

Recovery Strategy for the Dense Blazing Star (*Liatriis spicata*) in Canada

Dense Blazing Star



2014

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For copies of the recovery strategy, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk (SAR) Public Registry (www.sararegistry.gc.ca).

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PREFACE

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) 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.

The Minister of the Environment is the competent minister for the recovery of the Dense Blazing Star and has prepared this strategy, as per section 37 of SARA. It has been prepared in cooperation with the Province of Ontario.

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 Dense Blazing Star 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.

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EXECUTIVE SUMMARY

Dense Blazing Star (*Liatris spicata*) is an herbaceous perennial reaching up to 2 m in height with a dense, showy spike of purple (occasionally white) flowers. Flowering occurs from mid-July to mid-September. Cultivated strains of the species have been bred for use in the floral trade and as ornamentals in gardens.

There are at least 10 extant native populations of Dense Blazing Star in Canada, comprised of over 70 000 plants in total, and a number of additional populations have been planted from native seed stock. All populations are in southwestern Ontario. At least 13 additional populations are considered historical or are presumed to be extirpated. There are also at least seven populations that have originated from human-influenced dispersal mechanisms and/or that are of introduced origin in Ontario and Quebec. Introduced populations cannot be considered for recovery if the seed source is unknown because, without genetic analysis, it is unknown whether the individuals carry the native genotype adapted to Ontario habitats or if they carry traits that could weaken the survival of the species in Canada. The species is listed as Threatened on Schedule 1 of the federal *Species at Risk Act* (SARA). It is also listed as Threatened in Ontario under the *Endangered Species Act, 2007* (ESA, 2007).

Loss of habitat due to development and agriculture and a decline in habitat quality resulting from fire suppression and alteration of the hydrologic regime are primary threats to Dense Blazing Star. Other threats include invasive plants, fenced exclosures, herbicide use, maintenance activities (mowing and vegetation clearing), picking, trampling, off-road vehicle use, and hybridization with other species of Blazing Star. Given that the species is found at the northern edge of its range and has a naturally limited distribution in Canada, it will likely always be vulnerable to human-induced and natural stressors.

There are unknowns regarding the feasibility of recovery of Dense Blazing Star. In keeping with the precautionary principle, this recovery strategy has been prepared as per section 41(1) of SARA, as would be done when recovery is determined to be feasible. The population and distribution objective is to maintain, or to increase to the extent that it is biologically and technically feasible, the current overall abundance of Dense Blazing Star (of native genotype) in Canada across at least 10 populations within its native range. Broad strategies to be taken to address the threats to the survival and recovery of Dense Blazing Star are presented in the section on Strategic Direction for Recovery (Section 6.2).

Critical habitat for Dense Blazing Star is partially identified in this recovery strategy, based on the best available data. Critical habitat for Dense Blazing Star is located entirely on non-federal land. As more information becomes available, additional critical habitat may be identified and may be described within an area-based, multi-species at risk action plan developed in collaboration with the Walpole Island First Nation.

One or more such action plans for Dense Blazing Star will be posted on the Species at Risk Public Registry by December 2021.

RECOVERY FEASIBILITY SUMMARY

Based on the following four criteria outlined in the draft SARA policies (Government of Canada 2009), there are unknowns regarding the feasibility of recovery of the Dense Blazing Star. In keeping with the precautionary principle, this recovery strategy has been prepared as per section 41(1) of SARA, as would be done when recovery is determined to be feasible. This recovery strategy addresses the uncertainties surrounding the feasibility of recovery.

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 at least 10 extant native populations of Dense Blazing Star in Canada, comprised of over 70 000 plants in total, and a number of additional populations have been planted from native seed stock. As well, native sourced seed is available for restoration from several growers, and the species appears capable of establishment and reproduction.

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

Unknown. While Dense Blazing Star can sometimes become established in meadows, interdunal areas, roadside ditches, utility corridors, railways, and other habitats with periodic disturbance, it primarily inhabits tallgrass prairie, which is extremely limited within the Canadian range of this species. Restoration of historical tallgrass prairie sites may be possible, or it may be feasible to establish the species in suitable habitat in proximity to historical tallgrass prairie sites; however, it is unclear whether sufficient tallgrass prairie habitat is or can be made available to support recovery of Dense Blazing Star in Canada.

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

Unknown. The primary threats to this species include land development (residential, commercial, and agricultural), alteration of the fire and hydrologic regimes, and invasive plants. Outreach and stewardship activities may help to avoid or mitigate threats such as land development and alteration of the hydrologic regime on private or corporate land. Management actions may also help to mitigate the threat of habitat succession due to fire suppression. Some populations have a controlled burning regime in place, but this is not yet set up for all populations and assessing the feasibility of using controlled burns is proposed as a recovery approach. It is unknown if other significant threats such as invasive species can be mitigated to the extent required to ensure the long-term persistence of the species in Canada.

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

Yes. Dense Blazing Star can be direct-seeded successfully, either into cultivated ground or established turf. It may also be possible to undertake vegetative propagation from bulblets formed at the base of the stems and from stem cuttings (Waldron pers. comm. 2010). The species

responds favorably to prescribed burns, with the peak in flowering occurring in the first or second year following a burn.

In Canada, Dense Blazing Star occurs at the northern edge of its North American range; the species has likely always been rare in Ontario. Due to Dense Blazing Star's naturally limited distribution in Canada, it will likely always be vulnerable to human-induced and natural stressors.

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1. COSEWIC* SPECIES ASSESSMENT INFORMATION

Date of Assessment: April 2010

Common Name (population): Dense Blazing Star

Scientific Name: *Liatris spicata*

COSEWIC Status: Threatened

Reason for Designation:

This showy perennial herb is restricted in Canada to a few remnant tallgrass prairie habitats in southwestern Ontario. A variety of threats, including lack of consistent application of fire to control the spread of woody species, spread of invasive plants, loss of habitat to agriculture and development and various management practices, including mowing, have placed the species at continued risk.

Canadian Occurrence: Ontario

COSEWIC Status History: Designated Special Concern in April 1988. Status re-examined and designated Threatened in May 2001. Status re-examined and confirmed in April 2010.

* COSEWIC – Committee on the Status of Endangered Wildlife in Canada

2. SPECIES STATUS INFORMATION

Globally, Dense Blazing Star (*Liatris spicata*) is regarded as Secure¹ (G5) (NatureServe 2011). In the United States it is ranked nationally as Apparently Secure² (N4). It is ranked Presumed Extirpated³ (SX) in District of Columbia and Missouri; Critically Imperilled⁴ (S1) in Delaware and Maryland; Vulnerable⁵ (S3) in Wisconsin, West Virginia, and North Carolina (S3?); and Apparently Secure, Secure, or Unranked⁶ (S4, S5, SNR) in 19 additional states (Appendix B).

