.g. population genetics, viability, ethics, restrictions on the movement of plant material and soil between the USA and Canada).

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1. COSEWIC* Species Assessment Information

Date of Assessment: May 2000

Common Name (population): Western Silvery Aster

Scientific Name: *Symphyotrichum sericeum*

COSEWIC Status: Threatened

Reason for Designation: A perennial of dry prairies, fields and open woods found only at a few very small sites in southern Manitoba and northwestern Ontario.

Canadian Occurrence: Manitoba and Ontario

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

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

2. Species Status Information

Western Silvery Aster (*Symphyotrichum sericeum*) is designated as Threatened on Schedule 1 of the federal *Species at Risk Act* (SARA), as Endangered under Ontario's *Endangered Species Act* 2007 (ESA) and as Threatened under Manitoba's *Endangered Species and Ecosystems Act*. In Ontario, regulated habitat for Western Silvery Aster is described in *Ontario Regulation 242/08 (30).* The conservation status of Western Silvery Aster throughout its range is described in Table 1. It is estimated that Canada holds less than 10% of the species' global range, although this is difficult to estimate because the species abundance is not tracked in many states in the U.S.

Table 1. Conservation status of Western Silvery Aster (from NatureServe 2015b).

Global (G) Rank[1]	National (N) Rank[1]	Sub-national (S) Rank[1]
G5	Canada (N2N3)	Manitoba (S2S3), Ontario (S1)
	United States (N5?)	Arkansas (S2), Illinois (SNR), Indiana (S2), Iowa (S4), Kansas (SNR), Michigan (S2), Minnesota (SNR), Missouri (SNR), Nebraska (SNR), North Dakota (S2S3), Ohio (SNR), Oklahoma (SNR), South Dakota (SNR), Tennessee (SNR), Texas (SNR), Virginia (SNR), Wisconsin (SNR)

[1] Rank 1– critically imperiled; 2– imperiled; 3– vulnerable to extirpation or extinction; 4– apparently secure; 5– secure; H– possibly extirpated; SNR – status not ranked; ? – inexact or uncertain and qualifies the character immediately before it (NatureServe 2015c).

3. Species Information

3.1 Species Description

Western Silvery Aster is a perennial wildflower, 30 to 70 cm tall, that produces several to many sparsely branched upright stems. The leaves have long silky hairs giving it a silvery appearance, and this feature together with their lance-shape leaves and woody rootstock, distinguishes it from other asters (Figure 1, Semple 1988). Plants flower from early August to mid September. The inflorescence is branched, and densely hairy, bearing usually less than 10 heads of flowers with rose-purple petals (sometimes white), although some flowering stems can have up to 50-60 flowering heads (Figure 1). Stems are produced from an enlarged, bulblike woody base (called a corm) located just below the soil surface (COSEWIC 2000), and several Western Silvery Aster clumps may be connected by underground rhizomes (Jones 1978, Semple et al. 1996). Shoots for the next season are produced by early September with the tips just below the soil surface. Seeds are produced by early October (Robson 2010a).

Figure 1. Western Silvery Aster flower (left photo) and leaves on stem (right photo). © Candace Neufeld.

3.2 Population and Distribution

Western Silvery Aster is widespread in central North America ranging from Texas, north through the Midwestern United States to Manitoba and Ontario, Canada, and east as far as Ohio and Tennessee (Figure 2). It is frequent in the Great Plains of the United States and becomes rare in the northern and eastern portion of its range. Western Silvery Aster reaches the northern limit of its range in southeastern Manitoba and northwestern Ontario. As of 2014, there were 23 known extant[3] populations[4] in Canada (Appendix A).

In Ontario, there are three extant populations (Big Traverse Bay (Budreau's Beach), French Portage Narrows, and Cliff Island) and two additional populations (Rainy Lake and Ingolf) which are considered historic and extirpated[5] respectively (Figure 3, Appendix A). The population at Ingolf may have been initially introduced with railroad traffic (Semple 1988), but the presence of numerous other prairie plant species at the site leaves open the possibility that this was a native occurrence (COSEWIC 2000). Despite several surveys (most recently in 2001), Western Silvery Aster has not been seen at Ingolf since 1939 (Ben-Oliel and Oldham 2000). The cause of extirpation is unknown. The exact location of an 1827 record from Rainy Lake is unknown and the population has not been rediscovered despite botanical work on Rainy Lake (COSEWIC 2000).

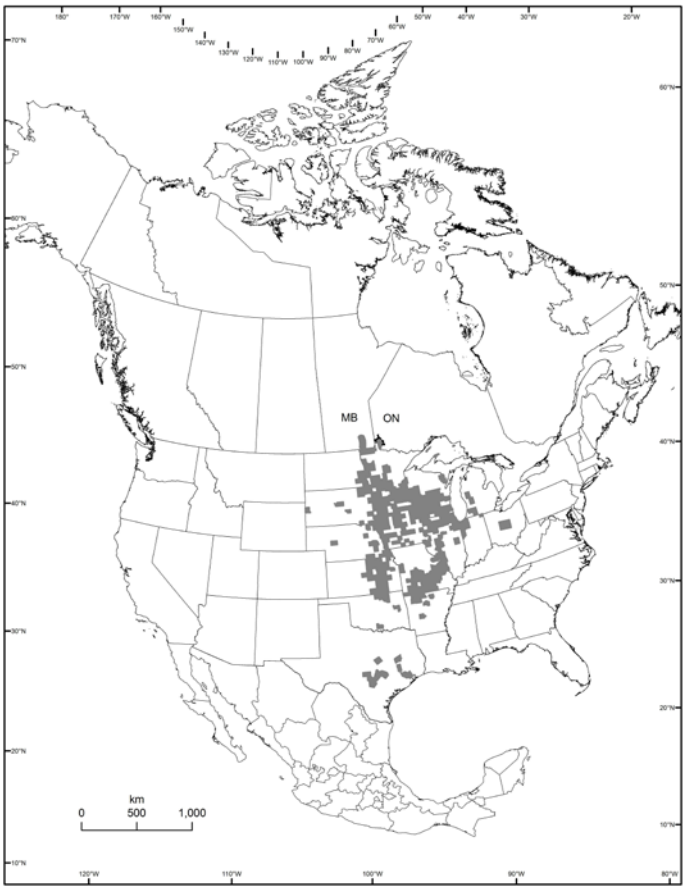

Figure 2. Current range of Western Silvery Aster in North America (adapted from Kartesz 2015).

In Manitoba, Western Silvery Aster occurs from northeast of Winnipeg south to the US border (Figure 3, Appendix A) as 20 extant populations in four general areas: the

[3] *Extant means the occurrence has been recently verified as still existing, information on the location is accurate, and habitat still exists at the time of writing the recovery strategy (NatureServe 2015c).*
[4] *Each population is composed of one or more occurrences and for the purposes of the recovery strategy will be equivalent to an element occurrence as defined by NatureServe (2015a).*
[5] *Extirpated either means that conditions or habitat no longer exist at an occurrence to support the species, or sufficient surveys have taken place at the occurrence over an adequate time period and during good growing years, conducted by experienced surveyors, yet failed to relocate the species at the occurrence (NatureServe 2015c).*

Bird's Hill gravel esker complex northeast of Winnipeg, southeastern Manitoba within the Rural Municipalities of Hanover, Franklin and Stuartburn, near the town of Beausejour, and east of St. Ann. At least 4 additional Manitoba populations are considered extirpated due to gravel extraction and/or urban development, and there are portions of extant populations which have been destroyed by threats like gravel extraction (Appendix A). A population was recorded near the town of Arnaud in 1939 but subsequent searches have not located appropriate habitat and the Manitoba Conservation Data Center does not have a record of this population (COSEWIC 2000).

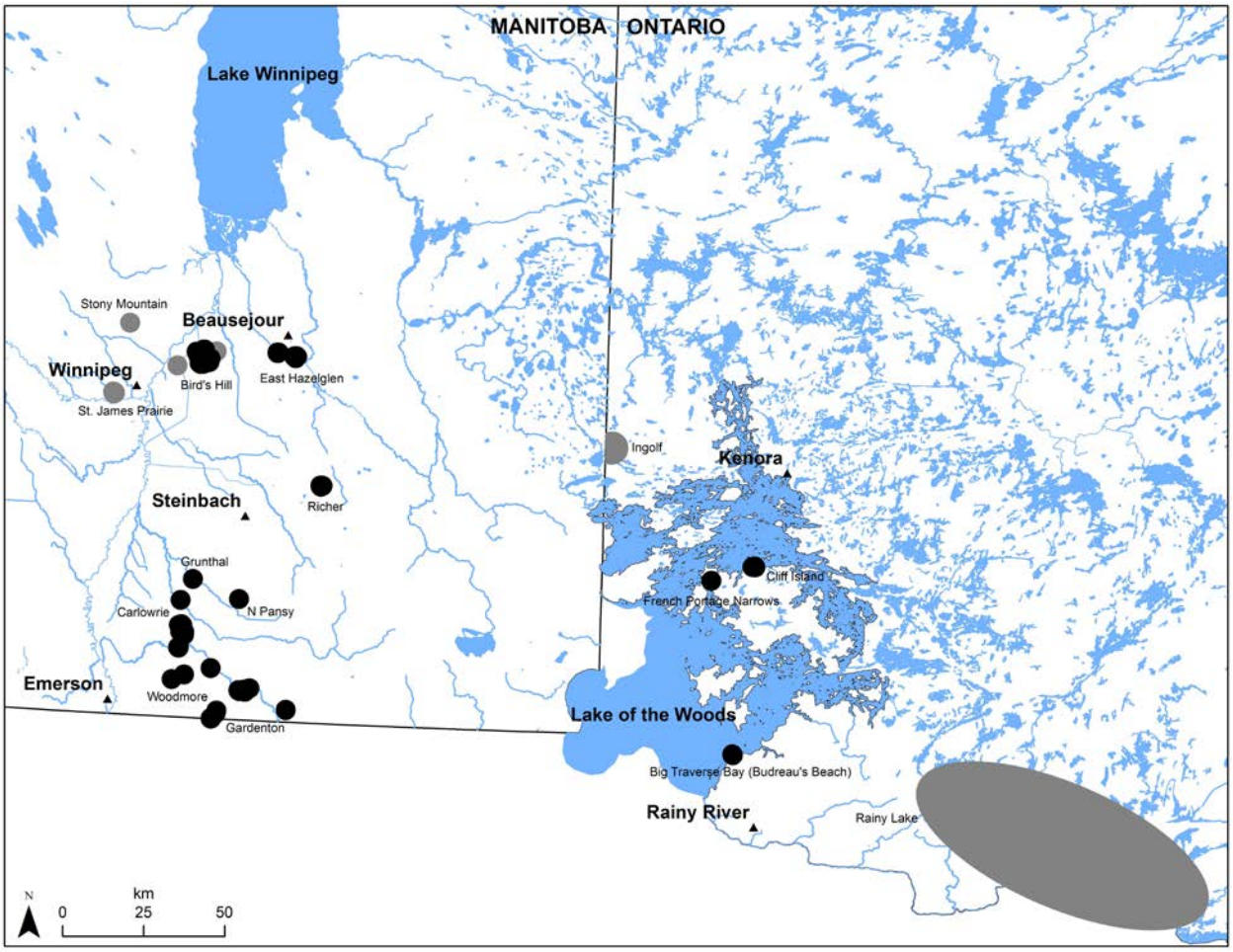

Figure 3. Current range (spatial distribution) of Western Silvery Aster in Canada [Note: black circles are extant populations, grey circles are historic and extirpated populations].

3.3 Needs of the Western Silvery Aster

a) Habitat Needs

In Manitoba, Western Silvery Aster inhabits prairies, fields and openings in Bur Oak (*Quercus macrocarpa*)/Trembling Aspen (*Populus tremuloides*) woodlands, usually on

south or west facing slopes (Semple 1988, COSEWIC 2000). Preferred substrates are "coarse, calcareous sand and gravel with little loam, sandy pockets and cracks in sandstone and limestone outcrops, and thin loamy soil over Canadian Shield" (Semple 1988). Most populations are on a series of beach ridges and nearshore deposits of calcareous sand and gravel marking a former shoreline of Glacial Lake Agassiz (COSEWIC 2000). Populations also exist on gravel eskers and small surficial gravel lenses (trapped gravel patches buried by other soil deposits) surrounded by finer soils. One historical site was found on sandy soil. The extirpated population at Stony Mountain was likely on a limestone outcrop. Well drained near-surface gravel and limestone outcrops are discontinuous in southern Manitoba.

In Ontario, Western Silvery Aster grows in grassy openings in Bur Oak savannah (Upland Bur Oak[6]) over mafic (basic) bedrock, rather than the much more common acidic (usually granitic) rocks. In the Lake of the Woods area, Bur Oak savannah communities are strongly associated with south-facing, mafic bedrock slopes with shallow, discontinuous Gray Luvisolic clay soils (COSEWIC 2000). Suitable habitat makes up a relatively small proportion of the northwestern Ontario landscape since surficial deposits often cover granitic bedrock; however, within this area suitable habitat patches exist.

Some natural disturbance such as grazing or fire may be required to maintain open habitat conditions, and the species appears moderately tolerant of human-caused disturbances that mimic these natural disturbance regimes (such as appropriately timed mowing), given its habit of growing in fields and road right-of-ways (Semple 1988, Oldham et al. 2003).

b) Biological Needs and Limiting Factors

Vegetation associates and abiotic conditions

Western Silvery Aster reaches the northern extreme of its range in Canada suggesting that climate may be a factor limiting expansion in Manitoba and Ontario. Populations at the limits of a species' range often occupy poorer habitat and are more fragmented, less dense, and more variable than those at their core range (Channell and Lomolino 2000, Vucetich and Waite 2003). Peripheral populations are therefore more vulnerable to extinction due to low immigration rate, disrupted pollinator relationships, and other density-related factors. Genetic diversity is sometimes, but not always, less in peripheral populations, but they may possess unique genetic characteristics (Vucetich and Waite 2003).

