Photo: Allen Woodliffe

Willowleaf Aster
(Symphyotrichum praealtum) in Ontario

Ontario Recovery Strategy Series

Recovery strategy prepared under the Endangered Species Act, 2007

2013

Natural. Valued. Protected.

Ministry of Natural Resources

Ontario

About the Ontario Recovery Strategy Series

This series presents the collection of recovery strategies that are prepared or adopted as advice to the Province of Ontario on the recommended approach to recover species at risk. The Province ensures the preparation of recovery strategies to meet its commitments to recover species at risk under the Endangered Species Act (ESA) and the Accord for the Protection of Species at Risk in Canada.

What is recovery?

Recovery of species at risk is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

What is a recovery strategy?

Under the ESA a recovery strategy provides the best available scientific knowledge on what is required to achieve recovery of a species. A recovery strategy outlines the habitat needs and the threats to the survival and recovery of the species. It also makes recommendations on the objectives for protection and recovery, the approaches to achieve those objectives, and the area that should be considered in the development of a habitat regulation. Sections 11 to 15 of the ESA outline the required content and timelines for developing recovery strategies published in this series.

Recovery strategies are required to be prepared for endangered and threatened species within one or two years respectively of the species being added to the Species at Risk in Ontario list. There is a transition period of five years (until June 30, 2013) to develop recovery strategies for those species listed as endangered or threatened in the schedules of the ESA. Recovery strategies are required to be prepared for extirpated species only if reintroduction is considered feasible.

What's next?

Nine months after the completion of a recovery strategy a government response statement will be published which summarizes the actions that the Government of Ontario intends to take in response to the strategy. The implementation of recovery strategies depends on the continued cooperation and actions of government agencies, individuals, communities, land users, and conservationists.

For more information

To learn more about species at risk recovery in Ontario, please visit the Ministry of Natural Resources Species at Risk webpage at: **www.ontario.ca/speciesatrisk**

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Cover illustration: Willowleaf Aster at Ojibway Park by P. Allen Woodliffe. *This photo may not be used separately from this recovery strategy without permission of the photographer.*

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DECLARATION

The recovery strategy for the Willowleaf Aster was developed in accordance with the requirements of the *Endangered Species Act, 2007* (ESA). This recovery strategy has been prepared as advice to the Government of Ontario, other responsible jurisdictions and the many different constituencies that may be involved in recovering the species.

The recovery strategy does not necessarily represent the views of all of the individuals who provided advice or contributed to its preparation, or the official positions of the organizations with which the individuals are associated.

The goals, objectives and recovery approaches identified in the strategy are based on the best available knowledge and are subject to revision as new information becomes available. Implementation of this strategy is subject to appropriations, priorities and budgetary constraints of the participating jurisdictions and organizations.

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.

RESPONSIBLE JURISDICTIONS

Ontario Ministry of Natural Resources
Environment Canada – Canadian Wildlife Service, Ontario

EXECUTIVE SUMMARY

Willowleaf Aster (*Symphyotrichum praealtum*) is listed as threatened under Ontario's *Endangered Species Act, 2007* and on Schedule 1 of the federal *Species at Risk Act* (SARA). It is a herbaceous, perennial plant that spreads vegetatively from rhizomes, forming colonies. The species is fall-flowering with pale lavender flowers. Willowleaf Aster requires cross-pollination from a genetically different individual for seed set. A recent genetic study found considerable genetic variability both among and within Willowleaf Aster populations in Windsor.

In Canada, Willowleaf Aster occurs only in southwestern Ontario. At least nine natural and two restoration populations are known to be extant. Most individuals of Willowleaf Aster are found in the City of Windsor and Town of LaSalle within an area of approximately 20 km^2. In this strategy, this area is treated as a single population. Outside this area, there are five other populations in Windsor – LaSalle, two elsewhere in Essex County, and one on the Walpole Island First Nation. In addition, there are four populations with unknown status and four considered historical or extirpated. Tens of thousands of stems of Willowleaf Aster were found during preparations for the Detroit River International Crossing and Windsor Essex (Rt. Hon. Herb Gray) Parkway and are being transplanted into 34 restoration sites in Windsor.