In Canada, Dense Blazing Star is ranked Imperilled⁷ both nationally (N2) and provincially in Ontario (S2). The species is not listed in Quebec where it is considered adventive⁸ or introduced and a rank is not applicable⁹ (SNA). Dense Blazing Star is listed as Threatened¹⁰ on Schedule 1

¹ common, widespread and abundant

² uncommon, but not rare; some cause for concern due to declines or other factors

³ species or community is believed to be extirpated from the jurisdiction

⁴ extremely rare (often 5 or fewer occurrences) or especially vulnerable to extirpation from the jurisdiction because of some factor(s) such as very steep declines

⁵ restricted range, relatively few populations, recent and widespread declines, or other factors make it vulnerable to extirpation

⁶ national or subnational conservation status not yet assessed

⁷ rare due to very restricted range, very few populations, steep declines, or other factors making it very vulnerable to extirpation from the jurisdiction

⁸ a species not native to and not fully established in a new habitat or environment

⁹ the species or ecosystem is not a suitable target for conservation activities

¹⁰ a wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction

of the federal *Species at Risk Act* (SARA). It is also listed as Threatened¹¹ under Ontario's *Endangered Species Act, 2007* (ESA, 2007).

The percentage of the global range found in Canada is estimated to be less than 1% (NatureServe 2011). The distribution of Dense Blazing Star is very restricted in Canada, where it occurs at the northern edge of its North American range.

3. SPECIES INFORMATION

3.1 Species Description

Dense Blazing Star is an herbaceous perennial reaching up to 2 m in height with a dense spike of compound heads of 4 to 18 purple (occasionally white) flowers. The species blooms from mid-July to mid-September. The stems¹² emerge singly or in clusters from a woody bulb-like structure. The leaves are spirally arranged. The lower leaves are 10 to 40 cm long and 0.5 to 2.0 cm wide, and they become smaller toward the flower spike. The fruit is brown or black, somewhat cylindrical, ribbed, 4 to 6 mm long with barbed bristles at the summit (Cronquist 1991). Native Canadian plants are of the variety *spicata*. Another variety, *resinosa*, occurs in the southeastern United States (NatureServe 2011). Cultivated strains have been bred for use in the floral trade and as ornamentals in gardens.

3.2 Populations and Distribution

Globally, Dense Blazing Star is restricted to eastern North America. In the United States, its range extends from Massachusetts to Florida, west to Wisconsin and Louisiana (Figure 1). The Canadian range of Dense Blazing Star (extant native populations) is shown in Figure 2.

COSEWIC (2010) documented 10 extant native populations of Dense Blazing Star in Canada (Table 1), all in southwestern Ontario. Together, they consist of upwards of 140 000 flowering stems (or roughly 70 000 plants). Most plants (>80% of the individuals in the Canadian population) have been found on Walpole Island First Nation (WIFN), where abundance was estimated at >120 000 flowering stems in 2008 (COSEWIC 2010). Four of the populations consisted of fewer than 10 flowering stems in 2008 and are probably not viable in the long-term (COSEWIC 2010). Thirteen additional populations are now presumed or known to be extirpated (Appendix C). Additional plants have been reported at a non-historical site in 2011 that have not been confirmed to be native (Haggeman pers. comm. 2011). The Canadian Index of Area of Occupancy (IAO)¹³ was estimated to be 172 km² in 2008 calculated on the basis of extant native populations only (COSEWIC 2010).

¹¹ a species that lives in the wild in Ontario and is likely to become endangered if steps are not taken to address factors threatening to lead to its extinction or extirpation

¹² A stem is the flower supporting stalk of a plant. A plant may have one or more stems.

¹³ Index of Area of Occupancy is calculated to be the number of occupied squares x area of an individual square. 2x2 km grid squares were used



Figure 1. North American Distribution of Dense Blazing Star (range distribution based on Royal Ontario Museum (2011), and subnational (state or province) status ranks based on NatureServe (2011)).

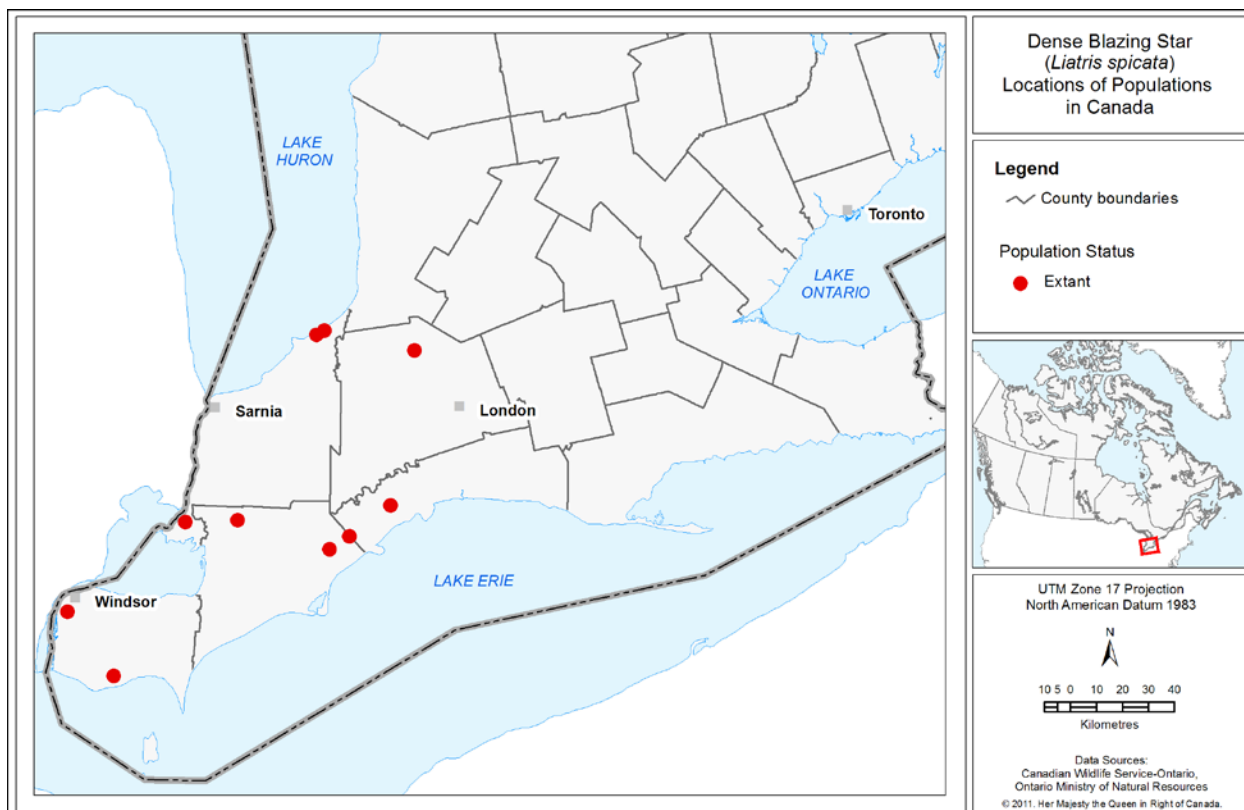


Figure 2. The Canadian range of Dense Blazing Star showing known extant native populations only. For a full list of populations, including those that are introduced or of unknown origin or status, see Table 1. For a list of extirpated and historic populations, see Appendix C.

In addition to native populations, there are several populations of Dense Blazing Star that may have originated from human-influenced dispersal mechanisms and/or that were introduced outside the species' native range in Canada. Some of these populations may have resulted from seeds that dispersed along railway tracks, and some populations may have been intentionally planted. In Ontario, populations at East Point Conservation Area (Scarborough), Kingston, and in the Kenora District west of Dryden (Harris pers. comm. 2010), may have originated from garden escapes or garden refuse, as may also be the case at Oka, Quebec. The actual seed source of these populations is unknown, so without genetic analysis it is impossible to say whether these individuals carry the native genotype adapted to natural Ontario habitats or whether they could be a source of unsuitable traits that could weaken the survival of the species in Canada (see Section 4. Threats). Without genetic information, these populations cannot be considered targets for recovery.