Western Silvery Aster possesses many of the characteristics of a stress tolerant plant, including a perennial corm and rhizomes, small leaf size, slow growth and sparse litter production (Grime 2001, Robson 2010b). Stress tolerant plants are capable of growing in low nutrient soils and tend to favour conservative growth and nutrient storage, rather

[6] Upland Bur Oak vegetation type (V3.3) as described in the Forest Ecosystem Classification for Northwestern Ontario (Sims et al. 1997).

than reproduction (Grime 2001). Flower and seed production in Manitoba appears to be inhibited by competition with other plants for pollinators during part of the year, the presence of weevil seed predators, and the low availability of soil resources (Robson 2010b). Issues such as limited genetic diversity may cause low seed set, but this has not been examined in Canada (Robson 2010b).

Pollination and pollinators

Western Silvery Asters are self-incompatible and require cross-pollination by insects. In Manitoba, 22 insect taxa (Diptera and Hymenoptera) visit Western Silvery Aster flowers, with the Two Form Bumble Bee (*Bombus bifarius)* the most frequent visitor overall, followed by the syrphid fly (*Toxomerus spp.*) (Robson 2010a). In Ontario, pollinators for Western Silvery Aster are unknown. Seed set is low in Western Silvery Aster in Manitoba due to competition with other co-flowering plants for pollinating insects, particularly earlier in the season, but may also indicate low insect fidelity to Western Silvery Aster plants during foraging by pollinators (Robson 2010a, b). Between 2 to 4 Western Silvery Aster stems/m^2 appears desirable to adequately attract insect visitors and ensure maximum seed production. The presence of a range of other co-occurring flowering plant species was optimal to support a permanent population of pollinating insects (Robson 2013). Disruption of pollination biology is a potential limiting factor, particularly at the periphery of the range where both plant and pollinator populations may be fragmented.

4. Threats

4.1 Threat Assessment

The Western Silvery Aster threat assessment is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system. Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational). In carrying out the threat assessment, only present and future (within a 10-year timeframe) threats are considered. Threats are characterized here in terms of scope, severity, and timing. The overall threat "impact" reflects a reduction of a species population or decline/degredation of the area of an ecosystem and is calculated from scope and severity. See the table footnotes for details on how the values are assigned in the table (Table 2). Historical threats, indirect or cumulative effects of the threats, or any other relevant information that would help understand the nature of the threats are presented in the narrative section. Limiting factors are not considered during this assessment process.

Table 2. Threats Classification Table for Western Silvery Aster

Threat #[e]	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]	Detailed threats/Comments
1	Residential & commercial development	Low	Small	Extreme	High	
1.1	Housing & urban areas	Low	Small	Extreme	High	Residential development; shoreline and/or cottage development
1.3	Tourism & recreation areas	Low	Small	Serious	High	Campground and parking lot expansion or increase in recreation in adjacent areas; golf course expansion; shoreline development
2	Agriculture & aquaculture	Low	Small	Extreme	High	
2.1	Annual & perennial non-timber crops	Low	Small	Extreme	High	Cultivation
2.3	Livestock farming & ranching	Negligible	Small	Negligible	High	Overgrazing
3	Energy production & mining	High	Large	Extreme	High	
3.2	Mining & quarrying	High	Large	Extreme	High	Gravel extraction
4	Transportation & service corridors	High	Large	Extreme	High	
4.1	Roads & railroads	High	Large	Extreme	High	Road construction and maintenance activities (mowing and pesticide spraying are captured under 7.3 and 9.3, respectively.)
4.2	Utility & service lines	Low	Small	Slight	High	Transmission line right of way maintenance and construction; hydro line right of way
6	Human intrusions & disturbance	Low	Small	Slight	High	
6.1	Recreational activities	Low	Small	Slight	High	Off-road all-terrain vehicle (ATV) use and trails;

Threat #[e]	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]	Detailed threats/Comments
						horse trails; hiking trails; hiking off dedicated trails; shore lunch sites; temporary campsites
7	Natural system modifications	Low	Large	Slight	High	
7.1	Fire & fire suppression	Unknown	Unknown	Unknown	Unknown	Fire suppression
7.3	Other ecosystem modifications	Low	Large	Slight	High	Mowing at inappropriate times (right of ways, roadsides)
8	Invasive & other problematic species & genes	Medium	Large	Moderate	High	
8.1	Invasive non-native/alien species	Medium	Large	Moderate	High	Invasive alien plant species
8.2	Problematic native species	Low	Restricted	Slight	High	Encroachment of shrubs or woody growth through natural vegetation succession. Interaction with improper management activities, climate, lack of natural disturbances. Seed predation.
9	Pollution	High	Restricted	Extreme	High	
9.3	Agriculture & forestry effluents	High	Restricted	Extreme	High	Non-specific pesticide and neonicotinoid use
11	Climate change & severe weather	Low	Large	Slight	Moderate-low	
11.2	Drought	Low	Large	Slight	Moderate-low	
11.4	Storms & flooding	Unknown	Small	Unknown	Unknown	Increased summer storms potentially causing greater erosion of cliff sites

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

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

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

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

[e] **Threat #** - Threats are numbered using the IUCN Classification System. Only those threats relevant to Western Silvery Aster are presented in this table and in Section 4.2 Description of Threats.

4.2 Description of Threats

Appendix A identifies the threats that are associated with each population.

IUCN Threat 1. Residential & commercial development

Threat 1.1 Housing & urban areas

Residential development contributed to the loss of at least four populations in Manitoba (Appendix A). Residential development could also further impact at least two other populations in Manitoba (Appendix A, COSEWIC 2000). Private and municipal lands south of the Bird's Hill Provincial Park lie within the Rural Municipality of Springfield, one of the fastest-growing municipalities in Manitoba's Capital Region (Lorch 2002). Residential development can not only lead to the direct loss of a population through the housing development itself, but it can indirectly impact a population by altering the occurrence and frequency of disturbance events required to maintain suitable habitat conditions, increasing the introduction and spread of invasive species, altering the hydrology and nutrients the habitat receives, and increasing the amount of trampling through recreational use of surrounding lands. Infrastructure associated with development, such as installation and maintenance of utility lines, road expansion or alteration, and clearing and maintenance of ditches may also be a concern since many populations are found along roadsides or right-of-ways (see threat 4.1, 4.2, 7.3).

Development of shoreline lots for cottages is a potential threat at Big Traverse Bay (Budreau's Beach) in Ontario (Ben-Oliel and Oldham 2000). Several cottages have been constructed within the area occupied by Western Silvery Aster and other lots have been designated for cottage development (Oldham et al. 2003). Less than 10% of the Western Silvery Aster plants occur on developed lots, with about a third of the population on potential cottage lots and the remainder on inland sites not under immediate threat of development (Harris et al. 2005). A roadway through the Big Traverse Bay (Budreau's Beach) site has caused some damage to the population.

Threat 1.3 Tourism & recreation areas

There are two campgrounds within close proximity to Western Silvery Aster populations (Appendix A), and expansion into the areas containing Western Silvery Aster could pose a threat, as could an increase in use of the prairie by visitors to the campground or parks. There is also a golf course adjacent to a known population (Appendix A); this golf course may have eliminated a portion of that population historically. Expansion of the golf course and the increased input of moisture and fertilizers could pose a threat to a portion of the population.

IUCN Threat 2. Agriculture & aquaculture

Threat 2.1 Annual & perennial non-timber crops

In Manitoba, it is estimated that tall-grass prairie habitat has declined 99.9% from its original 600,000 hectares, largely due to cultivation for forage and cereal crops (Samson and Knopf 1994). This has resulted in considerable historical habitat loss for species like Western Silvery Aster. Many of the remaining populations are in remnant strips of native prairie between cultivated fields and roadsides and may be further impacted by cultivation of the remaining strips, pesticide drift (threat 9.3) or encroachment of tame forage species from adjacent cultivated fields (threat 8.1). Those populations still in larger tracts of native pasture may be at risk of future cultivation in years where crop prices are high (Honey and Oleson 2006, Farm Credit Canada 2013, Wright and Wimberly 2013).

Threat 2.3 Livestock farming & ranching

Pre-settlement, habitat containing Western Silvery Aster would have evolved under periodic natural disturbances like fire, grazing and drought (Samson and Knopf 1994). These disturbances interacted independently and/or together (Collins 1987), to maintain the open, early successional habitat suitable for species like Western Silvery Aster. In the absence of these disturbances, woody vegetation or invasive alien species can encroach and litter levels can increase, leading to a change in the plant community (threats 8.1, 8.2; Higgins et al 1989, Milchunas et al. 1989, Milchunas et al. 1992, Samson and Knopf 1994, Hayes and Holl 2003). Post-settlement, alterations to grazing from what traditionally occurred with wild ungulates, have contributed to changes in the plant and animal communities and ecosystem processes of tall-grass prairie habitat (Samson and Knopf 1994, Knapp et al. 1999, Fuhlendorf and Engle 2001, Towne et al. 2005). Studies have shown processes (grazing, fire, or the combination of both) that influence vegetation composition and structure in grasslands, interact with limiting factors in the environment such as precipitation (drought) or soil nutrients, to create an optimum state for the system (Wedin 1994, Biondini et al. 1998). Grazing influence is likely determined by a combination of factors including grazing history of the landscape, climatic conditions (e.g. drought), and the length of time certain conditions persist (Biondini et al. 1998, Knapp et al. 1999). Although overgrazing has been reported to be a concern for Western Silvery Aster at a few populations (Appendix A), the impact of grazing in terms of frequency, scale and intensity on Western Silvery Aster populations and habitat is largely unknown at this point. It is possible that intensive grazing could damage the woody corm at and just below the surface of the soil. Grazing at the time of year when the plant is flowering or setting seed may result in reduced seed set if plants are grazed or trampled. It was reported that one population in an intensively grazed pasture had fewer Western Silvery Aster plants than an adjacent ungrazed area. Responsible grazing at appropriate intensity, frequency and duration, however, is likely not detrimental in a system that evolved under grazing pressure, and in fact, is likely beneficial by preventing succession, maintaining vegetation structure, and maintaining range condition (Higgins et al 1989, Milchunas et al. 1989, Milchunas et al. 1992, Samson and Knopf 1994, Biondini et al. 1998) .

IUCN Threat 3. Energy production & mining

Threat 3.2 Mining & quarrying

In Manitoba, the glacial beach ridges, eskers, and gravel lenses inhabited by the Western Silvery Aster contain valuable gravel deposits. More than half of the populations of Western Silvery Aster in Manitoba are currently adjacent to or within active gravel pits with a few others near old gravel pits. Gravel extraction may have been a contributing factor in the extirpation of the Stony Mountain population in Manitoba. It has also resulted in reduced population size at several extant populations in Manitoba, including destroying some habitat and plants at the population near Bird's Hill Provincial Park (Appendix A). Gravel extraction results in direct loss of plants and habitat, alters hydrology, fragments habitat, and increases the potential for invasive plant species to colonize disturbed areas. With the continued need for aggregate it is likely that additional populations of Western Silvery Aster in Manitoba will be threatened by new gravel pits or expansion of existing gravel pits. In Ontario, gravel extraction is not an apparent threat because none of the populations occur within appreciable surfical deposits.

IUCN Threat 4. Transportation & service corridors

Threat 4.1 Roads & railroads

More than half of the Western Silvery Aster populations in Manitoba are partially or entirely on remnant pieces of native prairie along roadsides and ditches (Appendix A). 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 spraying pesticides (threat 9.3), grading, haying or mowing (threat 7.3). The linear disturbances from roads also increase the potential for introduction and invasion by invasive alien species which may compete with Western Silvery Aster (threat 8.2). The linear disturbances and resultant habitat fragmentation may also impact animal movement, which may indirectly impact Western Silvery Aster seed dispersal among populations.

Threat 4.2 Utility & service lines

A few populations have been impacted in the past by construction and maintenance activities along transmission or hydro right of ways, including line extraction and tower removal. Future installation, maintenance, upgrading or decommissioning of these right of ways could impact populations that are adjacent to, or within, the utility right of ways. Populations in ditches near urban centres, recreation areas, or cottage developments may be at higher risk as infrastructure like utility right of ways will be installed or upgraded. Similar to roads, utility lines can result in fragmentation of habitat as well as introduction of invasive species.

IUCN Threat 6. Human intrusions & disturbance

Threat 6.1 Recreational activities

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 which increases opportunities for colonization by invasive alien plants. It can also introduce invasive alien plants from seed that falls from the vehicle. ATV use was reported as a threat at three Western Silvery Aster populations (Appendix A). Near Bird's Hill, ATV use that resulted in mild disturbance in areas where thatch build-up and/or shrub encroachment are threats has been found to be potentially beneficial in maintaining open habitat conditions for Western Silvery Aster. Other recreational activities, like a horse trail (Bird`s Hill) or hiking trails (Bird`s Hill, Big Traverse Bay (Budreau's Beach)), can also lead to damage to plants if use of the trails is heavy. Increased recreational use associated with existing and potential cottage developments and campgrounds is also a potential threat at a few populations (Appendix A; 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 existing populations in Ontario. These types of activities can cause trampling of Western Silvery Aster plants and surrounding vegetation, as well as displacement or compaction of soil.