In Canada, Willowleaf Aster is found in tallgrass prairies, oak savannas, meadows and woodland openings as well as open anthropogenic habitats such as abandoned fields, along railways and roadsides, and on the banks of streams, drains and ditches. The habitat must have disturbance, such as fire or human-made clearing, to remain open and suitable. The species prefers moist soils.

Threats to Willowleaf Aster include development, an altered disturbance regime, invasive species, conversion of habitat to agricultural use, mowing, herbicide use, habitat degradation and deer browsing.

The recovery goal is to maintain the current distribution, number and viability of all extant populations and corresponding subpopulations of Willowleaf Aster by maintaining, improving, and protecting habitat and reducing other threats. The protection and recovery objectives are to:

1. assess threats and plan measures for mitigation and reduction;
2. maintain or improve habitat suitability at all existing sites;
3. ensure adequate habitat and species protection by monitoring and initiating recovery actions when necessary; and
4. fill knowledge gaps.

It is recommended that the area to be prescribed for a habitat regulation include all sites where Willowleaf Aster has been reported unless the species is proven extirpated. In natural tallgrass prairie and oak savanna vegetation, it is recommended that the entire Ecological Land Classification (ELC) polygon in which Willowleaf Aster is present plus a protective zone of 50 m around the outside of the polygon boundary be prescribed. In

anthropogenic habitat and in natural tallgrass woodland vegetation it is recommended the entire continuous open area be prescribed, as well as a 50 m protective zone beyond the outside boundary, with a minimum 50 m radial distance around patches of Willowleaf Aster. In linear habitats, such as railway embankments, it is recommended that the prescribed area have a maximum length of 100 m. It is recommended that restoration sites be included in the habitat regulation.

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1.0 BACKGROUND INFORMATION

1.1 Species Assessment and Classification

COMMON NAME: Willowleaf Aster
SCIENTIFIC NAME: *Symphyotrichum praealtum* var. *praealtum*
SARO List Classification: Threatened
SARO List History: Threatened (2004)
COSEWIC Assessment History: Threatened (2003), Special Concern (1999)
SARA Schedule 1: Threatened
CONSERVATION STATUS RANKINGS: GRANK: G5 NRANK: N2 SRANK: S2

The glossary provides definitions for the abbreviations above and for technical terms used in this document.

1.2 Species Description and Biology

Species Description

Willowleaf Aster, also called Willow Aster [*Symphyotrichum praealtum* (Poir.) Nesom; formerly *Aster praealtus* Poir.] is a herbaceous perennial plant that spreads vegetatively from rhizomes. The upright stems are smooth, waxy and usually 50 to 150 cm tall, with alternate, narrow leaves that attach directly to the stem with no stalk or only a short taper from the leaf. Leaves on the lower part of the plant may grow up to 14 cm long and 1 cm wide, while leaves on the upper and middle branches are shorter (Semple et al. 2002).

Willowleaf Aster flowers from late September through October and sometimes into November. It produces a tall, pyramidal cluster of pale lavender composite flowers. Individual flower heads have 20 to 35 ray flowers that are 5 to 9 mm long and 1.7 mm wide, and a yellow central disk that becomes purple. The seed-like fruit is compressed and sparsely hairy, with a whorl of bristles about 5.5 mm long at the top. For further description and illustrations, see Semple et al. (2002).

Identifying asters can sometimes be difficult. Willowleaf Aster can be differentiated from other asters that have pale purple flowers by the smooth, waxy (glaucous) stems and pronounced veins on the undersides of the stiff leaves. Willowleaf Aster somewhat resembles the very common Panicled Aster (*S. lanceolatum*), but the latter lacks the

pronounced leaf veins and has longer bristles on the fruits, which may give the disc a whitish to pale yellow tone (Semple et al. 2002).