The origin and status of the population located at Bronte Creek Provincial Park (Halton Region) are unknown. There are no historical botanical records for the population, but the population was found in natural prairie habitat and is considered native by the Natural Heritage Information Centre (NHIC) (Oldham pers. comm. 2007 cited in COSEWIC 2010). It consisted of a single plant in 1998, and while it was not searched in 2008 its persistence is doubtful (COSEWIC 2010).

Restoration of several historical locations of tallgrass habitat is being undertaken by the Rural Lambton Stewardship Network (RLSN). Up until 2008, many seed mixes included Dense Blazing Star from a known native seed source, and the restorations can therefore be considered to contribute to the recovery of the species. As of 2008, native-sourced Dense Blazing Star had been planted at more than 105 sites¹⁴ in Lambton County (Ludolph pers. comm. 2010). Data from all the sites have not been compiled, and although observations at some sites indicate that Dense Blazing Star has successfully established (Lozon 2012), monitoring is needed to determine the extent to which the species has become established and how many separate populations have resulted; therefore, populations are not listed individually in Table 1. Within the Ojibway Prairie Complex and surrounding areas the portions of several subpopulations that were formerly located in the federal Plaza site, part of the Detroit International Crossing (DRIC), and in the corridor being developed for the Right Honourable Herb Gray Parkway (HGP) were removed and transplanted to restoration sites under *SARA* and *ESA 2007* permits respectively. Plants removed from the Plaza site were transplanted to the St. Clair National Wildlife Area, and plants removed from the HGP corridor were transplanted to restoration sites adjacent to the parkway. During implementation of mitigation measures for the HGP actual stem abundance was found to be higher than previous estimates and mitigation required under *ESA 2007* and *SARA* permits for both the HGP and the federal Plaza site required additional plants be propagated and planted at their respective restoration sites. With this in mind, the abundance information in Table 1 is quickly dated and subject to change and the restoration sites will require further surveys once the transplanted plants have had time to establish.

Table 1. List of Dense Blazing Star populations in Canada.

Canadian Populations	County or Regional Municipality	Last Observed	Abundance ¹ at last observation	Status ²	Notes
EXTANT NATIVE POPULATIONS					
1. Port Franks ANSI ³	Lambton	2008	54 stems	Extant	
2. Walpole Island First Nation	Lambton	2008	>120 000 stems	Extant	
3. Pinery Provincial Park	Lambton	2011	~2 100 stems (in 2008)	Extant	
4. Dutton Prairie	Elgin	2008	~400 stems	Extant	
5. Ojibway Prairie Complex and surrounding areas ⁴	Essex	2010	14 000 to 20 000 stems in >13 subpopulations	Extant	
6. Cedar Creek	Essex	2008	67 stems	Extant	
7. Tupperville	Chatham-Kent	2008	1 stem	Extant	Presumed native; Along a railway
8. Highgate	Chatham-Kent	2008	6 stems	Extant	Presumed native; Along a railway
9. Murkirk northeast of Highgate	Chatham-Kent	2008	3 stems	Extant	Presumed native; Along a railway
10. Lucan	Middlesex	2008	6 stems	Extant	Presumed native, although thought by some to be introduced;

¹⁴ A site in this document refers to a location supporting Dense Blazing Star and either a part or whole population.

Canadian Populations	County or Regional Municipality	Last Observed	Abundance ¹ at last observation	Status ²	Notes
					Along a railway
PLANTED POPULATIONS AT RESTORATION SITES (native seed source)					
Rural Lambton Stewardship Network restoration sites	Lambton	2010	More than 105 sites	To be confirmed	Known native seed source
INTRODUCED POPULATIONS AND POPULATIONS OF UNKNOWN ORIGIN OR STATUS					
Edwards Lake, Ontario	Kenora District	2003	20 stems	Extant	Derived from garden escapes but occurs in natural habitat
Westhill	York Region	2001	"thriving"	Presumed extant	"Introduced outside natural range" (COSEWIC 2010).
Oka, Quebec	Deux-Montagnes	Unknown	No information	Presumed extant	Listed as SNA (introduced) (NatureServe 2010)
Fort Erie	Niagara Region	2000	~200 plants	Unknown	May be an introduced population; Along a railway
Cofel Line Prairie	Chatham-Kent	2000	1 plant	Unknown	Not seen in 2008 but some areas not searched; Along a railway
Bronte Creek Provincial Park	Halton Region	1998	1 plant; 5 rosettes ⁵	Unknown	Origin unknown (possibly adventive) but occurs in prairie habitat; Not searched in 2008
Highland Hotel, Kingston	Frontenac County	1976	No information	Unknown	Introduced population derived from garden escapes
East Point Park, Scarborough	Toronto Metropolitan	Unknown	No information	Unknown	May be an introduced population; Along a railway

Sources: (Allen 2001; COSEWIC 2010; Ludolph pers. comm. 2010; NatureServe 2010; NHIC 2011).

¹Abundance information is reported using either the number of individuals (number of plants) or the stem count, depending on the source of the data. Both measures are not available for all sites.

² Subject to change

³ Area of Natural and Scientific Interest

⁴ Portions of several subpopulations were on the federal Plaza site and within the Endangered Species Act, 2007 permit boundary for the HGP and transplanted to restoration sites. Estimated abundance and extent of occurrence may be subject to change.

⁵ A rosette consists of leaflets with no flowering stalk

3.3 Needs of the Dense Blazing Star

In Canada, Dense Blazing Star primarily inhabits tallgrass prairie, although some plants occur in wetlands, meadows, thickets, interdunal areas, roadside ditches, and along utility corridors and railways (COSEWIC 2010). It occurs on moist to wet sandy soil with neutral to basic pH. Unlike the other two native *Liatris* species (*L. aspera* and *L. cylindracea*), Dense Blazing Star rarely grows in dry conditions (Voss 1996). The species may also be found in the openings of savannas

or open woodlands dominated by oaks (*Quercus palustris*, *Q. macrocarpa*, *Q. bicolor*, *Q. rubra*, and *Q. alba*) and hickories (*Carya ovata*, *C. glabra* and *C. laciniosa*). In its greater global range, Dense Blazing Star has been known to inhabit fields, road banks, fencerows, lakesides, wet to moist prairies and meadows, bogs, seepages, dunes, limestone and granite outcrops, sandy clays, sandy loams, moist woods, oak, oak-pine, and sweetgum flats, and tamarack swamps (Nesom 2006).

Dense Blazing Star is intolerant of shading and cannot compete with dense growths of other forbs or with woody species. It is dependent on disturbance to maintain the open habitat. The number of flowering stems can vary from year to year, sometimes in response to fire. When the habitat becomes too shady, the stems may become spindly and crooked, and the plants eventually may not flower at all, but may persist (above ground) in a non-flowering/vegetative state for quite some time until the light conditions become more favourable. In the Windsor area, when shrubby thickets have been opened up, flowering stems have re-appeared (Woodliffe pers. comm. 2010).