IUCN Threat 7. Natural system modifications

Threat 7.1 Fire & fire suppression

As discussed in threat 2.3, Western Silvery Aster habitat would have evolved under a natural disturbance regime that included ecological processes such as grazing and fire, acting independently or together (Daubenmire 1968, White 1979, Collins 1987, Lesica and Cooper 1999). Changes in land use practices since European settlement has resulted in reduction in the frequency and extent of prairie fires (Higgins et al. 1989). While natural disturbance is required to disrupt natural succession to woody vegetation and maintain the open habitat conditions required by this species, the level of tolerance of Western Silvery Aster to fire in terms of frequency, intensity, and timing is unknown. The relative cover of Western Silvery Aster increased in Kansas after a prescribed burn (Gibson and Hurlbert 1987). However, in Manitoba, Western Silvery Aster flowering stem density increased with higher lichen and club moss cover (Robson 2010b), and these spore bearing plants may be slow to recover, particularly after a higher intensity fire (Callison et al. 1985, Johansen et al. 1984, Wilson and Shay 1990, Belnap et al. 2001). At Cliff Island, French Portage Narrows, and Big Traverse Bay (Budreau's Beach), Ontario, shallow soils help limit tree and shrub invasion but lack of regular fire is still a concern. The site at Cliff Island is quite shrubby and estimates of the number of Western Silvery Aster stems in 2014 were considerably lower than in 2001. In Manitoba, succession of woody species or invasive alien species has been reported for numerous populations (Appendix A). Frequent prescribed fire has been found to

reduce seed herbivory in some plants (Vickery 2002) but the interaction between fire frequency and seed predation in Western Silvery Aster is unknown.

Threat 7.3 Other ecosystem modifications

Haying or mowing is a beneficial management practice for many prairie species, as it can reduce litter or control invasive alien plant species. Mowing is commonly used along road or utility right of ways and ditches to control invasive alien plant species or reduce vegetation height for public safety. However, inappropriately timed haying or mowing can cause physical damage to plants, remove the flowering head before seed set, or remove the seed head before seed has dispersed, thereby reducing seed production. A negative effect of clipping on Western Silvery Aster stem height was observed in a study by Robson (2010b). Removal of flowers also affects pollinators of Western Silvery Aster (see limiting factors). Repeated mowing during flowering or seed set over many years could have an impact on population size or pollinator communities. Depending on the equipment used, mowing may also leave thatch behind, increasing shading or altering moisture levels and microhabitat. All Western Silvery Aster populations occurring in roadsides or other right of ways could be impacted by inappropriately timed mowing (Appendix A).

IUCN Threat 8. Invasives & other problematic species & genes

Threat 8.1 Invasive non-native/alien species

Invasive alien plants can pose a direct threat through competition because they are aggressive and can displace native species, decrease species diversity or richness through their superior competitive ability and/or result in overall negative effects on ecosystem functioning (Wilson 1989, Wilson and Belcher 1989, Reader et al. 1994, Dillemuth et al. 2009, Koper et al. 2010). In Manitoba, agricultural land, roadsides/ditches, and residential or recreation areas surround most populations and the risk of invasion is much higher in these disturbed areas. Smooth Brome (*Bromus inermis*), Leafy Spurge (*Euphorbia esula*), sweet clover (*Melilotus alba* and *M. officinale*), Kentucky Bluegrass (*Poa pratensis*), thistle (*Cirsium* sp. or *Carduus* sp.), Reed Canarygrass (*Phalaris arundinacea*, European form), and Spotted Knapweed (*Centaurea stoebe*) are some of the main invasive alien plant species occurring with populations of Western Silvery Aster in Manitoba and may pose a threat to its habitat (Appendix A). In Ontario, Common Tansy (*Tanacetum vulgare*) and Quackgrass (*Elymus repens*) were reported at the population in Big Traverse Bay (Budreau's Beach) but are largely restricted to the immediate vicinity of the cabins and road (Oldham et al. 2003), although future development could encourage the spread of these plants. European Reed (*Phragmites australis*) and Reed Canarygrass may pose a threat to populations occupying ditches in the future (Environment Canada 2014a, Environment Canada 2014b). Inappropriate use of herbicide intended to control invasive species has the potential to directly kill Western Silvery Aster plants, or to negatively alter habitat occupied by Western Silvery Aster (threat 9.3).

Threat 8.2 Problematic native species

In the absence of natural disturbances like fire or grazing, or during extended wet climatic periods, woody vegetation can encroach and litter levels can increase, leading to a change in the plant community (Higgins et al 1989, Milchunas et al. 1989, Milchunas et al. 1992, Samson and Knopf 1994, Hayes and Holl 2003). The disruption of the natural disturbance regime has allowed encroachment of woody vegetation and other competition at some Manitoba sites (COSEWIC 2000). Suppressing fire allows trees and shrubs to invade prairies and savannahs, allows invasive weed species to gain a foothold, may increase susceptibility to weevil seed predation (Vickery 2002) and has been a contributing factor in declines of other prairie plant species (Kaye et al. 2001). Encroachment and thatch build-up can result in increased competition for limited resources, such as sunlight, can limit availability of suitable sites for establishment, and can alter moisture and temperature levels which may affect germination. Encroachment of woody vegetation is a potential threat to several Manitoba populations and at Cliff Island and French Portage Narrows in Ontario (Appendix A).

Seed predation may have a significant impact on rare plants when population size is low (Evans et al. 1989, Bevill et al. 1999, Vickery 2002). In Manitoba, 37% of flowering heads were damaged by insect seed predators, particularly by *Anthonomus* weevils (Newman 1999, COSEWIC 2000, Robson 2010b) which lay an egg at the base of the flower at or before bloom which destroys all the seeds in the flowering head. In another native grassland plant, New England Blazing Star (*Liatris scariosa var. novae-angliae),* frequent prescribed fire reduced seed herbivory (Vickery 2002); the interaction between fire frequency and seed predation in Western Silvery Aster is unknown.

IUCN Threat 9. Pollution

Threat 9.3 Agriculture & forestry effluents

The indiscriminate or inappropriate use of pesticides intended to control undesirable plants (broad-leaf herbicide) or insect pests (indirectly through herbicide or directly through insecticide) in right of ways, ditches, or adjacent fields can affect Western Silvery Aster plants and its pollinators. Pesticide use or chemical drift was reported as a threat for three populations, but this likely affects more populations in Manitoba due to the high proportion of populations in roadside ditches or adjacent to cultivated fields. Broad-leaf herbicides if sprayed on Western Silvery Aster will kill the plant; targeted applications or other means of invasive species control are required in areas with Western Silvery Aster populations. Reducing flowering plants through herbicide use, as well as spraying insecticides to control insect pest species, can both reduce pollinators and potentially affect reproduction of Western Silvery Aster. Western Silvery Aster depends primarily on insect pollinators to ensure sufficient seed production (Robson 2010a, 2010b, 2013; see limiting factors). The syrphid fly, a main pollinator of Western Silvery Aster, is a predator of small insects as larvae and may be indirectly affected by insecticide use causing a lack of insect prey. Declining native bee populations across North America have been observed to coincide with declines in native plant populations,

although it is not clear whether bee declines are causing plant declines or vice versa (Nabhan and Buchmann 1997, Kearnes et al. 1998, Scheper et al. 2014, Gill and Raine 2014, Godfray et al. 2014).

As of 2014, neonicotinoids were being used on more than 40 million hectares of cropland in the United States and are now the most widely used insecticide in the world, trends that are consistent with the Canadian use of this insecticide (Douglas and Tooker 2015). Research has shown that even sublethal exposure to this insecticide can cause acute and chronic effects in pollinating species, specifically in social bees (honeybees, bumblebees, and stingless bees) (Gill and Raine 2014, Godfray et al. 2014). Chronic exposure to sublethal doses of neonicotinoids can alter bumblebee (*Bombus spp.*) behaviour including changing forager preferences for flower types, impairing forager performance (carry out fewer foraging bouts and bring back smaller pollen loads), and impair bee learning performance (Gill and Raine 2014, Godfray et al. 2014). Bumblebees are the main pollinator of Western Silvery Aster and effects from changes in bee behaviour could be exacerbated by the competition for pollinators with other co-flowering plants (Robson 2010a, b). Considering the high proportion of Western Silvery Aster populations in Manitoba that exist adjacent to cultivated fields, this threat may be more prevalent than initially reported.

IUCN Threat 11. Climate change & severe weather

Threat 11.2 Droughts

Although Western Silvery Aster 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 of Western Silvery Aster (Robson 2010b). Periods of drought may reduce seed production in Manitoba populations (COSEWIC 2000). In 1998, some populations, especially those in the Bird's Hill Provincial Park area, failed to produce mature heads. At other sites in Manitoba, heads were produced but no seeds were set (R. Staniforth pers. comm., E. Punter 1998 personal observation). Failure to produce heads and seeds was probably the result of low precipitation in August and early September (R. Staniforth & E. Punter, 1998 personal observation).

Threat 11.4 Storms & flooding

An increase in summer storms, as a result of climate change, has the potential to cause greater erosion on cliff sites inhabited by Western Silvery Aster. This may become a concern at two populations (Cliff Island and French Portage Narrows) which occur in the Lake of the Woods region in Ontario. The impact, severity, and timing of this threat is unknown at this time. Further research or modeling is required to fully understand the implications of this threat to these populations.

5. Population and Distribution Objectives

The population and distribution objective for the Western Silvery Aster is to maintain the overall population size and distribution[7], within the natural range of variation, including all extant populations as well as any newly discovered or reconfirmed populations [8], to ensure the long-term persistence, and where feasible, the natural expansion of Western Silvery Aster in Canada.

At this time, it is not feasible to define quantitative population objectives because there are no accurate estimates of population size, long-term data on population trends, or understanding of the range of natural variability for the Western Silvery Aster populations. While baseline estimates of population size are available for most populations (Appendix A), these data are insufficient to describe trends or to compare populations, because of inconsistent survey and monitoring methods among years. Standardized methodology is needed to accurately estimate population sizes and quantify the natural range of variation in abundance within and between populations. Once this is established, quantitative population objectives may be able to be defined.

A decrease in the distribution of Western Silvery Aster could reflect a loss of both habitat and individuals. Maintaining the species' distribution at the current levels will help ensure the extent of occurrence and index area of occupancy are maintained, preventing the species from being evaluated as "declining" in future COSEWIC assessments, as per the COSEWIC criteria in either category A, "decline in total number of mature individuals", category B, "small distribution range and decline or fluctuation", or category C, "small and declining number of mature individuals" (COSEWIC 2012). Therefore, until reliable and accurate population estimates are available, establishing quantitative distribution objectives is a more meaningful approach for recovery planning purposes for this species.

Appropriate stewardship actions that maintain or increase habitat quality may benefit Western Silvery Aster populations. If habitat quality and quantity continue to decline, however, known populations will also decline as a result. Therefore, quantitative distribution objectives are set in the context of needing to reverse or prevent further declines in the quality and quantity of habitat through mechanisms and tools such as: beneficial management practices, conservation agreements, and stewardship arrangements.

[7] *Extent of occurrence and index area of occupancy as defined in COSEWIC 2012.*
[8] *Occurrences that are considered historic are excluded from these objectives until such time as they are reconfirmed.*

6. Broad Strategies and General Approaches to Meet Objectives

6.1 Actions Already Completed or Currently Underway

Manitoba

- Manitoba Conservation Data Centre staff have conducted inventories of Western Silvery Aster in Manitoba in 2001, 2004, 2005, 2006, 2009, 2010 and 2013 (Reimer and Hamel 2002, Hamel and Foster 2005, Foster and Hamel 2006, Foster and Reimer 2007, Friesen and Murray 2010, 2011).
- In 2008, possible causes of low seed production in Western Silvery Aster were examined at Bird's Hill Provincial Park, Manitoba. The effects of pollinator competition and seed predation were examined, as well as the impact on flower and seed production of clipping surrounding vegetation and/or fertilizing with nitrogen (see Robson 2010a, 2010b, 2013).
- In 2006 and 2009, the Manitoba Conservation Data Centre prepared maps of road allowances highlighting the location of Western Silvery Aster for the Rural Municipalities of Franklin and Stuartburn in Manitoba to help mitigate threats associated with road maintenance activities and mowing (Foster and Reimer 2007, Friesen and Murray 2010).

Ontario

- Surveys for new populations have been conducted at Lake of the Woods and Rainy Lake by Ontario Natural Heritage Information Centre staff and Ontario Ministry of Natural Resources and Forestry (OMNRF) Kenora District staff.
- The Big Traverse Bay (Budreau's Beach) population in Ontario has been systematically surveyed in 2002, 2007 and 2012 (Oldham et al. 2003, Van den Broeck and Elliott 2007, Van den Broeck 2012). Stewardship actions by the landowner have increased the density and distribution of Western Silvery Aster at this location since 2002. OMNRF Fort Frances District staff have also been involved in surveys of this population.
- A provincial regulation was enacted under the Ontario ESA in February 2010 to protect the species and its habitat at Cliff Island and Big Traverse Bay (Budreau's Beach); The French Portage Narrows population does not currently receive habitat protection under the Ontario ESA, although its location within a Provincial Park affords some habitat protection.
- The French Portage Narrows population was discovered and surveyed in 2014 by OMNRF Kenora District staff.