Species Biology

Due to its growth from rhizomes, Willowleaf Aster forms clusters or colonies of many stems (also called clones), all of which belong to a single plant and are thus genetically identical. For successful fertilization and seed set, Willowleaf Aster must cross-pollinate with a genetically different individual (Jones 1978). Self-fertilization is possible but does not usually occur (Zhang 1999). In a study of 10 species of perennial asters including Willowleaf Aster, Jones (1978) found that self-fertilization produced an average of less than 0.1% of potential achenes. As a result, in large colonies thousands of heads may bloom but produce only a few seeds because flowers must receive pollen from a different colony to set seed.

For cross-pollination to be possible, individuals from different colonies must grow in close enough proximity that insect pollinators can travel among them. If colonies of Willowleaf Aster are too far apart, it may result in reduced seed set. However, in the course of several seasons Willowleaf Aster clones may expand by vegetative reproduction from a shady spot into a more favourable position and subsequently flower. In this way, the species may bridge a gap with adjacent populations in order to accomplish pollen transfer and seed production (Jones 1978). Willowleaf Aster is also able to spread from fragmentation of the rhizomes (WEMG 2012).

Willowleaf Aster is insect pollinated. Asters are pollinated by a large variety of insect species, with butterflies and moths favouring the purple-flowered species (Jones 1978). No information was available on pollinators specific to Willowleaf Aster. Flowering in asters is triggered by an interaction between day length and temperature (Jones 1978). Willowleaf Aster is a very late-flowering species. Fruits of Willowleaf Aster may disperse either by falling from the plants by gravity or by being blown from the plant when the wind catches in the bristles on the fruits.

The distance that wind-blown aster fruits can travel is unknown but may be less than theorized. It is hard to predict dispersal distance because it is related to a number of changeable factors, including wind speed, weather conditions and humidity, release height, plume-loading and the height of the surrounding vegetation (Soons et al. 2004). Dispersal in the Aster Family is most favourable in fair weather with low humidity, which opens and stiffens the bristles on the fruits. In such conditions, wind speed is usually low (Sheldon and Burrows 1973). Tackenberg et al. (2003) studied the wind dispersal potential of 335 grassland species with a variety of adaptations presumed to aid in wind dispersal. They found that none of the species studied reached dispersal distances of 100 m. They found that some long-distance dispersal does occur in extreme weather conditions but that in open, flat landscapes this happens only rarely. Sheldon and Burrows (1973) conclude that in most cases, long distance dispersal in the Aster Family is prevented unless convection currents can carry fruits high up in the air.

Newmaster et al. (2012) investigated the genetic variability of nine populations of

Willowleaf Aster in the City of Windsor. Each population was genetically fairly unique with a high genetic distance among populations. Considerable diversity was shown at several scales in genomic variation, from whole genome size to sequence variation in the nuclear and chloroplasts to that of variation in alleles, clones and genetic distance. Clonal diversity within populations was considerable and no genotypes were shared between any of the sampled populations. The size of the genome was found to be comparable to that of other aster species. The authors concluded that the combination of clonal and sexual reproduction is responsible for the high level of genetic diversity.

Little is known about the ecological role of Willowleaf Aster, but asters and goldenrods (*Solidago* spp.) flower late in the summer and are likely an important source of nectar and pollen for a wide variety of invertebrates at that time of year.

1.3 Distribution, Abundance and Population Trends

The global range of Willowleaf Aster extends from the northeastern United States, west to Nebraska and south to Texas and adjacent northern Mexico. Several varieties have been recognized, but the validity of some still need confirmation (Brouillet et al. 2006). The main variety of the species, *S. praealtum* var. *praealtum*, extends into Canada.

In the United States, Willowleaf Aster is found in 32 states. It occurs in northern Mexico, in the states of Nuevo Leon, Chihuahua and Coahuila (Brouillet et al. 2006). In all but two jurisdictions, it has not been given any conservation ranking. However, in New York it is ranked S5 or Secure, and in New Jersey it is ranked S1 and legally listed as endangered. Globally, the species is considered secure and ranked G5 (NatureServe 2012). In Ontario, Willowleaf Aster is ranked S2 or imperilled[1] (NHIC 2012).