In areas that are burned, the peak number of flowering stems generally occurs in the first or second year following a burn. After a few years, if the vegetation or thatch gets too thick, flowering may diminish until after the next burn. It has been suggested that burning every 3 to 4 years would be ideal, but that if the prairie becomes very overgrown, more frequent fires may be needed to return the prairie to conditions optimal for Dense Blazing Star (Woodliffe pers. comm. 2010). High numbers of plants are found in areas that have been burned (i.e., Windsor, Ojibway Prairie, and Walpole Island First Nation) (Allen 1988). However, some other areas that remain open due to human disturbance also provide suitable habitat.

The existence of populations that were introduced far outside the range of tallgrass prairie, such as the Oka, Quebec population (Table 1), shows the species is able to tolerate a range of climatic conditions. Bees, butterflies and beetles are known to pollinate the flowers. The plants are self-compatible but self-pollination rarely takes place. The seeds are wind-dispersed (Molano-Flores 2002).

4. THREATS

4.1 Threat Assessment

Table 2. Threat Assessment Table.

Threat	Level of Concern ¹	Extent	Occurrence	Frequency	Severity ²	Causal Certainty ³
Habitat Loss or Degradation⁴						
Residential, commercial, and industrial development	High	Widespread	Historical / Anticipated	Recurrent	High	High

Agricultural development	High	Localized	Historical / Current	Recurrent	High	High
Shoreline erosion	Medium	Localized	Current	Recurrent	Medium	Medium
Changes in Ecological Dynamics or Natural Processes						
Alteration of the fire regime	High	Widespread	Current	Continuous	High	Medium
Alteration of the hydrologic regime	High	Localized	Current	Continuous	High	Medium
Exotic, Invasive, or Introduced Species/Genome						
Invasive plants	High	Widespread	Current	Continuous	High	High
Fenced exclosures	Medium	Localized	Current	Continuous	Medium	High
Hybridization and genetic erosion ¹⁵	Medium	Widespread	Current	Continuous	Medium	Medium
Accidental Mortality						
Herbicide use	Medium	Localized	Historical / Anticipated	Recurrent	Unknown	Medium
Maintenance activities (Mowing and vegetation clearing)	Medium	Localized	Current	Continuous	Medium	Medium
Disturbance or Harm						
Off-road vehicle use and other recreational activities	Medium	Widespread	Current	Unknown	Medium	Medium
Trampling and picking	Medium	Localized	Current	Recurrent	Medium	High

Sources: (COSEWIC (2010), Woodliffe (pers. comm. 2010); Pratt (pers. comm. 2010); Jacobs (pers. comm. 2010), and direct observations by members of the Tallgrass Communities of Southern Ontario Recovery Team).

¹ *Level of Concern: signifies that managing the threat is of (high, medium or low) concern for the recovery of the species, consistent with the population and distribution objectives. This criterion considers the assessment of all the information in the table).*

² *Severity: reflects the population-level effect (High: very large population-level effect, Moderate, Low, Unknown).*

³ *Causal certainty: reflects the degree of evidence that is known for the threat (High: available evidence strongly links the threat to stresses on population viability; Medium: there is a correlation between the threat and population viability e.g. expert opinion; Low: the threat is assumed or plausible).*

⁴ *Threat categories are listed in order of decreasing significance.*

¹⁵ a process whereby an already limited gene pool of an endangered species diminishes even more when individuals from the surviving population die off without getting a chance to reproduce

4.2 Description of Threats

Residential, Commercial, and Industrial Development

Tallgrass communities (including prairie and savanna) once covered between 800 km² and 2000 km² of southern Ontario (Rodger 1998). Today, approximately 21 km² remains due to urbanization and conversion for agricultural use (Bakowsky and Riley 1994; Rodger and Woodliffe 2001); this represents less than 3% of its original extent.

Most populations of Dense Blazing Star in Canada are in open areas that are vulnerable to residential, commercial, and industrial development. The threat of residential, commercial and industrial development is high in southwestern Ontario (e.g., the LaSalle and West Windsor area). On Walpole Island First Nation, increased housing construction, in response to critical housing shortages, has resulted in the loss of suitable habitat for Dense Blazing Star (COSEWIC 2010).

Agricultural Development

Several populations of Dense Blazing Star have been extirpated as a result of habitat loss due to conversion to agricultural fields, and this continues to be an ongoing threat (COSEWIC 2010). This is especially true at Walpole Island First Nation, where agricultural development has occurred at several sites in the last 10 years, and continues to be a potential threat on many land parcels (COSEWIC 2010).

Alteration of the Fire Regime

Dense Blazing Star requires open habitat, and all populations are vulnerable to shading resulting from growth of trees and shrubs. The natural wildfires that once controlled woody growth and maintained open prairie habitat are now generally suppressed. Thus, natural succession is a potential threat at all sites and is implicated in the extirpation of at least three populations (COSEWIC 2010). Prescribed burning is conducted at the Ojibway Prairie complex, parts of Walpole Island First Nation, and Pinery Provincial Park, but would be needed at other sites to arrest succession to woody vegetation species.

Alteration of the Hydrologic Regime

Some populations are threatened by habitat degradation from changes in drainage that alter soil properties. Installation of drainage tiles and ditches for agriculture has altered the hydrologic regime at some sites and was possibly the cause of extirpation of several populations between the St. Clair River and the mouth of the Thames River.

Invasive Plants

Invasive species are a widespread threat to Dense Blazing Star. European Common Reed (*Phragmites australis* ssp. *australis*) invasion is believed to be the primary cause of extirpation of three populations and is a current threat to the Windsor, Port Franks and Walpole Island First Nation populations, where it is invading meadow marshes and moist prairies (Allen 2001; COSEWIC 2010). Purple Loosestrife (*Lythrum salicaria*) and White Sweet Clover (*Melilotus alba*) are also implicated in several extirpations (COSEWIC 2010).

Fenced Enclosures

Several fenced enclosures were established at Pinery Provincial Park in the 1980s to protect Dense Blazing Star, Bluehearts (*Buchnera americana*), and the wet meadows from trampling and herbivory by White-tailed Deer (*Odocoileus virginianus*). Although additional deer control measures have since been put in place, the enclosures remain. Currently, browsing by deer outside the enclosures may help to maintain open conditions, while within the fenced areas Dense Blazing Star is declining due to encroachment by woody species (COSEWIC 2010).

Shoreline Erosion

One Dense Blazing Star site on the Walpole Island First Nation is threatened by shoreline erosion due to wave action in the St. Clair River. The wake of passing ships may be contributing to the local loss of plants (COSEWIC 2010).

Hybridization and Genetic Erosion

Hybridization of Dense Blazing Star with native Rough Blazing Star (*Liatris aspera*) and non-native Prairie Blazing Star (*L. pycnostachya*) as well as cultivated varieties of *L. spicata* has been documented. *L. spicata* x *L. aspera* hybrids have been recorded on Walpole Island First Nation (COSEWIC 2010). Furthermore, nursery stock of uncertain genetic origin is sometimes used by some organizations during prairie restoration work. Hybridization may introduce contamination into the gene pool. For example, traits bred into ornamental strains to improve suitability for the floral trade, such as earlier blooming, larger flowers, etc. may reduce the ability of the species to survive and reproduce in its natural Canadian habitats.