6.2 Strategic Direction for Recovery

Table 3. Recovery Planning Table

Threat # or Limitation	Priority[a]	General Description of Research and Management Approaches
Broad Strategy: Habitat assessment, management and conservation		
All except 11.2 and 11.4	High	• Mitigate the impact of threats to populations and habitat by engaging landowners and land managers in voluntary stewardship agreements, conservation agreements, or fee-simple purchases, especially at high-risk or priority sites (populations identified in Appendix A with threats 3.2, 4.1, 9.3). The aim should be to develop and implement best management practices (BMPs). • Monitor and assess effectiveness of conservation agreements and stewardship arrangements in conserving habitat. • Develop BMPs and using adaptive habitat management, monitor the effectiveness of BMPs to improve habitat; amend BMPs as necessary. • Integrate habitat management with that for other species occurring in the same habitat and surrounding management area (Appendix C). • Through collaboration with other agencies and organizations, identify appropriate approaches (e.g. zoning, mitigation, etc) for the recovery of Western Silvery Aster in park, resource or land use management plans. • In cooperation with Provincial Governments, promote consistent enforcement or implementation of existing protection measures and regulations to ensure the conservation of habitat.
Broad Strategy: Communication, Collaboration and Engagement		
1.1, 1.3, 4.1, 4.2, 6.1, 7.1, 7.3, 8.1, 8.2, 9.3	Medium-High	• Develop (or expand upon existing) communication/outreach strategies for road crews, city and municipal planners, and land users, to minimize or eliminate habitat deterioration or destruction during road maintenance or construction activities. • Develop (or expand upon existing) communication/outreach strategies for land-users, stakeholders, and land managers to address threats such as off-road vehicle use, indiscriminate use of herbicides, introduction of invasive alien species, etc., and to change perceptions of management tools such as prescribed burns. • Develop communications strategy regarding the species and its habitat protection/management to target the general public, recreationalists, park staff, land use planners, and municipalities to address threats such as off-road ATV use, recreational activities, recreational areas, and cottage/residential developments.

Broad Strategy: Research as part of an adaptive management framework		
All threats, limiting factors/ knowledge gaps	High Medium	• Determine long-term impacts of threats and existing management practices on Western Silvery Aster populations and habitat quality. • Apply findings of research on threats and management practices to develop or refine population or location-specific BMPs for the species to reduce threats, improve habitat and sustain or increase populations. • Conduct research to develop an understanding of the species' ecology and habitat needs (e.g., seed bank dynamics, germination requirements, seed viability, seed dormancy, seed dispersal, pollen dispersal, recruitment). • Determine effect of population size and isolation on genetic diversity and population viability, including developing a seed gene bank if deemed necessary. • Determine genetic relationships between Canadian populations and nearby United States populations to determine feasibility of restoration efforts and transplanting, if necessary. • Develop method and conduct population viability analyses on known populations to assess population viability under current conditions.
Broad Strategy: Inventory and monitoring		
All threats Supports measuring of progress towards achieving the population and distribution objective	Medium High	• Use models (e.g., habitat suitability and/or species distribution models) to refine priority search areas for new populations and areas of suitable habitat in Manitoba and Ontario. • Using standardized survey techniques (e.g. Henderson 2010a), continue surveys to locate new populations. Continue to survey for presence of Western Silvery Aster at historical/possibly extirpated sites during good growing years if habitat still exists. • Using standardized monitoring techniques (e.g. Henderson 2010a), conduct / continue monitoring of extant populations, collecting information on threats, trends, and range of natural variation for population size and area of occupancy. • Coordinate survey and monitoring efforts through the provincial Conservation Data Centres.

[a] *"Priority" reflects the degree to which the broad strategy contributes directly to the recovery of the species or is an essential precursor to an approach that contributes to the recovery of the species.*

6.3 Narrative to Support the Recovery Planning Table

Due to the continued loss of habitat quality and quantity, and the limited number of populations, the most important recovery activity for Western Silvery Aster will be habitat conservation and stewardship through conservation agreements or stewardship arrangements. This will be particularly important for populations at immediate risk from threats like gravel extraction or road construction and maintenance. Implementation of best management practices for mowing, burning and grazing are also high priority activities to investigate because they may represent a threat if applied intensively or at inappropriate times in the life cycle of Western Silvery Aster, but may be useful management practices for maintaining habitat when applied appropriately. Research into habitat and species' needs may be required to refine management practices, and adaptive monitoring is warranted before and after implementation to determine the habitat and population response. Effective communication strategies will be necessary to reduce some threats and change perceptions about conservation and management approaches.

Research into aspects of Western Silvery Aster ecology such as seed bank dynamics, seed viability, seed germination requirements, seed dormancy, seedling survival, and seed dispersal, recruitment, generation time is a medium priority. This information is required to understand population demographics, reproductive ecology, dispersal and recruitment, and resiliency to various types of disturbance and will help inform best management practices and a better informed definition of critical habitat. Research on seed viability and germination requirements may already be available from native plant/seed suppliers in Manitoba and research on the pollination biology of Western Silvery Aster has already begun. Finally, research is needed to determine whether the small size and isolation of many local populations of Western Silvery Aster represents a threat to genetic diversity and/or population viability of the population as a whole. This type of information will help determine the feasibility of restoration efforts and when/if restoration efforts would be deemed necessary.

Education and communication efforts are needed to ensure that Western Silvery Aster populations on public lands are recognized during land use planning, recreation, and maintenance or construction activities. Raising awareness among key landowners, land managers and land users on private and public land will help to ensure that land management practices benefitting the species can be implemented.

Information on the impacts of human-related threats and habitat management techniques on the ecology and habitat needs of Western Silvery Aster is relevant to long-term conservation and management. More specifically, research and adaptive management are needed to evaluate the magnitude and direction of threats and mitigation effects on plant fitness, population size, and area of occupancy. Ex-situ or in-situ experimental and observational field investigations that could be undertaken include examining the effects, timing and intensity of grazing, fire, invasive species

control, brush control, mowing, and idled[9] habitats, or a combination thereof, on Western Silvery Aster survival and reproductive output and its habitat quality and availability.

Regular monitoring is needed to determine the natural range of variability, trends, and health of the populations (including seed production and recruitment). Baseline estimates of population size are available for most extant populations but repeated and consistent monitoring of population size and area of occupancy is lacking. Threats such as human disturbance, vegetation succession and invasion of exotic species should be incorporated into the monitoring protocol. Monitoring will also track whether the population and distribution objectives are being met at extant sites. To support population recovery and management, a population viability analysis is required to develop quantitative targets for the population objectives. Surveys of potential habitat are needed because there are still unsurveyed parcels of native prairie (e.g. Bur Oak savannah) where Western Silvery Aster may reside, particularly in the Lake of the Woods area in northwestern Ontario, and in larger pastures in Manitoba.

7. Critical Habitat

7.1 Identification of the Species' Critical Habitat

Critical habitat is defined in the *Species at Risk Act* (SARA) section 2(1) as "the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species". Section 41 (1)(c) of SARA requires that recovery strategies include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction.

Critical habitat for Western Silvery Aster is fully identified for all 23 known extant populations in Canada (20 in Manitoba and 3 in Ontario), to the extent possible, based on the best available information[10], and is sufficient to achieve the population and distribution objectives. Critical habitat identification is based on the best available information as reviewed and further developed by separate committees in each jurisdiction. Based on consensus expert opinion, different approaches for identifying critical habitat in each province have been developed. Additional critical habitat may be added in the future if new or additional information supports the inclusion of areas beyond those currently identified (e.g., new sites become colonized or existing sites expand into adjacent areas). The identification of critical habitat in each province is described in detail below.

[9] *Habitat where no active management is occurring.*

[10] *Western Silvery Aster occurrences known to Environment Canada as of September 2013 (for Manitoba populations) and January 2015 (for Ontario populations). Data was obtained from the Manitoba Conservation Data Center, the Ontario Conservation Data Center (Natural Heritage Information Center), and the Ontario Ministry of Natural Resources and Forestry.*

7.1.1 Critical Habitat Identification in Manitoba

The approach used for identifying critical habitat for Western Silvery Aster in Manitoba is based on a decision tree developed by the Recovery Team for Plants at Risk in the Prairie Provinces as guidance for identifying critical habitat for terrestrial and aquatic prairie plant species at risk (Appendix A in Environment Canada 2012). Since Western Silvery Aster occupies habitat that usually has distinct boundaries well-defined in space and time, and because it is a perennial, reliably present and easy to detect during the flowering period, critical habitat is identified as per the criteria for 3a of the decision tree (Appendix A in Environment Canada 2012). Critical habitat for Western Silvery Aster in Manitoba is identified as the extent of suitable habitat occupied by the species [11] and all natural biophysical attributes[12] within a 300 metre critical function zone extending from the outer boundary of the occupied suitable habitat. Existing human developments and infrastructure within the area identified as critical habitat are not considered to be critical habitat.

Although the exact extent of habitat needed to surround Western Silvery Aster plants to fulfill the reproductive, dispersal and long-term survival needs of the population is not fully known, the 300 metre critical function zone is based upon a detailed literature review that examined edge-effects of various land use activities that could affect resource availability and contribute to negative population growth for native prairie plants generally (Henderson 2010b; Appendix B in Environment Canada 2012). Based on a detailed literature review that examined factors affecting the quality of native prairie patches in the tall-grass prairie of Manitoba, and the pollination biology of Western Silvery Aster, the 300 metre critical function zone is appropriately applied to critical habitat identification of Western Silvery Aster in Manitoba (Environment Canada 2015 unpublished review). This approach is consistent with the critical habitat identification for a number of other prairie plant species that occupy similar type habitats (e.g. Tiny Cryptantha *Cryptantha minima*, Slender Mouse-ear-cress *Halimolobos virgate*, Western Spiderwort *Tradescantia occidentalis*, Rough Agalinis *Agalinis aspera*). Thus, to ensure the long-term persistence, and where feasible, the natural expansion, of Western Silvery Aster in Manitoba, the 300 metre critical function zone is thought to be the minimum distance needed to maintain the habitat required to meet the population and distribution objectives. As new information on species' habitat requirements and site-specific characteristics become available, this distance may be refined.

[11] *Suitable habitat patches were delineated ex-situ using the best available satellite imagery (World View 01 and World View 02 imagery (0.5m) at 1:500 map scale, SPOT5 Panchromatic imagery (2.5m) at 1:2500 map scale, and IKONOS and NAIP imagery (1.0m) at 1:1000 map scale) following concepts of object-based segmentation (Jobin et al. 2008). Suitable habitat patches were identified based on vegetation community type using colour and texture. For a description of suitable habitat refer to Section 3.3 of this document.*

[12] *Biophysical attributes include, but are not limited to, soils and bedrock geology, surface and sub-surface hydrology, vegetation and vegetation community composition, and landforms. Rivers, lakes, and wetlands are exempt from this definition and are therefore not considered critical habitat.*

7.1.2 Critical Habitat Identification in Ontario

In Ontario, the biophysical attributes of suitable habitat for Western Silvery Aster are best described using the Forest Ecosystem Classification for Northwestern Ontario (FEC) (Sims et al. 1997). The FEC framework provides a standardized approach to the interpretation and delineation of dynamic ecosystem boundaries. This system classifies habitats not only by vegetation community; it also considers soils and moisture, and as such encompasses the biophysical attributes of habitat for Western Silvery Aster in Ontario (Table 4). Within the FEC system in Ontario, the vegetation type containing Western Silvery Aster has been described as Upland Bur Oak (V3.3 vegetation type). The Upland Bur Oak vegetation type is generally described as having stunted, often widely spaced trees on savannah-like sites that have a warmer than average microclimate (Sims et al. 1997). The understory is described as being high in species diversity with both an abundance of graminoid (grasses) species and few shrubs or abundant with shrubs (Sims et al. 1997).

Table 4. Biophysical attributes of suitable Western Silvery Aster habitat in Ontario (Sims et al. 1997, COSEWIC 2000).

Biophysical Attributes	Ontario
Soils and bedrock geology	south facing, mafic (basic) bedrock slopes with shallow, discontinuous Gray Luvisolic clay soils
Surface and sub-surface hydrology	dry to fresh moisture regime with rapid drainage
Vegetation and vegetation community composition	grassy savannah-like openings in Upland Bur Oak vegetation communities with a warmer than average microclimate
Landforms	landforms such as rocky outcrops and cliff sides

Within the FEC system, the ecosite boundary best captures the extent of biophysical attributes required by this species. The Upland Bur Oak vegetation type includes the areas occupied by Western Silvery Aster and the surrounding areas that provide suitable habitat conditions (e.g., open, well drained) to carry out essential life processes for the species and should allow for natural processes related to population dynamics and reproduction (e.g., dispersal and pollination) to occur. The habitat patch surrounding the plant may also promote ecosystem resilience to invasive species while protecting what are rare vegetation communities (oak savannahs) in Ontario. Western Silvery Aster may also be able to colonize areas following disturbance (e.g., areas of ingrown savannah).

Critical habitat for Western Silvery Aster in Ontario is identified as the extent of suitable habitat occupied by the species[13]. In addition, a critical function zone of 50 metres (radial distance around each plant) is applied when the biophysical attributes around a plant extend for less than 50 metres. This approach is consistent with critical habitat identification for other plant species in Ontario (e.g., Dense Blazing Star *Liatris spicata* and Colicroot *Aletris farinosa*) that occupy similar type habitats.

The 50 metre radial distance used is considered a minimum 'critical function zone', or the threshold habitat fragment size required for maintaining constituent microhabitat properties for a species (e.g., essential light, moisture, humidity levels necessary for survival) where it occurs. At present, it is not clear at what exact distances physical and/or biological processes begin to negatively affect Western Silvery Aster and this distance is likely to depend on local habitat characteristics. Studies on micro-environmental gradients at habitat edges (light, temperature, litter, moisture) (Matlack 1993), and of edge effects on plants in mixed hardwood forests, as evidenced by changes in plant community structure and composition (Fraver 1994), have shown that edge effects could be detected up to 50 metres into habitat fragments, although other studies show that the magnitude and distance of edge effects will vary depending on the structure and composition of adjacent habitat types (Harper et al. 2005). Research is required to more specifically address the edge effects to savannah ecosystems in Canada. A 50 metre radial distance from any Western Silvery Aster plant is chosen as a precautionary approach to ensure that microhabitat properties are maintained as part of the identification of critical habitat. The area within the 50 metre critical function zone may include both suitable and unsuitable habitat as Western Silvery Aster may be found near the transition zone between suitable and unsuitable habitat (e.g., along woodland edges). As new information on species' habitat requirements and site-specific characteristics become available, distances may be refined.