In Canada, Willowleaf Aster is only found in southwestern Ontario. At least nine natural populations and two restoration populations from mitigation work are known to be extant (Figure 1; Table 1). Most individuals of Willowleaf Aster are found in the City of Windsor and the Town of LaSalle (just to the south) in an area of roughly 20 km^2, straddling the line between the two municipalities. Within this area, there are numerous patches of Willowleaf Aster, most of which are within 1 km of one another and thus would be considered subpopulations of a single population or occurrence[2]. There has been a lot of recent field work (2009–2012) in this area, and many new patches of Willowleaf Aster have been discovered. These have connected many patches that were previously treated as separate populations by COSEWIC (2003) and NHIC (2012). Some patches may or may not be considered part of this large population, depending on whether or not there is suitable habitat present between patches or if there are barriers to dispersal. As well, some new patches are being established as mitigation for highway construction (see below), and these may or may not be treated the same as natural patches when

[1] See glossary on page 19 for an explanation of G- and S-ranks.

[2] Populations are groups of plants separated from each other by more than 1 km. Patches that are in closer proximity to each other are considered subpopulations of a single population (NHIC 2012).

evaluating which patches belong to this large population. However, for the purpose of discussion in this recovery strategy, most of the Windsor - LaSalle subpopulations will be treated as a single, large population.