Herbicide Use

Herbicide spraying, often to control invasive species (e.g., those listed above) is likely a threat to some populations of Dense Blazing Star. The extirpation of the Patrick Cove population was likely related to the heavy herbicide use in Dover Township, which had led to loss of prairie forbs¹⁶ and many leafy herbs in the area (Allen 1998). It also threatens other populations that are on roadsides and railway embankments that are sprayed as part of right-of-way maintenance.

Maintenance Activities (Mowing and Vegetation Clearing)

Regular (or poorly-timed) mowing and seeding is another threat that may be associated with both development and agriculture, and was the cause of the extirpation of the Rumble Prairie population. At Dutton Prairie, vegetation clearing and soil scarification under a hydro right-of-way is believed to be the cause of the large decline in the Dense Blazing Star population that has occurred since the 1980s (COSEWIC 2010).

Off-road Vehicle Use and Other Recreational Activities

Because most populations of Dense Blazing Star in Canada occupy open ground that is vulnerable to residential and commercial development, this species is also vulnerable to impacts from recreational activities such as off-road vehicle use and hiking that result from proximity to developed landscapes.

¹⁶ A herbaceous flowering plant that is not a graminoid

Trampling and Picking

At Pinery Provincial Park, while some Dense Blazing Star plants occur in nature reserves, others occur within an active campground and suffer from trampling and plant collection. Trampling is also a concern to a lesser extent on Walpole Island First Nation (COSEWIC 2010).

5. POPULATION AND DISTRIBUTION OBJECTIVES

In the wild in Canada, most Dense Blazing Star plants occur in areas with tallgrass prairie associates (COSEWIC 2010), suggesting that maintaining and restoring tallgrass prairie habitat is key to successful recovery. Given the widespread, possibly irreversible loss of tallgrass prairie habitat in southern Ontario, in combination with threats such as invasive species, and its naturally restricted range, it is unknown whether it is feasible to fully recover Dense Blazing Star in Canada. The population and distribution objective is therefore to maintain, or to increase to the extent that it is biologically and technically feasible, the current overall abundance of Dense Blazing Star (of native genotype) in Canada across at least 10 populations within its native range.

Achieving the objective may involve population augmentation at some known extant locations where population viability is believed to be low, provided sufficient suitable habitat is available or can be made available to support long-term persistence, or alternatively, it may involve re-establishing populations at historic sites, and/or introducing new populations to sites with suitable habitat within the native range of the species.

6. BROAD STRATEGIES AND GENERAL APPROACHES TO MEET OBJECTIVES

6.1 Actions Already Completed or Currently Underway

Population inventory and habitat descriptions for most locations were completed in 2008 for an update COSEWIC status report (COSEWIC 2010). The Walpole Island Heritage Centre has monitored populations of Dense Blazing Star on Walpole Island First Nation. A census of the population was performed in 2003 and 2008 (COSEWIC 2010).

The provincially and municipally protected areas of Ojibway Prairie Provincial Nature Reserve, Tallgrass Prairie Heritage Park, Spring Garden Natural Area, and Pinery Provincial Park have active burn programs. Burns have also occasionally been undertaken at Dutton Prairie. Some prairie and savannah habitat is burned every year by Walpole Island First Nation community members.

Efforts by the Walpole Island Heritage Centre to lease lands for conservation have resulted in a reduction in the rate of conversion of prairie and savannah habitat to agriculture (COSEWIC 2009) during the tenure of the 5-year leases. The Walpole Island Land Trust was established in

2008 to conserve land on the Walpole Island First Nation (Jones 2013). Over 300 acres of land with tallgrass prairie, oak savannah and forest habitats have been acquired since 2001 for conservation (Jacobs 2011), benefitting species at risk such as Dense Blazing Star.

Recovery actions described in the Draft Walpole Island Ecosystem Recovery Strategy (Bowles 2005) included raising awareness in the community about species at risk, including Dense Blazing Star. Pamphlets, calendars, newsletter articles, posters and other promotional material have been used to raise awareness of species at risk in the Walpole Island First Nation community.

The Walpole Island First Nation is currently developing an ecosystem protection plan based on the community's traditional ecological knowledge (TEK).

In the Windsor area, the development of the DRIC and the HGP involves the construction of a divided multi-lane highway with on-ramps, overpasses, Plaza site, and ditches that affected a portion of a Dense Blazing Star population (Ojibway Prairie and surrounding areas population). As part of the mitigation for the HGP all impacted Dense Blazing Star plants have been transplanted to restoration sites established in appropriate habitat adjacent to the HGP footprint under an *Endangered Species Act, 2007* permit. Seed collected from Dense Blazing Star plants within the HGP footprint has also been propagated and planted into the restoration sites. Under the *Endangered Species Act, 2007* permit, all planted and transplanted individuals are being monitored from the time of planting until five years after construction is completed. A management plan has been developed that includes invasive species management techniques at the restoration sites and adaptive management strategies. Mitigation measures for Dense Blazing Star occurring at the DRIC Plaza site (federal land) have been implemented under *Species at Risk Act* and *Canada Wildlife Act* permits. All Dense Blazing Star plants in addition to approximately 3,200 m² of prairie sod within the DRIC footprint have been removed from the Plaza site and transplanted to the St. Clair National Wildlife Area. The transplants will be monitored and managed under permit for five years.

6.2 Strategic Direction for Recovery

Table 3. Recovery Planning Table

Threat or Limitation	Priority	Broad Strategy to Recovery	General Description of Research and Management Approaches
All threats	High	Monitor populations and habitat	<ul style="list-style-type: none"> Update species and habitat mapping, including sites where the species has been re-introduced or newly established
Residential commercial, and industrial development; Agricultural development	High	Protection and stewardship	<ul style="list-style-type: none"> Establish policies, bylaws, regulations, agreements or other tools that protect existing Dense Blazing Star habitat as required Promote stewardship on lands with Dense Blazing Star (e.g., easements, acquisition, leasing) to conserve habitat, where appropriate
Invasive plants; Alteration of the fire regime	High	Habitat management	<ul style="list-style-type: none"> Where possible, use best management practices to control or remove invasive species such as European Common Reed from Dense Blazing Star habitat Investigate the feasibility of using prescribed burns to manage habitat and reduce woody species encroachment
All threats	Medium	Outreach and education	<ul style="list-style-type: none"> Promote community involvement and awareness of species at risk and their habitat Conduct outreach to municipalities, railway companies, and utility companies about herbicide use and mowing along roadsides, verges, and corridors Encourage the transfer and archiving of Traditional Ecological Knowledge
Hybridization and genetic erosion; Knowledge gaps	Medium	Conduct research	<ul style="list-style-type: none"> Determine genetic variability of existing populations of Dense Blazing Star and examine the genetics of populations of unknown or unconfirmed origin Research population dynamics of Dense Blazing Star to understand what constitutes a viable population Research biological needs of the species to guide management actions
Small population size and distribution	Low	Assess the feasibility of reintroduction, introduction, and population augmentation	<ul style="list-style-type: none"> Assess potential habitat at historical sites and within historical range and re-establish Dense Blazing Star if biologically and technically feasible or establish it in suitable habitat in proximity to historical tallgrass prairie sites Assess the habitat at existing small populations, and determine whether population augmentation is appropriate and feasible to increase the likelihood of long-term persistence

7. CRITICAL HABITAT

7.1 Identification of the Species' Critical Habitat

Critical habitat for Dense Blazing Star is identified in this recovery strategy to the extent possible based on the best available information. It is recognized that the critical habitat identified below is insufficient to achieve the population and distribution objectives for the species. The Schedule of Studies (Table 4) outlines the activities required for identification of additional critical habitat necessary to support the population and distribution objectives.