Critical habitat is fully identified for all 23 extant populations of Western Silvery Aster in Canada (Table A1), totaling up to 2,826 hectares (28.26 km²) in Manitoba and 14 hectares (0.14 km²) in Ontario. In Manitoba, approximately 124 quarter sections contain critical habitat for the Western Silvery Aster. The general geographic areas containing critical habitat are presented in Appendix B using a standardized 1 x 1 km UTM grid square system (Table B1). In Manitoba, critical habitat is the extent of suitable habitat occupied by the species and all natural biophysical attributes[11] that occur within the discrete boundaries represented by the shaded yellow polygons (Appendix B, Figures B1 to B6). In Ontario, critical habitat is the extent of suitable habitat occupied by the species, plus a 50 metre critical function zone around the plants where they occur near the edge of suitable habitat (Appendix B, Figure B7). Due to provincial data sharing agreements in Ontario, critical habitat in Ontario is only presented using the 1 x 1 km UTM grid squares to indicate the general geographic areas containing

[13] *Suitable habitat is considered the Upland Bur Oak (v3.3 vegetation type) vegetation type and was delineated and identified based on biophysical attributes of vegetation community type, soils, and moisture by the FEC framework for Northwestern Ontario.*

critical habitat. More detailed information on critical habitat may be requested on a need to know basis by contacting Environment Canada – Canadian Wildlife Service at ec.planificationduretablissement-recoveryplanning.ec@canada.ca.

7.2 Activities Likely to Result in the Destruction of Critical Habitat

Destruction is determined on a case by case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time. Activities described in Table 5 outline examples of activities likely to cause destruction of critical habitat for Western Silvery Aster; however, destructive activities are not limited to those listed.

Some activities that result in a temporary alteration of critical habitat (e.g., cattle grazing, brush cutting and prescribed burns) may have the potential to contribute to the future quality of critical habitat, given proper management. Some disturbance to Western Silvery Aster habitat may be beneficial to the species by maintaining open habitat and managing invasive species or woody vegetation growth within a given site. Appendix D describes some management practices that may be beneficial to the Western Silvery Aster.

Table 5. Activities Likely to Result in the Destruction of Critical Habitat

Description of activity	**Description of effect (on biophysical attribute or other) in relation to function loss of critical habitat**	**Additional information**
Compression or erosion of soils, which can be caused by activities such as: creation of trails and roads; motorized traffic; or concentration of livestock activity by the placement of bales, or establishment of new corrals or watering sites	Compression and erosion can damage soil structure and porosity, reduce water availability by increasing runoff and decreasing infiltration, prevent establishment of seedlings, or increase the likelihood of invasive alien plants by disturbing native ground cover.	This activity must occur within the bounds of critical habitat to cause its destruction, may result in destruction either directly or cumulatively, and is applicable at all times of the year, with the exception of winter months when the ground is snow covered and frozen solid (soil temperature below -10^{0}C).
Covering of soils, which can be caused by activities such as: creation or expansion of permanent/ temporary structures such as land conversion to residential/cottage developments; spreading of solid waste materials; or roadbed construction	Covering the soil prevents solar radiation and water infiltration needed for germination and survival of plants, such that critical habitat is destroyed.	This activity must occur within the bounds of critical habitat to cause its destruction, is a direct effect, and is applicable at all times of the year.

Description of activity	Description of effect (on biophysical attribute or other) in relation to function loss of critical habitat	Additional information
Inversion/excavation/extraction of soils, which can be caused by activities such as: new or expanded cultivation; sand and gravel extraction pits; mineral exploration; dugouts; certain road construction and maintenance activities; residential/cottage development; pipeline installation; or removal of topsoil	Inverting, excavating or extracting soil results in the direct loss of critical habitat by removing or disturbing the substrate within which the plant grows, and altering the biophysical conditions (e.g. soil porosity, soil temperature, soil moisture) required for germination, establishment and growth of the Western Silvery Aster. This activity can also lead to vegetation community change to one dominated by competitive invasive species.	This activity must occur within the bounds of critical habitat to cause its destruction, may result in destruction either directly or cumulatively, and is applicable at all times of the year.
Alteration to hydrological regimes, which can be caused by activities such as: temporary or permanent inundation from construction of impoundments downslope or downstream; releases of water upslope and upstream, including but not limited to damming, ditching, drainage, culvert installation, road widening or straightening; or residential/cottage developments that affect the hydrology of critical habitat	As the seed bank and plants of Western Silvery Aster are adapted to well-drained soils, flooding or inundation by substances like water, even for a short period of time, can be sufficient to alter habitat enough to be unsuitable for survival and re-establishment. Altering hydrology can also result in too dry conditions, mimicking drought. For example, road construction can interrupt or alter overland water flow, altering habitat conditions and threatening the long-term survival of the species at a particular location. An increase in moisture may also lead to increased encroachment by woody vegetation and some invasive plant species.	This activity may result in destruction of critical habitat whether it occurs within or outside the bounds of critical habitat, may result in destruction either directly or cumulatively, and is applicable at all times of the year.
Indiscriminate application of fertilizers or pesticides, which can be caused by activities such as: non-selective spraying of broad-leaf herbicide and insecticide; or arbitrary additions of fertilizers to soil	Herbicide and fertilizer can alter soil or water nutrient status, creating conditions suitable for some plant species and unsuitable for others, such that species composition in the surrounding plant community can change. Changes to soil or water nutrient status will also influence the outcome of interspecific competition for nutrients. Pesticide runoff and drift can alter plant and pollinator communities, thereby possibly reducing the capability of the habitat to support Western Silvery Aster.	This activity may result in destruction of critical habitat whether it occurs within or outside the bounds of critical habitat (e.g. chemical drift, groundwater or overland flow of contaminated water), may result in destruction either directly or cumulatively, and is applicable at all times of the year.

Description of activity	Description of effect (on biophysical attribute or other) in relation to function loss of critical habitat	Additional information
Spreading of wastes or release of deleterious materials, which can be caused by activities such as: spreading or release of materials such as manure and septic fluids	These substances have the potential to change soil nutrient status and availability of these nutrients for uptake by plants, species composition, and increase surrounding competitor plants, effectively destroying the critical habitat. These liquid or semi-liquid materials can infiltrate the surface in the short-term, but leave little long-term evidence at the surface that could point to the cause of negative changes observed thereafter.	This activity may result in destruction of critical habitat whether it occurs within or outside the bounds of critical habitat (e.g. drift, groundwater or overland flow of contaminants), can be a direct or cumulative effect, and is applicable at all times of the year.
Deliberate introduction or promotion of invasive alien plant species, which can be caused by activities such as: intentional dumping or spreading of feed bales containing viable seed of invasive alien species; seeding invasive alien species within critical habitat; use of motorized vehicles contaminated with invasive species material transporting invasive species; or planting of woody vegetation (shrubs and trees)	Once established, invasive alien plant species and woody vegetation can alter hydrology, soil nutrient and moisture availability, and create shade, resulting in direct competition with Western Silvery Aster, such that population declines occur, effectively destroying the critical habitat. Critical habitat may be destroyed by invasive alien species mentioned in Section 4.2, as well as by other noxious prohibited weeds and aggressive opportunistic species. It may also be destroyed by the following species which are not restricted by any legislation due to their economic value: Smooth or Awnless Brome, Kentucky Bluegrass, Crested Wheatgrass (*Agropyron cristatum*), Yellow Sweet Clover (*Melilotus officinalis*), White Sweet Clover (*Melilotus alba*).	This activity can occur within or adjacent to the bounds of critical habitat to cause its destruction, can be a direct or a cumulative effect, and is applicable at all times of the year.

8. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives. Beginning in 2020 and every five years thereafter, success of recovery strategy implementation will be measured against the following performance indicators:

- All 23 extant populations have been maintained, at a minimum, at their current estimated population size and distribution, and any newly discovered or reconfirmed populations are maintained

- Habitat quality and quantity have been maintained at a level that supports Western Silvery Aster populations

9. Statement on Action Plans

One or more action plans will be completed for Western Silvery Aster by 2022.

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Appendix A: Summary of Western Silvery Aster Populations in Canada

Table A1. Summary of Western Silvery Aster Populations in Canada[14]. Grey shading indicates that the population is extirpated or historic.

Population Name [EO_ID][15]	First Observed	Last Observed	Recent Survey Estimate [Year]	Highest Estimate [Year]	Threats
Manitoba					
East Hazelglen [78]	2000	2013	>1265 Plants [2013]	>1265 Plants [2013], >20000 Stems [2005]	1.1, 2.1 (historic), 3.2, 4.1, 7.3, 8.1, 8.2, 9.3
East Hazelglen [4501]	1999	2013	>50 Plants [2013]	150 Plants [2005]	2.1 (historic), 3.2, 7.3, 8.1, 9.3
Carlowrie [165][16]	1905	2008	>544 Stems [2008]	800 Stems [1998], >106 Plants [2004]	2.3, 3.2, 4.1, 7.3, 8.1, 8.2
Carlowrie [3917][17]	1953	2008	>105 Plants and >2303 Stems [2008]	>900 Plants [2004], >105 Plants and >2303 Stems [2008]	2.1, 2.3, 3.2, 4.1, 4.2, 7.3, 8.1, 8.2, 9.3
Carlowrie [4894]	2007	2007	50 Plants [2007]	50 Plants [2007]	1.3, 4.1, 7.3
N Gardenton [744]	2001	2008	150 Stems [2008]	150 Stems [2008], 103 Plants [2001]	3.2, 4.1, 7.3
N Gardenton [984]	2001	2006	30 Plants [2006]	1000 Plants [2003]	3.2, 8.1

[14] *Values and populations in the table are those known to Environment Canada as of September 2013 (for Manitoba populations) and January 2015 (for Ontario populations), and were obtained from the Manitoba Conservation Data Center, the Ontario Conservation Data Center (Natural Heritage Information Center), and the Ontario Ministry of Natural Resources and Forestry.*
[15] *Populations are defined as an element occurrence (EO) based on the Natureserve (2015a) habitat-based plant delimitation guidance.*
[16] *There is a historic occurrence within this population.*
[17] *There are some historic and inaccurate occurrences within this population.*

N Gardenton [4893][18]	2006	2008	40 Stems [2008]	40 Stems [2008], 7 Plants [2006]	4.1, 7.3
W Gardenton [1270]	1998	2006	>1000 Plants [2006]	>1000 Plants [2006]	3.2, 4.1, 7.3
W Gardenton [3242]	1998	2008	100 Stems [2008]	>200 Plants [2006]	2.3, 3.2, 4.1, 7.3, 8.1, 8.2, 9.3
E Gardenton [5210]	2008	2010	>350 Stems [2010]	>350 Stems [2010]	4.1, 7.3,
Grunthal [1502]	1998	2001	50 Stems [2001]	50 Stems [2001]	3.2, 4.1, 7.3
Bird's Hill [2189]	1996	2009	>100 Stems [2009]	>1000 Stems [1998], 500 Plants [1996]	4.1, 7.3
Bird's Hill [2793][19]	1996	2013	>89 Plants [2013]	>2300 Stems [1998], >330 Plants [2010]	1.1, 1.3, 3.2, 4.1, 4.2, 6.1, 7.3, 8.1, 8.2, 7.3, 9.3
Bird's Hill [3755][15]	1970	2012	12 Plants [2012]	200 Plants [1996], >2040 Stems [1998]	3.2, 6.1, 7.3, 8.1, 8.2
N Pansy [3578]	1998	2001	3 Plants [2001]	6 Plants [1998]	3.2, 4.1, 7.3, 8.1, 9.3
Richer [4895]	2006	2013	>357 Plants and >325 Stems [2013]	>600 Plants and >584 Stems [2006]	1.1, 4.1, 6.1, 7.3, 8.1, 9.3
Woodmore [5188]	2008	2008	Unknown	Unknown	none recorded

[18] *There is an inaccurate occurrence within this population.*
[19] *There are some inaccurate and extirpated occurrences within this population.*

Woodmore [5189]	2008	2008	Unknown	Unknown	2.1, 4.1, 7.3
Woodmore [7576]	2009	2009	Unknown	Unknown	2.1, 4.1, 7.3
Bird's Hill [5619][20]	1918	1919	Unknown	Unknown	1.1
Bird's Hill/ Pine Ridge [5620][19]	1953	1953	Unknown	Unknown	1.1
Stony Mountain [2117][19]	1939	1939	0 [1998]	Unknown	1.1, 3.2
St. James Prairie [630][19]	1970	1970	0 [2001]	Unknown	1.1
Ontario					
French Portage Narrows	2014	2014	~127 stems [2014]	~127 stems [2014]	6.1, 7.1, 8.2, 11.4
Cliff Island	2003	2014	Partial survey (4 patches (100 stems)) [2014]	1000 plants [2003]	6.1, 7.1, 8.2, 11.4
Big Traverse Bay (Budreau's Beach)	1981	2012	2200-2799 plants [2012]	2200-2799 plants [2012]	1.1, 4.1, 6.1, 8.1
Ingolf[19]	1939		0 [2001]	Unknown	
Rainy Lake[21]	1827		0 [2003]	Unknown	

[20] *This population is considered extirpated.*
[21] *This population is considered historic.*