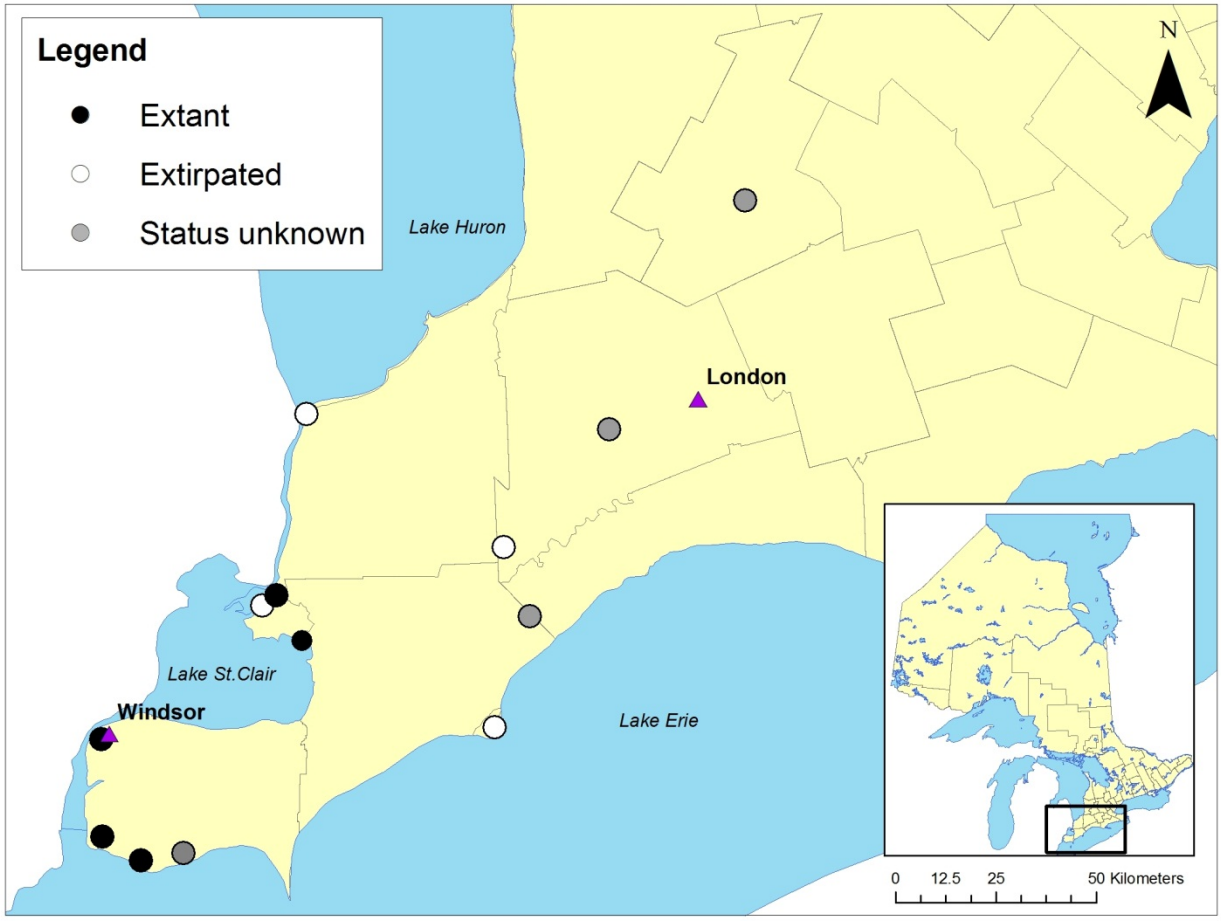

Figure 1. Historical and current distribution of Willowleaf Aster in its Canadian range in southwestern Ontario. Note: black dot at Windsor represents several extant populations.

Table 1. Populations of Willowleaf Aster in Canada showing current status (extant, unknown, or extirpated) and abundance if known. Extant populations are numbered and shown in bold type. An R denotes a restoration site that could be considered a stand-alone population based on distance from other subpopulations. Sources: Bkejwanong Natural Heritage Centre 2006; P.D. Pratt, pers. comm. 2010; Town of LaSalle 2010; P.A. Woodliffe, pers. comm. 2011-2012; R. Gould, pers. comm. 2012; D. Lebedyk, pers. comm. 2012; NHIC 2012; G.E. Waldron, pers. comm. 2012; WEMG 2012.

POPULATION Subpopulation (indented)	**Current Status**	**Last Obs.**	**Abundance at last observation**
1. WALPOLE ISLAND FIRST NATION	**Extant**	Post-2000	No data
2. WINDSOR-LASALLE NORTH including:	**Extant**		
Ojibway Prairie Provincial Nature Reserve	**Extant**	2009	Dozens of stems
West of Matchette Rd near Raceway	**Extant**	2011	Hundreds of stems
Spring Garden Natural Area	**Extant**	2011	"very large population"
Tallgrass Prairie Heritage Park	**Extant**	2007	Locally common
Ojibway Park	**Extant**	2007	>100 stems
Black Oak Heritage Park	Unknown*	1994	~50 plants
DRIC-WEP**: 29 restoration sites	**Extant**	2011	>120,000 stems
Between Matchette and Malden Roads	Unknown	2004	One plant
St. Clair College SCC Prairie and several other sites	**Extant**	2010	>50 plants
DRIC-WEP: 3 restoration sites	**Extant**	2011	Present
LaSalle North	**Extant**	2010	Present
LaSalle Northwest	**Extant**	2010	Present
LaSalle-Windsor Railway Corridor	**Extant**	2012	Present
3. EAST OF HURON CHURCH ROAD, WINDSOR	**Extant**	2010	Hundreds of stems
4. WINDSOR EAST SIDE RAILWAY COORIDOR	**Extant**	2009	"large population"
5. LASALLE WEST	**Extant**	2010	Present
6. LASALLE CENTRE	**Extant**	2010	Present
7. LASALLE EAST	**Extant**	2010	Present
8. BIG CREEK CONSERVATION AREA, AMHERSTBERG	**Extant**	2012	At least 10 flowering stems
9. COLCHESTER SOUTH, ESSEX CO.	**Extant**	2010	Present
R1.DRIC-WEP: SOUTHEAST WINDSOR 2 restoration sites	**Extant**	2011	Present
R2. ST. CLAIR NATIONAL WILDLIFE AREA, CHATHAM-KENT	**Extant**	2013	180 stems to be transplanted in 2013
Cedar Creek Conservation Area, Essex County	Unknown* but likely extant	1984	Small clump
Near Mt. Brydges, Caradoc Township, Middlesex County	Unknown* but likely extirpated	1992	"Rare" Not found in 1998
North of Highgate, Orford Township, Chatham-Kent	Unknown*	1991	"Common"