Sites where Dense Blazing Star has been planted or transplanted using a native seed source and as part of a restoration program will not be considered for critical habitat identification until it can be determined that the plantings are successful. Determination of restoration success will be measured through plant vigour and fitness, and successful sexual reproduction. Critical habitat may be identified at restoration sites following long-term monitoring to determine success, extent of suitable habitat and suitable habitat occupancy.

7.1.1 Suitable Habitat

Dense Blazing Star habitat is found on moist to wet sandy soil usually associated with tallgrass prairie habitat, but also in other open mesic (moderately moist) habitats. Suitable habitat for Dense Blazing Star is identified using the Ecological Land Classification (ELC) framework for Ontario (from Lee et al. 1998). This habitat has been documented (Woodliffe pers. comm. 2010; McFarlane pers. comm. 2010) to occur within the following ELC ecosite designations:

- Fresh-Moist Tallgrass Prairie (TPO2)
- Fresh-Moist Tallgrass Savannah (TPS2)
- Fresh-Moist Tallgrass Woodland (TPW2)
- Dry-Moist Cultural Meadow (CUM1)
- Mineral Cultural Thicket (CUT1)
- Mineral Cultural Savannah (CUS1)
- Mineral Cultural Woodland (CUW1)
- Ash Mineral Deciduous Swamp (SWD2)
- Maple Mineral Deciduous Swamp (SWD3)
- Mineral Thicket Swamp (SWT2)
- Mineral Meadow Marsh (MAM2)
- Organic Meadow Marsh (MAM3)
- Tallgrass Meadow Marsh (MAM6)

The ELC framework provides a standardized approach to the interpretation and delineation of dynamic ecosystem boundaries. The ELC approach classifies habitats not only by vegetation community but also considers hydrology and topography, and as such provides a basis for describing the ecosystem requirements of the natural habitat for Dense Blazing Star.

Within these habitat types, the vegetation immediately adjacent to Dense Blazing Star consists predominantly of herbaceous plants, especially grasses and sedges. Suitable habitat may be a large open area or a smaller opening within a woodland, forest, thicket, swamp, or meadow marsh. There may also be a history of fire or other disturbance that maintains the openness of the habitat.

Although only a small portion of the ELC ecosite polygon may be occupied, unoccupied area is required for dispersal, establishment, and expansion of the species to meet population and distribution objectives. Since the seeds of Dense Blazing Star are wind-dispersed, the species is capable of dispersing relatively long distances, and it frequently colonizes newly available habitat adjacent to a seed source (COSEWIC 2010). In addition, suitable habitat requires periodic disturbance, so the entire polygon is required to provide space for ecological processes that maintain habitat (such as fire, periodic flooding, etc.) to take place.

7.1.2 Suitable Habitat Occupancy

Suitable Habitat Occupancy Criterion: Suitable habitat is considered occupied when native Dense Blazing Star has been observed in any single year since 2006.

The boundary of occupied suitable habitat is defined by the extent of the ELC ecosite polygon (identified as suitable in Section 7.1.1) in which the species occurs. Where two or more ELC ecosite polygons meeting the Suitable Habitat Occupancy Criterion are continuous (connected), they are combined and considered one site. In situations where Dense Blazing Star is observed in small openings not well defined by ELC (e.g. a small opening in a forest), a radial distance of up to 50 m from the Dense Blazing Star observations will be applied as the occupancy criterion.

Information from 2006-2010 (which represents the time period of information currently available to Environment Canada) is used in this document to determine habitat meeting the suitable habitat occupancy criterion. During this time period (2006-2010), adequate surveys were conducted for many known extant populations to provide the information necessary to identify critical habitat. Furthermore, the five-year period will protect sites where plants have not been seen recently but are highly likely to still be present. For reports prior to 2006, it cannot be assumed that the species is still present due to the high level of threats to open, tallgrass prairie habitats and to the high level of human activity in disturbed areas.

Any sites containing plants that are considered horticultural specimens, and those clearly planted in landscaped settings such as urban gardens, are not considered to be occupied for the purposes of identifying critical habitat

7.1.3 Application of Dense Blazing Star Critical Habitat Criteria

Critical habitat for Dense Blazing Star is identified as the entire ELC ecosite polygon described as suitable in Section 7.1.1 that meets the suitable habitat occupancy criterion described in Section 7.1.2. In addition, in order to maintain moisture regimes, allow natural processes to occur, and to protect the plants from impacts such as the encroachment of weeds or the use of herbicides, the habitat within a radial distance of up to 50 m from a Dense Blazing Star plant

occurring in suitable habitat (including small opening not well defined by ELC) is also included as critical habitat. If a hard edge (e.g., paved road, building) occurs prior to the 50 m distance, critical habitat ends at the hard edge. At present, it is not clear at what distance physical and/or biological processes begin to negatively affect Dense Blazing Star. Studies on micro-environmental gradients at habitat edges, i.e., light, temperature, litter moisture (Matlack 1993), and of edge effects on plants, as evidenced by changes in plant community structure and composition (Fraver 1994), have shown that edge effects could be detected up to 50 m into habitat fragments. As such, a 50 m distance from any Dense Blazing Star plant is appropriate to ensure microhabitat properties for rare plant species occurrences are incorporated in the identification of critical habitat. These additional areas identified as critical habitat (i.e., those up to a radial distance of 50 m) may include habitat that is not considered suitable (as described in section 7.1.1), such as forests, because Dense Blazing Star may be found along woodland edges or near the transition from suitable into unsuitable habitat. Maintained roadways or built-up features such as buildings do not assist in the maintenance of natural processes and are therefore not critical habitat.

Application of the critical habitat criteria to available information identifies 28 sites for five populations as critical habitat for Dense Blazing Star (Appendix D). It is important to note that the coordinates provided are a cartographic representation of where critical habitat sites can be found, presented at the level of a 1km x 1km grid and do not represent the extent or boundaries of the critical habitat itself. More detailed information on the location of critical habitat, to support protection of the species and its habitat, may be requested on a need-to-know basis by contacting Environment Canada – Canadian Wildlife Service.

The identification of critical habitat in this recovery strategy is applied based on the information currently available to Environment Canada for the period of 2006-2010 (more recent data is not currently available) and is insufficient to meet the population and distribution objectives. As additional information becomes available, critical habitat identification may be refined or more sites meeting critical habitat criteria may be added.

Critical habitat is not identified for the following four extant populations: Tupperville, Highgate, Murkirk NE of Highgate, and Lucan. These populations occur on existing or old railway lines with very limited suitable habitat available and although the individuals are presumed to be of native source, they were likely transported to those locations by the railway. In addition, for each of these populations, there are fewer than 10 Dense Blazing Star stems and their viability in the long-term is doubtful (COSEWIC 2010). Additionally, although the Lucan population is presumed native some have suggested it may be introduced (COSEWIC 2010). Similarly, critical habitat is not identified for the Windsor railway site which is currently considered part of the Ojibway Prairie and surrounding areas population. It is approximately 4 km away from the other locations in this population and may have been transported to this location given it is along the railway. Although, critical habitat is not identified for these populations or specific sites, the individual plants may contain important genetic material for recovery and, depending on where they occur, are either protected under the prohibitions listed in the *Species at Risk Act* (on federal lands) or the *Endangered Species Act, 2007* (on non-federal lands).