Appendix B: Critical Habitat for Western Silvery Aster in Canada

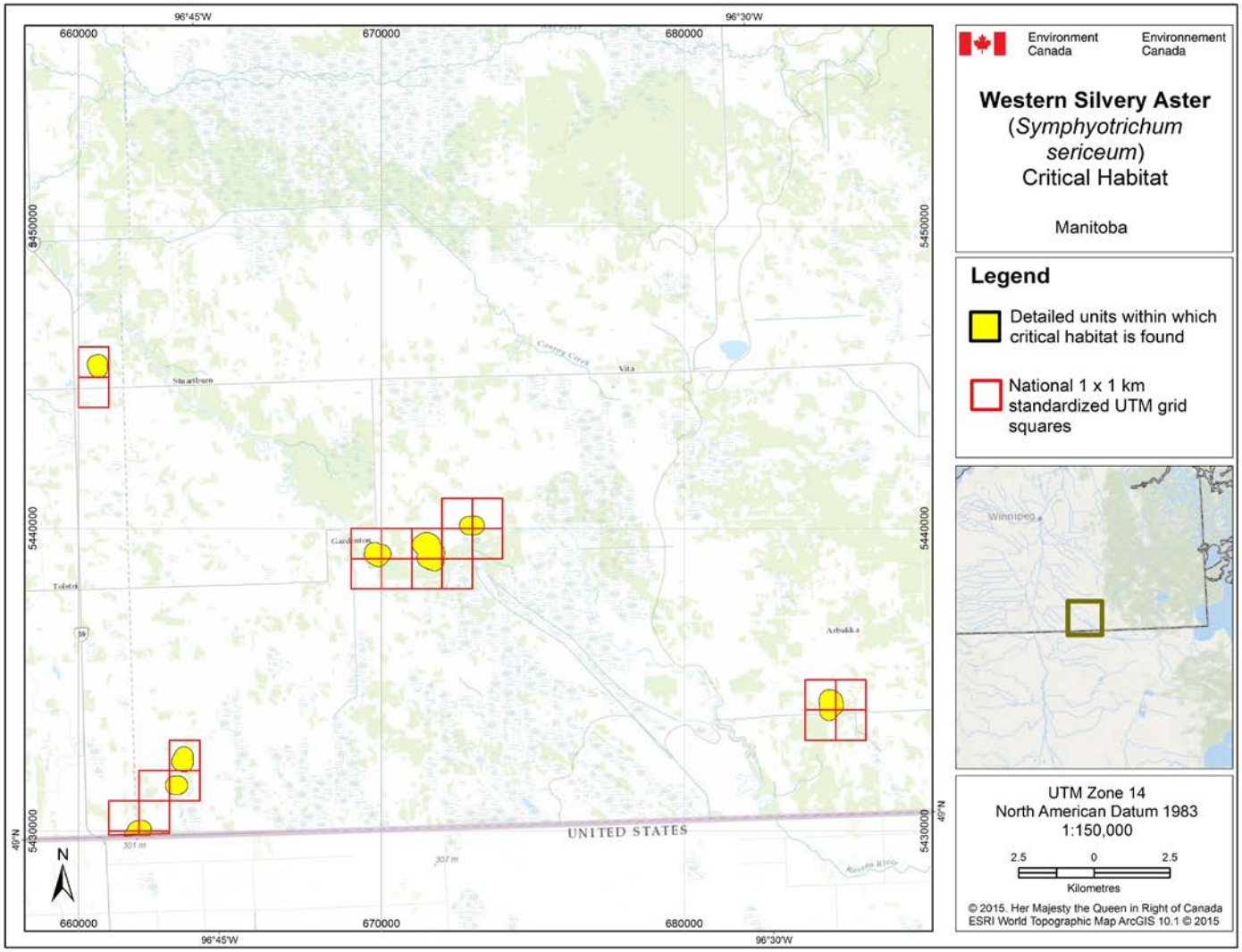

Figure B1. Critical habitat for Western Silvery Aster in Manitoba (E Gardenton [5210], N Gardenton [4893], N Gardenton [744], N Gardenton [984], W Gardenton [3242], W Gardenton [1270], and Woodmore [5188] populations as described in Table A1) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat. Areas outside of the yellow shaded units do not contain critical habitat.

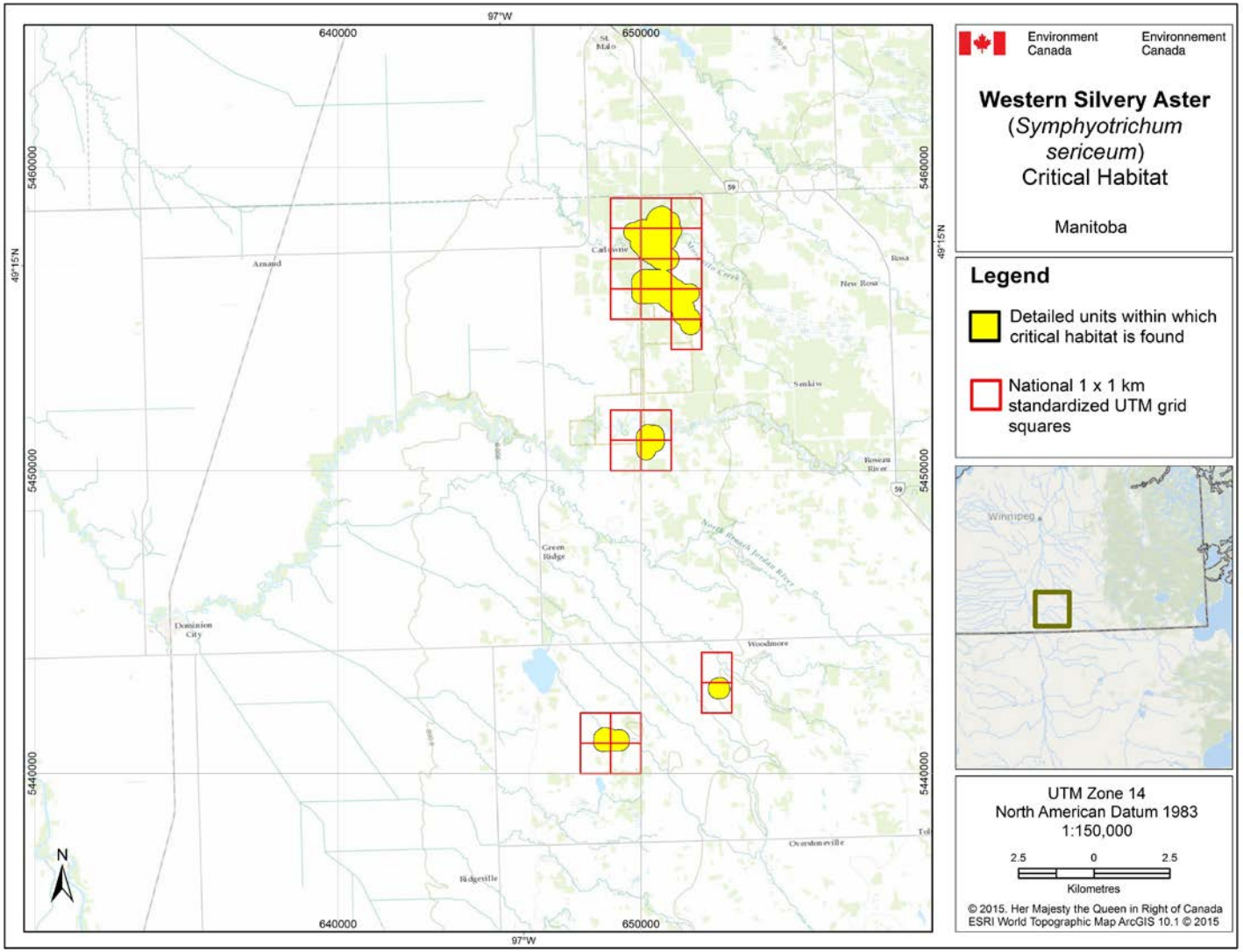

Figure B2. Critical habitat for Western Silvery Aster in Manitoba (Woodmore [5189], Woodmore [7576], Carlowrie [3917], and Carlowrie [165] populations as described in Table A1) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat. Areas outside of the yellow shaded units do not contain critical habitat.

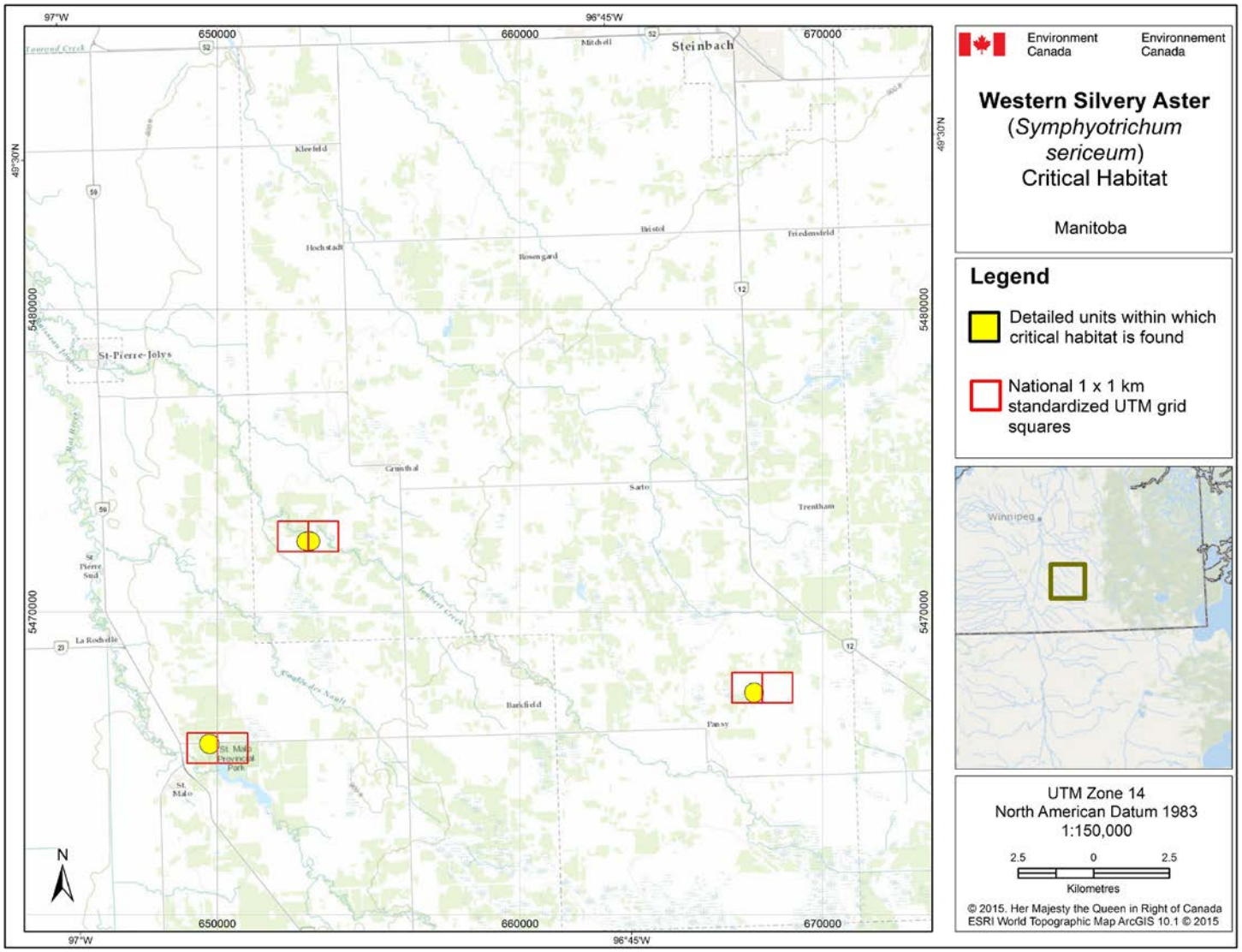

Figure B3. Critical habitat for Western Silvery Aster in Manitoba (Carlowrie [4894], Grunthal [1502], and N Pansy [3578] populations as described in Table A1) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat. Areas outside of the yellow shaded units do not contain critical habitat.