POPULATION Subpopulation (indented)	**Current Status**	**Last Obs.**	**Abundance at last observation**
Ellice Township, Perth County	Unknown*	1983	Small clump
Cairngorm intersection Middlesex County	Extirpated	1960	
Rondeau Provincial Park Chatham-Kent	Extirpated	1956	Not found in life science inventory of 2011–2012
Pt. Edward (Sarnia) Lambton County	Extirpated	1958	
Squirrel Island	Extirpated	1916	

*The NHIC currently lists these locations as historic because they have not been visited in more than 20 years. It does not mean the species is not extant at these locations. For the purposes of the recovery strategy the status of these sites at these locations is considered 'unknown'.
** DRIC-WEP: corridor of the Detroit River International Crossing and Windsor Essex Parkway, discussed next page.

In addition to the large Windsor-LaSalle population discussed above, there are at least five other populations in the City of Windsor or Town of LaSalle, two elsewhere in Essex County (R. Gould, pers. comm. 2012, D. Lebedyk, pers. comm. 2012, G.E. Waldron, pers. comm. 2012, P.A. Woodliffe, pers. comm. 2010), and at least one on the Walpole Island First Nation in the St. Clair River delta. In addition, there are four populations that have not been visited since the early-1990s (or earlier), and it is unknown if any of these are still extant. An additional four populations are considered extirpated (NHIC 2012).

A patch of Willowleaf Aster may contain one or many individuals, and it is usually difficult to tell how many true genetic individuals are present at a given location. Therefore, in this document, the number of stems is used for the purposes of making comparisons in population size or extent.

Willowleaf Aster may be easily overlooked and is probably under-reported. In southwestern Ontario, the species flowers from late September through October, sometimes continuing as late as mid-November (P.A. Woodliffe, pers. comm. 2010, E. Reimer, pers. comm. 2012). However, very little biological field work is done this late in the fall because most other species have already completed their growing season. During summer field work Willowleaf Aster would not be in flower, and sterile aster plants are difficult to identify. In addition, Willowleaf Aster is known to colonize some disturbed areas and abandoned agricultural fields (G.E. Waldron, pers. comm. 2012), places not often explored by botanists. New discoveries of the species in the City of Windsor (WEMG 2012) and the Town of LaSalle (2010) seem to indicate that the species may be more abundant and widespread than had been previously reported although it is still restricted to a very small range in southwestern Ontario.

There are no accurate trend data available for Willowleaf Aster populations in Canada. The most recent COSEWIC status report (COSEWIC 2003) was based on field work done in 1997. That report listed 12 populations as extant, including one on Walpole

Island First Nation and seven that are now considered part of the large Windsor-LaSalle population. The remaining four populations are those with unknown status in Table 1. Therefore, there is very little current or past abundance data available for use in comparisons. It is unknown whether any subpopulations have been lost, but it can be inferred that some patches may have been lost due to development in Windsor. However, many other new subpopulations have been discovered recently, making it difficult to detect a trend. Furthermore, in the last 20 years the number of abandoned agricultural fields has increased, some of which may provide suitable habitat. It is reported that Willowleaf Aster has moved into some of these types of places recently (G.E. Waldron, pers. comm. 2012), but whether this constitutes an increase in population size or not is unknown.

The Detroit River International Crossing and the Windsor-Essex (Rt. Hon. Herb Gray) Parkway

Willowleaf Aster is present in the corridor being developed for the Detroit River International Crossing (DRIC), the expansion of the Windsor-Essex (Rt. Hon. Herb Gray) Parkway (WEP), and the area that will become the federal customs plaza (Canada-U.S.-Ontario-Michigan Border Transportation Partnership 2009). A summary of work being done to mitigate impacts to the species is presented here because this work affects a large number of stems and thus a great proportion of the total Canadian population. As well, the results of mitigation and the success of the methods being used may provide guidance on how to do recovery work for Willowleaf Aster elsewhere.