In addition, the information required to identify critical habitat for the population of Dense Blazing Star at Walpole Island First Nation is not available for use by Environment Canada. Although the continued presence of Dense Blazing Star has been confirmed (as in COSEWIC, 2010), the data required to satisfy the critical habitat criteria (i.e., location and extent of populations, biophysical habitat attributes), are not yet available to Environment Canada. Given the known historic and current threats to the species, confirmation of the location and extent of the Dense Blazing Star population on Walpole Island First Nation is required. Location data available for use by Environment Canada predates 2005, and evidence exists that indicates that certain threats may have impacted portions of the population (see Section 4.1) after that date. Confirming the biophysical habitat attributes (i.e., extent and amount of the ELC ecosite of suitable habitat (as listed in Section 7.1.1)) is also required for this population. Once adequate information is available for use, additional critical habitat may be identified and may be described within an area-based multi-species at risk action plan developed in collaboration with the Walpole Island First Nation.

The restoration areas for the DRIC Plaza site (current and future federal lands¹⁷) created under a *Species at Risk Act* permit and for the HGP created under the *Endangered Species Act, 2007* permit, are not currently identified as critical habitat. All plants previously occurring inside the HGP footprint have been transplanted into existing suitable habitat (in some cases with existing, naturally occurring Dense Blazing Star) or restored habitat. The majority of these restoration sites occur within the Ojibway Prairie complex and surrounding areas. Additional plants were propagated and planted in the restoration sites. All Dense Blazing Star plants inside the DRIC Plaza site footprint were transplanted to the St. Clair National Wildlife Area's Corsini Cell. Additional plants were propagated from seed and planted at this location as well. Once the restoration plantings have established both the DRIC and HGP restoration areas will be reviewed and additional critical habitat may be identified.

7.2 Schedule of Studies to Identify Critical Habitat

Table 4. Schedule of Studies

Description of Activity	Rationale	Timeline
Confirm/obtain population information and conduct Ecological Land Classification for the Walpole Island First Nation population.	Location of population becomes known and habitat associations, biophysical habitat attributes and extent of suitable habitat are confirmed.	2014-2019
Confirm/obtain population and ELC information for Rural Lambton Stewardship Network, DRIC and HGP projects and any other restoration planting sites and determine the location and extent of the plantings and identify any additional critical habitat.	Locations of successful new or re-established populations becomes known and habitat associations, biophysical habitat attributes and extent of suitable habitat are confirmed and critical habitat is fully identified.	2014-2019

¹⁷ Transport Canada has not yet finished acquiring all of the land at the future DRIC plaza site. It is anticipated that they will acquire the remaining land in 2013.

7.3 Activities Likely to Result in the Destruction of Critical Habitat

Understanding what constitutes destruction of critical habitat is necessary for the protection and management 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 (Government of Canada 2009). Activities described in Table 5 include those likely to cause destruction of critical habitat for the species, however, destructive activities are not limited to those listed.

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

Description of Activity	Description of Effect	Details of Effect
Development and conversion of land (e.g. clearing of ground for agriculture, construction of buildings, driveways or roads).	Results in loss of suitable substrate conditions, habitat fragmentation/increased edge effects and/or direct covering up of suitable ground Can reduce quality of germinating sites and/or prevent growth of Dense Blazing Star	Direct effect, applicable at all times.
Operation of off road vehicles	Results in ruts or trampled vegetation and loss of suitable substrate conditions. These activities can reduce the quality of germinating sites.	Repeated events will cause soil compaction, with the exception of in winter months when ground is frozen
Use of herbicides, constant mowing, livestock grazing, tree planting, depositing fill	Results in alteration of soil conditions and/or light intensity rendering habitat unsuitable for growth of Dense Blazing Star Can result in loss of native species and degradation of critical habitat	Even localized impacts by these activities can change soil and light conditions affecting the species
Introduction of invasive species (e.g. direct seeding or planting or through vectors such as ATVs)	Results in increased resource competition through crowding or shading Can make habitat unsuitable for Dense Blazing Star	A single event of this kind is likely to result in destruction of critical habitat
Alteration of moisture levels (e.g. ditching or tiling)	Results in sites that are too wet or too dry Soil conditions are no longer suitable for Dense Blazing Star germination or growth	A single event of this kind is very likely to result in destruction of critical habitat

8. MEASURING PROGRESS

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

- The abundance of Dense Blazing Star (of native genotype) in Canada has been maintained at its current level or has increased;
- There are at least 10 extant populations of Dense Blazing Star with the native genotype across its native range in Canada.

9. STATEMENT ON ACTION PLANS

One or more action plans will be completed for Dense Blazing Star by December 2021.

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APPENDIX A: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. 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.

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 at-risk and rare species occur in tallgrass prairie habitats. Therefore, management actions that benefit Dense Blazing Star are expected to also benefit many other species that occur in these habitats (see Table 5). Habitat securement, policy, and stewardship approaches do not alter habitat and are not expected to have any adverse effects.

Table 6. Species expected to benefit from recovery techniques directed at Dense Blazing Star in Canada.

Common Name	Scientific (Latin) Name	SARA Status
Climbing Prairie Rose	<i>Rosa setigera</i>	Special Concern
Monarch	<i>Danaus plexippus</i>	Special Concern
Riddell's Goldenrod	<i>Solidago riddellii</i>	Special Concern
Butler's Gartersnake	<i>Thamnophis butleri</i>	Threatened
Colicroot	<i>Aletris farinosa</i>	Threatened
Massasauga	<i>Sistrurus catenatus</i>	Threatened
Willowleaf Aster	<i>Symphotrichum praealtum</i>	Threatened
Eastern Foxsnake	<i>Pantherophis gloydi</i>	Endangered
Eastern Prairie Fringed-Orchid	<i>Platanthera leucophaea</i>	Endangered
Northern Bobwhite	<i>Colinus virginianus</i>	Endangered
Showy Goldenrod	<i>Solidago speciosa</i>	Endangered
Small White Lady's-slipper	<i>Cypripedium candidum</i>	Endangered

While some of the proposed recovery activities will benefit the environment in general and are expected to positively affect other sympatric native species, there could be consequences to those species whose requirements differ from those of Dense Blazing Star. Consequently, it is important that habitat management activities for Dense Blazing Star be considered from an ecosystem perspective through the development, with input from responsible jurisdictions, of multi-species plans, ecosystem-based recovery programs or area management plans that take into account the needs of multiple species, including other species at risk.

Prescribed burning can improve habitat for many rare and at-risk tallgrass prairie species, but burning may also harm some species sensitive to fire. However, fire is recognized as an integral part of prairie ecosystems and has been used by First Nations people as a management tool for

millennia. Therefore, it is intended that any reduction of species sensitive to fire should still result in population levels that fall within the natural range of fluctuations. Monitoring to determine the effects of fire on some species may be necessary. Fire may reduce the presence of woody species to the benefit of tallgrass prairie species. This is not expected to have a significant impact since the encroaching woody species are common in non-burned habitats.

APPENDIX B: SUBNATIONAL CONSERVATION RANKS OF DENSE BLAZING STAR IN THE UNITED STATES

Table 7. List and description of the various conservation status ranks for the Dense Blazing Star in the United States (from NatureServe 2011).