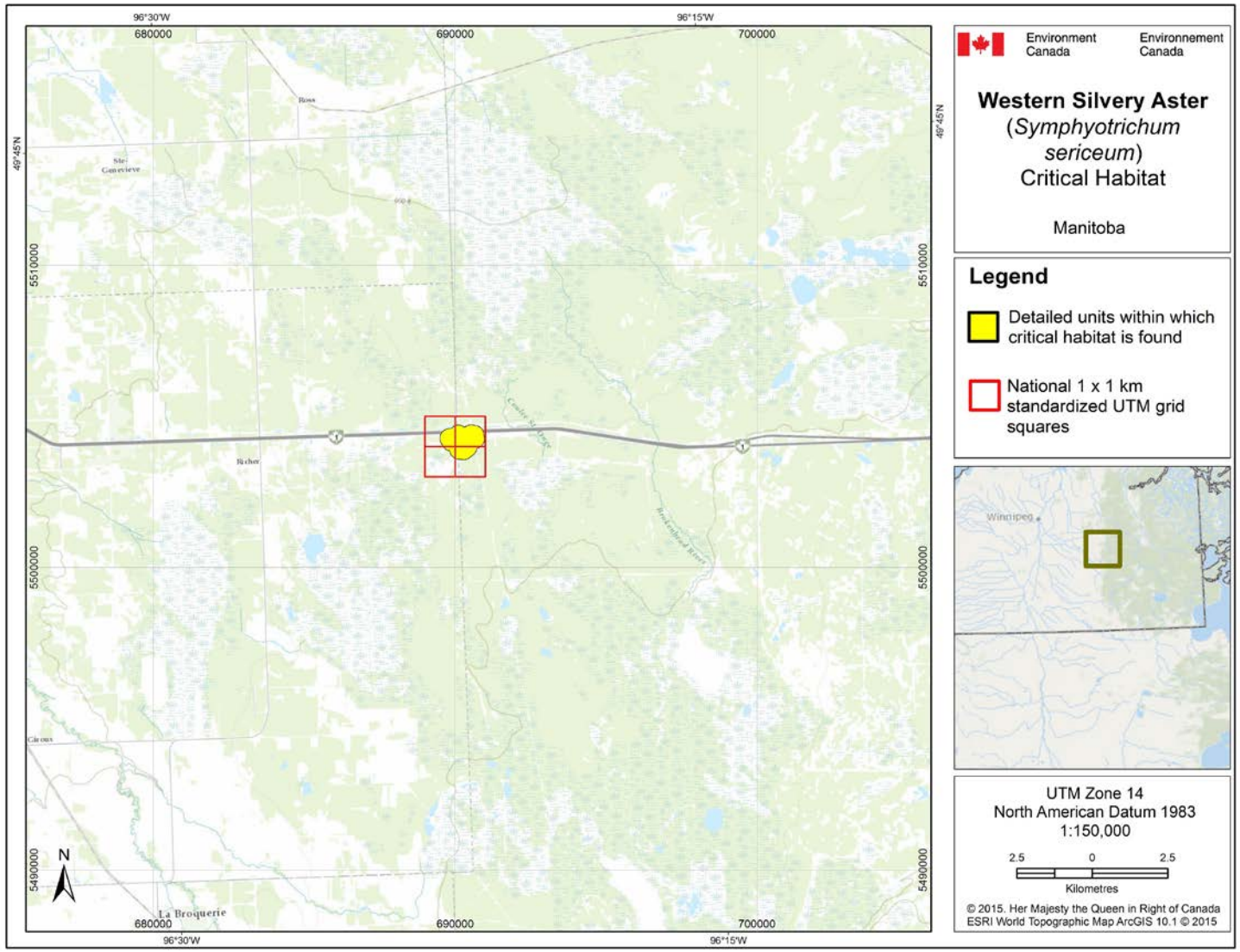

Figure B4. Critical habitat for Western Silvery Aster in Manitoba (Richer [4895] population as described in Table A1) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat. Areas outside of the yellow shaded units do not contain critical habitat.

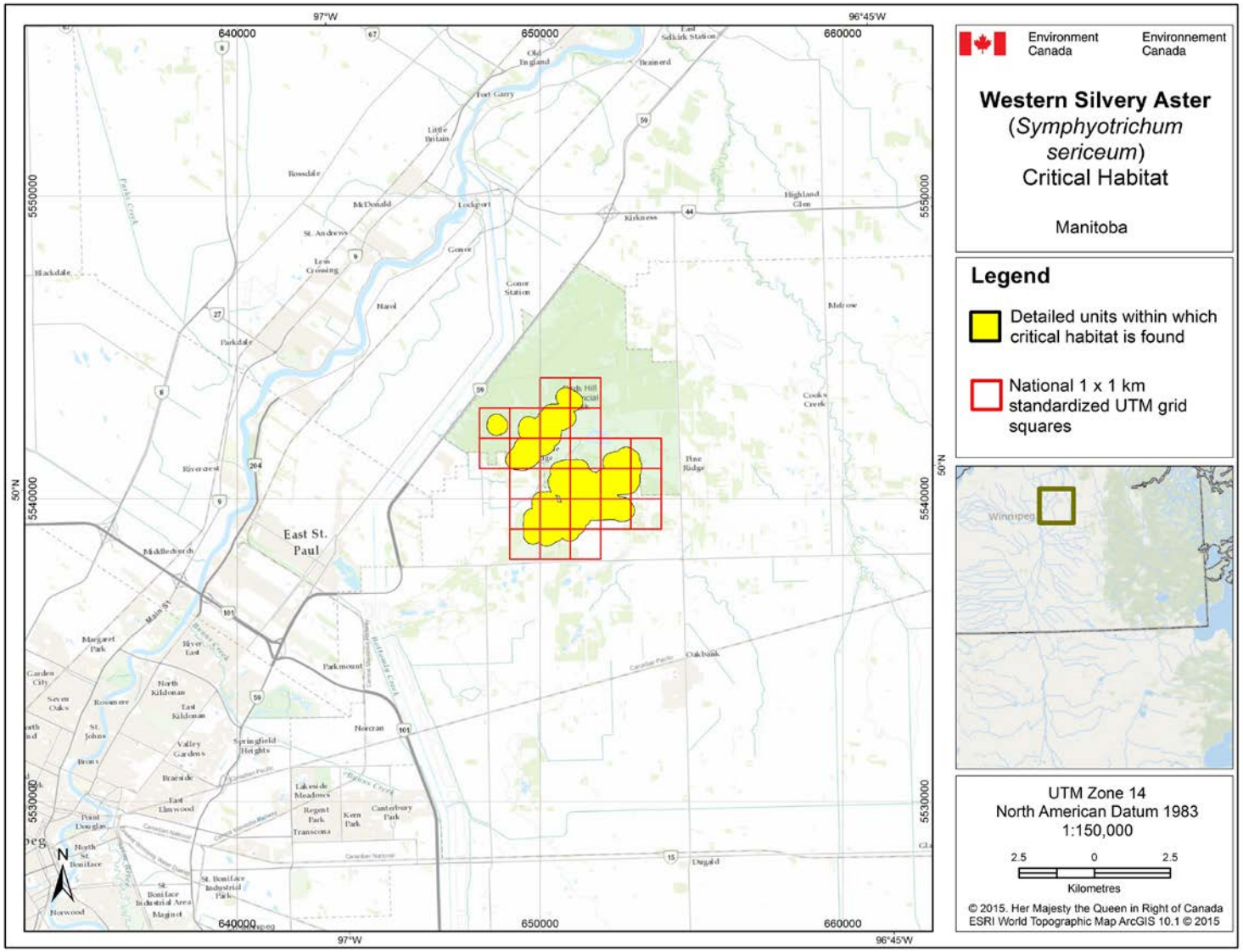

Figure B5. Critical habitat for Western Silvery Aster in Manitoba (Bird's Hill [2189], Bird's Hill [2793], and Bird's Hill [3755] populations as described in Table A1) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat. Areas outside of the yellow shaded units do not contain critical habitat.

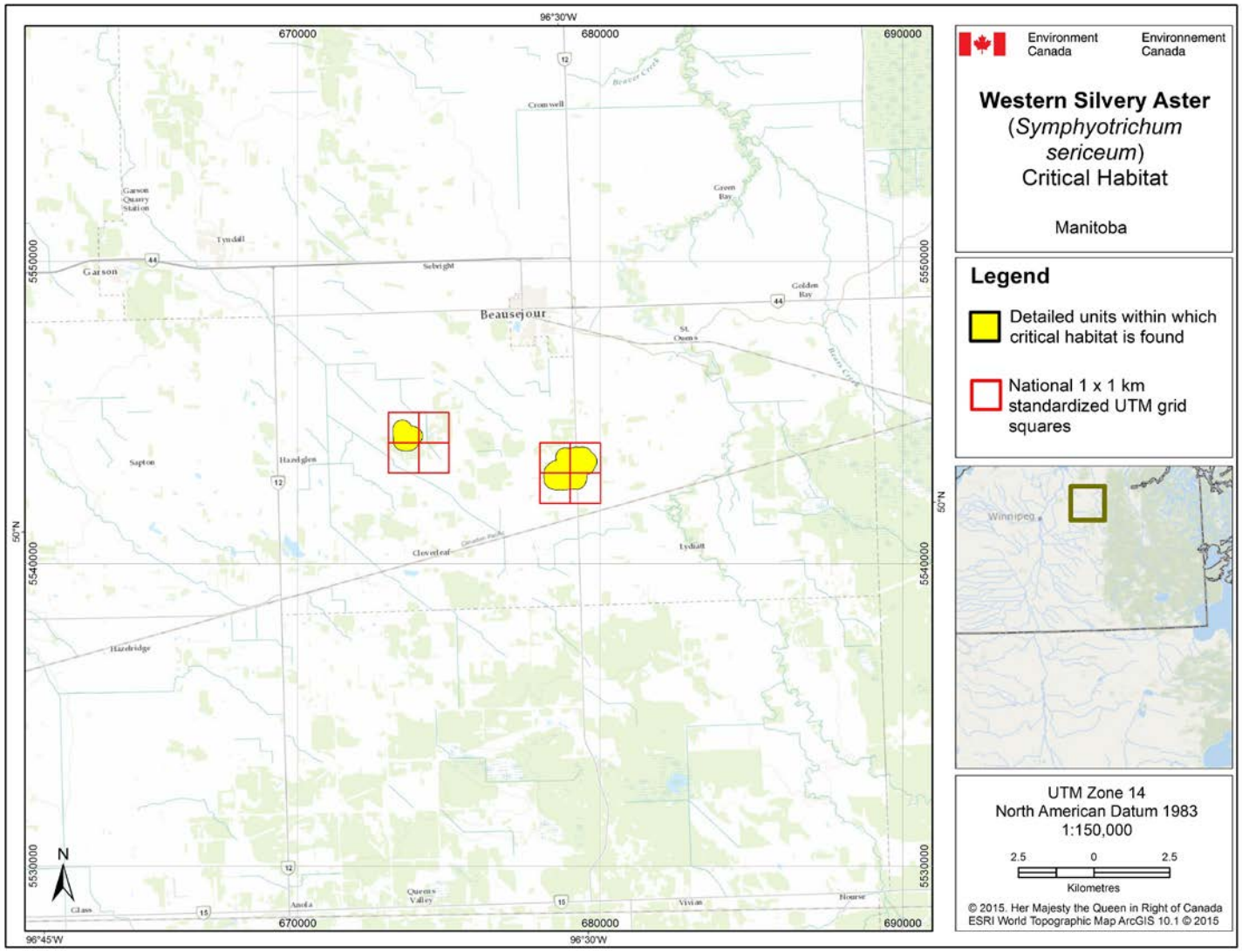

Figure B6. Critical habitat for Western Silvery Aster in Manitoba (East Hazelglen [4501] and East Hazelglen [78] populations as described in Table A1) is represented by the yellow shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat. Areas outside of the yellow shaded units do not contain critical habitat.

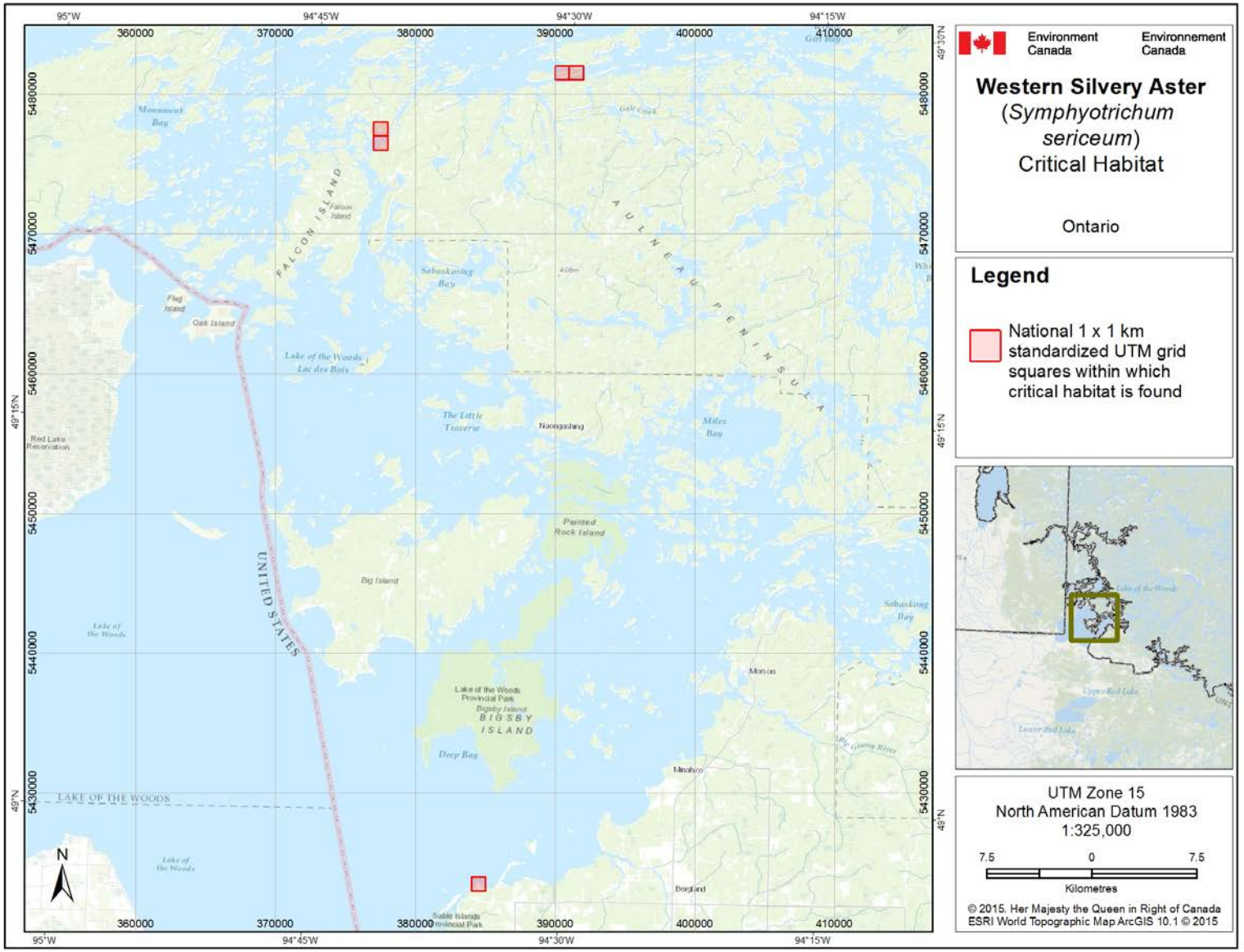

Figure B7. Critical habitat for Western Silvery Aster in Ontario (French Portage Narrows, Cliff Island, and Big Traverse Bay (Budreau's Beach) populations as described in Table A1) is represented by the red shaded units, where the criteria set out in Section 7.1 are met. The 1 km x 1 km UTM grid overlay shown on this figure is a standardized national grid system that indicates the general geographic area containing critical habitat.