During initial study work in the DRIC-WEP corridor, tens of thousands of stems of Willowleaf Aster were found (WEMG 2012). In February 2010, a permit was issued under the *Endangered Species Act, 2007* to the Ontario Ministry of Transportation (MTO) for the construction of the WEP. Activities authorized by the permit and related to Willowleaf Aster include tallgrass prairie creation, enhancement and restoration, as well as removing and transplanting Willowleaf Aster to approved restoration sites. In addition, monitoring the transplanted individuals will be required for five years after completion of the WEP, and long-term habitat protection must be ensured (WEMG 2012).

More than 30,000 stems of Willowleaf Aster are being removed from construction areas in the WEP corridor and transplanted to 34 approved restoration sites, most of which are just outside of the WEP corridor. Many sites already have Willowleaf Aster present (WEMG 2012). This work is expected to finish in the fall of 2013. Willowleaf Aster is being transplanted either as stems within intact sod clusters (1 m^2 soil sections), as rhizome cuttings, or as individual root masses. The methods used to remove plants, process rhizomes, and replant are described in WEMG (2012). At the end of 2011, roughly 17,600 root masses, 25,000 rhizome cuttings and 33,000 stems in sod clusters had been transplanted. Rhizome cuttings will augment the number of stems available for transplantation.

In addition, in June 2012 a permit was issued under the federal *Species at Risk Act (SARA)* for mitigation work on the land that will become the federal customs plaza for

the DRIC (Permit SARA-OR-2012-0197). This work will include transplanting 180 Willowleaf Aster stems and approximately 3804 m^2 of associated tallgrass prairie vegetation to the St. Clair National Wildlife Area (southern dot on Lake St. Clair in Figure 1, above).

It is expected that at the end of mitigation work, more than 120,000 stems will have been transplanted, which will represent a four-fold increase from the original number of stems removed from the corridor. It will also create an increase of at least an order of magnitude in the estimated number of stems of Willowleaf Aster in the entire Canadian population compared to the estimate given in the COSEWIC Assessment and Status Report (COSEWIC 2003). Furthermore, mitigation work will result in the creation of two new populations (shown as R1 and R2 in Table 1).

1.4 **Habitat Needs**

Prior to European settlement, Willowleaf Aster probably grew in tallgrass prairies that occurred east of the Great Plains and extended over large areas of the American mid-west and into southwestern Ontario. Prairies are believed to have developed during a warm, dry period about 5,000 years ago (Szeicz and MacDonald 1991). It is likely that the use of fire by First Nations as well as lightning strikes were key factors in the persistence of tallgrass prairies in Ontario, since fire is a factor that can limit the establishment and growth of woody plants in grasslands (Reichman 1987)

In Canada, Willowleaf Aster is mainly found in tallgrass prairies, oak savannas, thickets and meadows but may also occasionally be found at the edges of woods or in woodland openings. Willowleaf Aster also occurs in open, unshaded, anthropogenic habitats (open ground that is the result of human disturbance) where suitable soil, light and moisture conditions are present. Anthropogenic habitats used by Willowleaf Aster include railway embankments, roadsides, abandoned agricultural fields, utility corridors, vacant city lots and other areas (NHIC 2012, G. Waldron, pers. comm. 2012; P.A. Woodliffe, pers. comm. 2012) The species shows a preference for moist soils (Gleason and Cronquist 1991, Brouillet et al. 2006). Several populations are found along the banks of streams, drains, ditches and dikes. Within the Ojibway Prairie Complex[3], Willowleaf Aster occurs in damp prairies and old fields (Pratt 2007). In Michigan, Willowleaf Aster habitat is reported as moist fields (including recent clearings) and prairies (Voss 1996, Reznicek et al. 2011). G.E. Waldron (pers. comm. 2012) has observed that the species does better in lighter, sandy soil.