	Global (G) Rank	National (N) Rank (United States)	Sub-national (S) Rank
Dense Blazing Star (<i>Liatris spicata</i>)	G5 (Secure – common; widespread and abundant)	N4 (Apparently Secure – uncommon but not rare)	Alabama (SNR) Arkansas (SNR) Connecticut (SNR) Delaware (S1) District of Columbia (SX) Florida (SNR) Georgia (SNR) Illinois (SNR) Indiana (SNR) Iowa (SNR) Kentucky (S4) Louisiana (SNR) Maryland (S1) Massachusetts (SNR) Michigan (SNR) Mississippi (SNR) Missouri (SX) New Jersey (SNR) New York (SNA) North Carolina (S3?) Ohio (SNR) Pennsylvania (SNR) South Carolina (SNR) Tennessee (SNR) Virginia (S4) West Virginia (S3) Wisconsin (S3)

S1: Critically Imperilled; S3: Vulnerable; S4: Apparently Secure; SNR: Unranked; SH: Possibly Extirpated; SX: Presumed Extirpated.

APPENDIX C: HISTORICAL AND EXTIRPATED POPULATIONS OF DENSE BLAZING STAR

Table 8. Historical and extirpated populations of Dense Blazing Star

Canadian Population	County	Last Obs.	Status	Notes
Patrick's Cove	Kent	2000	Extirpated	Apparently replaced by <i>Phragmites australis</i> and <i>Lythrum salicaria</i> or destroyed by herbicides to control these species; No plants seen in 2008
Ipperwash / Kettle and Stony Point First Nation	Lambton	1993	Probably extirpated	No plants seen in 2008 or 2009
West Lorne	Elgin	1990	Extirpated	No plants seen in 2008
Chenal-Ecarte Prairie	Kent	1985	Extirpated	Prairie has closed in due to fire suppression since 1985.
Deyo's Woods	Kent	1985	Extirpated	Extirpated in the late 1980s due to invading shrubs.
Rumble Prairie, near Blenheim	Kent	1985	Extirpated	Abundant in 1985, but extirpated by mowing and overseeding
St. Clair National Wildlife Area (main unit)	Kent	1982	Extirpated	Not found in 1986.
6 km west of Wallaceburg on St. Clair Parkway	Kent	1982	Extirpated	Not found in 1986.
Point Edward	Lambton	1980	Extirpated	These marshes have been filled in.
Glasgow's Woods, S.E. of Tupperville	Kent	1970s	Extirpated	Extirpated by plant succession and some clearing of land
Near bridge to Walpole Island First Nation.	Kent	1944	Extirpated	Not seen since 1944, despite numerous searches.
Sarnia	Lambton	1894	Extirpated	Two subpopulations: one extirpated within City of Sarnia; second extirpated by agriculture
Leamington	Essex	1886	Extirpated	Not seen since original collection.

(Sources: Allen 1988; Allen 2001; Neegan Burnside 2009; COSEWIC 2010; NHIC 2011)

APPENDIX D: GRIDS IDENTIFIED AS CONTAINING CRITICAL HABITAT FOR DENSE BLAZING STAR (*LIATRIS SPICATA*) IN CANADA

Table 9. Critical Habitat for Dense Blazing Star occurs within these 1 km grid squares where criteria described in Section 7.1 are met.

Grid ID ¹	UTM Zone	Province/Territory	Easting ²	Northing ²	Number of Critical Habitat Site Centroids within Grid ³	Total Site Area (ha) within the Grid that contains Critical Habitat ⁴	Land Tenure ⁵
17LG27_88	17	Ontario	328000	4678000	1	1	Non-federal
17LG27_89	17	Ontario	328000	4679000	0	3	Non-federal
17LG27_99	17	Ontario	329000	4679000	0	2	Non-federal
17LG28_80	17	Ontario	328000	4680000	0	15	Non-federal
17LG28_81	17	Ontario	328000	4681000	3	11	Non-federal
17LG28_82	17	Ontario	328000	4682000	1	2	Non-federal
17LG28_90	17	Ontario	329000	4680000	1	35	Non-federal
17LG28_91	17	Ontario	329000	4681000	2	23	Non-federal
17LG28_92	17	Ontario	329000	4682000	0	8	Non-federal
17LG37_09	17	Ontario	330000	4679000	0	2	Non-federal
17LG37_19	17	Ontario	331000	4679000	1	9	Non-federal
17LG37_28	17	Ontario	332000	4678000	0	0	Non-federal
17LG37_29	17	Ontario	332000	4679000	0	2	Non-federal
17LG37_38	17	Ontario	333000	4678000	1	2	Non-federal
17LG37_39	17	Ontario	333000	4679000	1	3	Non-federal
17LG38_00	17	Ontario	330000	4680000	1	3	Non-federal
17LG38_01	17	Ontario	330000	4681000	3	12	Non-federal
17LG38_02	17	Ontario	330000	4682000	2	3	Non-federal
17LG38_10	17	Ontario	331000	4680000	1	14	Non-federal
17LG38_11	17	Ontario	331000	4681000	1	1	Non-federal
17LG38_20	17	Ontario	332000	4680000	1	4	Non-federal
17LG45_75	17	Ontario	347000	4655000	0	0	Non-federal
17LG45_85	17	Ontario	348000	4655000	1	2	Non-federal
17MH28_66	17	Ontario	426000	4786000	1	7	Non-federal
17MH28_87	17	Ontario	428000	4787000	1	2	Non-federal
17MH28_88	17	Ontario	428000	4788000	3	3	Non-federal
17MH28_98	17	Ontario	429000	4788000	1	1	Non-federal
17MH51_39	17	Ontario	453000	4719000	0	2	Non-federal
17MH51_49	17	Ontario	454000	4719000	0	2	Non-federal
17MH52_40	17	Ontario	454000	4720000	1	7	Non-federal
17MH52_50	17	Ontario	455000	4720000	0	8	Non-federal

17MH52_51	17	Ontario	455000	4721000	0	3	Non-federal
17MH52_61	17	Ontario	456000	4721000	0	0	Non-federal
Total					28	192 ha	

¹Based on the standard UTM Military Grid Reference System (<http://www.nrcan.gc.ca/earth-sciences/geography-boundary/mapping/topographic-mapping/10098>), where the first 2 digits represents the UTM Zone, the 2 letter code indicates the 100km block, followed by 2 digits to represent the 10km square. The last 2 digits represent the 1km grid containing all or a portion of the critical habitat site.

²The listed coordinates are a cartographic representation of where critical habitat can be found, presented as the southwest corner of the 1km grid containing all or a portion of the critical habitat site. The coordinates may not fall within critical habitat and are provided as a general location only.

³A value of "0" means the grid square contains a portion of (a) critical habitat site(s) but not the site centroid.

⁴The area presented is that contained within the critical habitat site boundary (rounded up to the nearest 1 ha); therefore, the actual area of critical habitat within this boundary may be significantly less. Field verification is required to determine the precise area of critical habitat. Refer to Section 7.1 for a description of how critical habitat within these areas is defined.

⁵Land tenure is provided as an approximation of the types of land ownership that exist at the sites containing critical habitat and should be used for guidance purposes only. Accurate land tenure will require cross referencing critical habitat boundaries with surveyed land parcel information.