Table B1. Grid squares that contain critical habitat for the Western Silvery Aster in Canada. Critical habitat for the Western Silvery Aster occurs within these 1 x 1 km standardized UTM grid squares where the description of critical habitat in Section 7.1 is met.

Population Name [EO_ID]	1 x1 km Standardized UTM grid square ID[1]	Province/ Territory	UTM Grid Square Coordinates[2]		Critical Habitat Unit Area (ha)[3]
			Easting	Northing	
Bird's Hill [2189] [2793] [3755]	14UPA5318	Manitoba	651000	5538000	1149
	14UPA5308	Manitoba	650000	5538000	
	14UPA4398	Manitoba	649000	5538000	
	14UPA5339	Manitoba	653000	5539000	
	14UPA5329	Manitoba	652000	5539000	
	14UPA5319	Manitoba	651000	5539000	
	14UPA5309	Manitoba	650000	5539000	
	14UPA4399	Manitoba	649000	5539000	
	14UPA5430	Manitoba	653000	5540000	
	14UPA5420	Manitoba	652000	5540000	
	14UPA5410	Manitoba	651000	5540000	
	14UPA5400	Manitoba	650000	5540000	
	14UPA4490	Manitoba	649000	5540000	
	14UPA5431	Manitoba	653000	5541000	
	14UPA5421	Manitoba	652000	5541000	
	14UPA5411	Manitoba	651000	5541000	
	14UPA5401	Manitoba	650000	5541000	
	14UPA4491	Manitoba	649000	5541000	
	14UPA4481	Manitoba	648000	5541000	
	14UPA5412	Manitoba	651000	5542000	
	14UPA5402	Manitoba	650000	5542000	
	14UPA4492	Manitoba	649000	5542000	
	14UPA4482	Manitoba	648000	5542000	
	14UPA5413	Manitoba	651000	5543000	
	14UPA5403	Manitoba	650000	5543000	
East Hazelglen [78] [4501]	14UPA7492	Manitoba	679000	5542000	264
	14UPA7482	Manitoba	678000	5542000	
	14UPA7493	Manitoba	679000	5543000	
	14UPA7483	Manitoba	678000	5543000	
	14UPA7443	Manitoba	674000	5543000	
	14UPA7433	Manitoba	673000	5543000	
	14UPA7444	Manitoba	674000	5544000	
	14UPA7434	Manitoba	673000	5544000	
Richer [4895]	14UPA9003	Manitoba	690000	5503000	126
	14UPA8093	Manitoba	689000	5503000	
	14UPA9004	Manitoba	690000	5504000	

	14UPA8094	Manitoba	689000	5504000	
N Pansy [3578]	14UPV6687	Manitoba	668000	5467000	31
	14UPV6677	Manitoba	667000	5467000	
Grunthal [1502]	14UPV5732	Manitoba	653000	5472000	38
	14UPV5722	Manitoba	652000	5472000	
Carlowrie [165] [3917] [4894]	14UPV5605	Manitoba	650000	5465000	677
	14UPV4695	Manitoba	649000	5465000	
	14UPV5514	Manitoba	651000	5454000	
	14UPV5515	Manitoba	651000	5455000	
	14UPV5505	Manitoba	650000	5455000	
	14UPV4595	Manitoba	649000	5455000	
	14UPV5516	Manitoba	651000	5456000	
	14UPV5506	Manitoba	650000	5456000	
	14UPV4596	Manitoba	649000	5456000	
	14UPV5517	Manitoba	651000	5457000	
	14UPV5507	Manitoba	650000	5457000	
	14UPV4597	Manitoba	649000	5457000	
	14UPV5518	Manitoba	651000	5458000	
	14UPV5508	Manitoba	650000	5458000	
	14UPV4598	Manitoba	649000	5458000	
	14UPV5500	Manitoba	650000	5450000	
	14UPV4590	Manitoba	649000	5450000	
	14UPV5501	Manitoba	650000	5451000	
	14UPV4591	Manitoba	649000	5451000	
Woodmore [5188] [5189] [7576]	14UPV4490	Manitoba	649000	5440000	160
	14UPV4480	Manitoba	648000	5440000	
	14UPV4491	Manitoba	649000	5441000	
	14UPV4481	Manitoba	648000	5441000	
	14UPV5422	Manitoba	652000	5442000	
	14UPV5423	Manitoba	652000	5443000	
	14UPV6404	Manitoba	660000	5444000	
	14UPV6405	Manitoba	660000	5445000	
E Gardenton [5210]	14UPV8353	Manitoba	685000	5433000	65
	14UPV8343	Manitoba	684000	5433000	
	14UPV8354	Manitoba	685000	5434000	
	14UPV8344	Manitoba	684000	5434000	
N Gardenton [744] [984] [4893]	14UPV7328	Manitoba	672000	5438000	196
	14UPV7318	Manitoba	671000	5438000	
	14UPV7308	Manitoba	670000	5438000	
	14UPV6398	Manitoba	669000	5438000	
	14UPV7339	Manitoba	673000	5439000	
	14UPV7329	Manitoba	672000	5439000	

	14UPV7319	Manitoba	671000	5439000	
	14UPV7309	Manitoba	670000	5439000	
	14UPV6399	Manitoba	669000	5439000	
	14UPV7430	Manitoba	673000	5440000	
	14UPV7420	Manitoba	672000	5440000	
W Gardenton [1270] [3242]	14UPV6320	Manitoba	662000	5430000	120
	14UPV6310	Manitoba	661000	5430000	
	14UPV6331	Manitoba	663000	5431000	
	14UPV6321	Manitoba	662000	5431000	
	14UPV6332	Manitoba	663000	5432000	
	14UPV6219	Manitoba	661000	5429000	
	14UPV6229	Manitoba	662000	5429000	
Cliff Island	15UUQ9811	Ontario	391000	5481000	9
	15UUQ9801	Ontario	390000	5481000	
French Portage Narrows	15UUQ7777	Ontario	377000	5477000	3
	15UUQ7776	Ontario	377000	5476000	
Big Traverse Bay (Budreau's Beach)	15UUQ8243	Ontario	384000	5423000	2

[1]Based on the standard UTM Military Grid Reference System (see http://www.nrcan.gc.ca/earth-sciences/geography-boundary/mapping/topographic-mapping/10098), where the first 2 digits and letter refer to the UTM zone, the following 2 letters indicate the 100 x 100 km Standardized UTM grid followed by 2 digits to represent the 10 x 10 km Standardized UTM grid. The last 2 digits represent the 1 x 1 km Standardized UTM grid containing all or a portion of the critical habitat unit. This unique alphanumeric code is based on the methodology produced from the Breeding Bird Atlases of Canada (See http://www.bsc-eoc.org/ for more information on breeding bird atlases).

[2]The listed coordinates are a cartographic representation of where critical habitat can be found, presented as the southwest corner of the 1 x 1 km Standardized UTM grid square containing all or a portion of the critical habitat unit. The coordinates are provided as a general location only in NAD 1983 UTM.

[3]The area presented is that of the unit(s) containing critical habitat (rounded to the nearest 1ha); therefore, the actual area of critical habitat may be significantly less. Refer to Section 7.1 for a description of how critical habitat within these areas is defined.

Appendix C: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*[22]. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[23] (FSDS) goals and targets.

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

Many federal species at risk are found in habitat occupied by Western Silvery Aster (Table C1), as well as provincially rare species. Most, if not all, of these species will benefit from recovery activities and management of threats intended to maintain habitat for the benefit of Western Silvery Aster.

The potential for the recovery strategy to inadvertently lead to adverse effects on other species was considered. Broad approaches to recovery for the Western Silvery Aster include habitat protection, stewardship, and habitat management activities (such as prescribed burns, invasive species control, and brush removal). These activities are aimed at maintaining or improving provincially rare habitats such as tall-grass prairie fragments and Bur Oak savannah. For the most part, managing for healthy native ecosystems will benefit non-target species, natural communities, or ecological processes. As a general rule, management actions that incorporate or mimic natural disturbance regimes (e.g., fire and grazing) are natural components of prairie ecosystems and are not likely to negatively impact the persistence of other native species particularly if the timing, intensity and frequency mimic those natural processes (Samson and Knopf 1994). However, some management practices, including prescribed burns, mowing or grazing, and some forms of integrated weed management, have the potential to affect other species negatively in the short or long-term. Dakota Skipper (*Hesperia dacotae*), Western Silvery Aster and Rough Agalinis (*Agalinis aspera*), for example, can be negatively affected by mowing if done in late summer/fall whereas Small White Lady's-slipper (*Cypripedium candidum*) can be harmed if the area is mowed in spring/early summer (Environment Canada 2014a, MB Conservation unpublished management summaries). Therefore, it is important that management

[22] http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[23] http://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=A22718BA-1

actions resulting from recovery strategies, action plans and beneficial management plans are developed from an ecosystem perspective (including development of multi-species action plans and ecosystem beneficial management plans), incorporating as many species needs as possible, and evaluating the ecological risks of any action, in order to reduce any possible negative effects to other species. An ongoing monitoring program should also be in place to evaluate short and long term effects of management actions on the ecosystem and individual species at risk. Efforts should be coordinated with recovery teams and organizations working in the tall-grass prairie ecosystem to ensure the most efficient use of resources and to prevent duplication of effort or conflicts with research.

The SEA concluded that this strategy will not entail significant adverse effects. For further details see the following sections: 3.3 Needs of the Western Silvery Aster, 4. Threats, and 6. Broad strategies and general approaches to meet objectives.

Table C1. Federal species at risk that co-occur, or may co-occur, in areas occupied by Western Silvery Aster

Common Name	Scientific name	SARA designation	Province
Rough Agalinis	*Agalinis aspera*	END	MB
Gattinger's Agalinis	*Agalinis gattingeri*	END	MB
Small White Lady's Slipper	*Cypripedum candidum*	END	MB
Western Prairie Fringed Orchid	*Platanthera praeclara*	END	MB
Riddell's Goldenrod	*Oligoneuron riddellii*	SC	MB
Dakota Skipper	*Hesperia dacotae*	END	SK, MB
Poweshiek Skipperling	*Oarisma poweshiek*	THR	MB
Monarch	*Danaus plexippus*	SC	BC, AB, SK, MB, ON, QC, NB, PEI, NS
Yellow Rail	*Coturnicops noveboracensis*	SC	NWT, BC, AB, SK, MB, QC, NB

Appendix D: Some Potentially Beneficial Management Practices

Western Silvery Aster occupies habitat varying in ecology, land use history, and land tenure, as well as occupying habitat containing other species at risk (Appendix C). For these reasons, it is difficult to propose a general beneficial management plan that would be appropriate to encompass all habitat and needs. Instead, specific recommendations will be made in one or more action plans or beneficial management plans at scales appropriate for the habitat, land use, suite of species, and application. Any management undertaken will require baseline data on habitat and species at risk populations, followed up by regular monitoring so that adaptive management practices can occur and knowledge gaps on impacts of threats and management practices can be answered. At this time only a few general statements can be made regarding on-going activities that should benefit Western Silvery Aster.

Careful and deliberate application of grazing by one or more classes of livestock may help maintain open and slightly disturbed prairie habitat needed by Western Silvery Aster. Management of these livestock requires occasional and randomly dispersed overland access on-foot, on-horseback, by all-terrain vehicle[24], or on existing trails by vehicles up to 1 tonne. In light of these facts, no changes are recommended at this time to current stocking rates, grazing seasons, classes of livestock, or access methods used by ranchers with Western Silvery Aster on their land. Research is needed to determine ideal stocking rates, and if alternative grazing systems could enhance habitat, reproductive output, or dispersal of Western Silvery Aster. In habitat where grazing is not feasible (e.g. roadsides), occasional mowing and subsequent removal of thatch during times of the year appropriate to the life cycle of Western Silvery Aster may be beneficial in maintaining open habitat and managing invasive species or woody vegetation growth; monitoring of the populations will be needed to determine how this management action is affecting the reproduction and survival of Western Silver Aster. Timing of mowing will need to consider not only the life cycle of Western Silvery Aster but other species at risk co-occurring in these habitats (Appendix C).

Integrated weed management to control invasive alien species and management to control encroachment of woody vegetation could directly reduce competition with Western Silvery Aster. Approaches used to reduce the occurrence and density of invasive alien species or woody vegetation in Western Silvery Aster habitat need to be dealt with on a site-specific basis through consultation with experts or in one or more action plans; monitoring of the population response to any management action is necessary.

Fires resulting from accidental or deliberate ignition by people will not destroy Western Silvery Aster habitat nor harm individual plants under most circumstances. In fact,

[24] *This applies to the management practices in rangelands only and does not include recreational use of all-terrain vehicles in other areas.*

prescribed burns that are carefully managed and that mimic the timing, frequency and intensity of natural processes may improve habitat by reducing or preventing invasion of woody vegetation, invasive alien species, grass litter, insect pests and pathogens. Co-occurring species that may be negatively affected by prescribed burning should be considered (Appendix C).

Environment Canada will work with all of its partners to define and improve best practices for conserving the Western Silvery Aster across its range and to incorporate multi-species requirements and management practices.