A detailed description of the habitat conditions in which Willowleaf Aster has been found was made by P.A. Woodliffe (pers. comm. 2011). The sites where he observed Willowleaf Aster included very good quality tallgrass prairie and oak savanna communities but also disturbed sites, usually those that had been left alone for awhile

[3] The Ojibway Prairie Complex is a conglomerate of parks and protected areas in the City of Windsor. It is part of the Windsor-LaSalle North population.

and were moving towards an old field or early re-developing prairie. Most sites were quite open, with relatively little woody growth, but the species was also seen doing fairly well even with a shrubby component of probably up to 50%. As well, the species was seen at the edges of woodlands with a young tree canopy with a south-facing aspect that provided a lot of sunlight. In a mostly herbaceous setting, most of the forb species were the same height or lower than Willowleaf Aster although some taller prairie species were usually present, such as sunflowers (*Helianthus* spp.), Tall Tickseed (*Coreopsis tripteris*), Dense Blazing Star (*Liatris spicata*), Big Bluestem (*Andropogon gerardii*) or Indian Grass (*Sorghastrum nutans*). However, the tall forbs were seldom dominant and the tall grasses generally did not create dense shade. Willowleaf Aster was also occasionally found under dogwoods (*Cornus* spp.) and sumac (*Rhus* spp.), as long as the area was still fairly open and filtered sunlight was still able to reach the plants.

The natural habitat of Willowleaf Aster has not been documented according to the Ecological Land Classification (ELC) (Lee et al. 1998). However, based on descriptive reports of community structure and composition around extant populations (P.A. Woodliffe, pers. comm. 2011, G. Waldron, pers. comm. 2012), Fresh-moist Tallgrass Prairie (TPO2-1), Fresh-moist Pin Oak – Bur Oak Tallgrass Savanna (TPS2-1) and edges and openings on Fresh-moist Tallgrass Prairie Woodland (TPW2) will provide suitable habitat. However, other suitable habitats, such as utility corridors, abandoned fields and the banks of drains and ditches are not well characterized by ELC vegetation types. In addition, COSEWIC (2003) reports the species from thickets, which also have not been characterized to a specific ELC vegetation type.

To remain open, the habitat of Willowleaf Aster must have periodic disturbance, such as fire, drought or human clearing, to prevent trees and shrubs from becoming established. Without disturbance, natural succession will lead to increasingly dense vegetation and shading, causing habitat to close in and become unsuitable. In anthropogenic habitats, disturbance from past human activities mimics, at least on a short-term basis, the natural disturbance required by the species and creates land that is sufficiently open to provide suitable habitat. Once the species is established in these habitats, repeated disturbance such as mowing, ploughing or All Terrain Vehicle (ATV) use may harm Willowleaf Aster plants. However, some level or type of periodic disturbance is required, and even mowing and ploughing may be useful if done as part of management practices to keep habitat open.

Willowleaf Aster appears to tolerate a broad range in the frequency and intensity of disturbance required. For example, the species is reported from highly disturbed areas, including urban land that was in the process of being developed into a parking lot (G.E. Waldron, pers. comm. 2012). On the other end of the spectrum, the species is also reported from areas with vegetation that has grown in to the point of having young tree cover (P.A. Woodliffe, pers. comm. 2011). Although fire and drought historically provided natural forms of required disturbance, today the activities of humans in utility corridors, along railway embankments and in other disturbed places also appear to provide adequate disturbance, at least over some time frames.

1.5 Limiting Factors

Willowleaf Aster is affected by biological limitations in its Canadian range. The species flowers very late in the fall and is often the last thing flowering in the Windsor area (E. Reimer, pers. comm. 2012). It sometimes flowers as late as mid-November, a time at which very few insects are present to serve as pollinators. Thus, it can be speculated that pollination may be a limitation in the late part of the season. Even if pollination is successful, the plants still have to set seed before extended frost or snowfall occurs, and the time span between flowering and the onset of winter conditions is probably shorter in Ontario than in portions of the species' range further south. It is possible that the species frequently experiences low or lost seed set in years when hard frost or snowfall arrives early. Southwestern Ontario has the longest growing season in the province, so the earlier arrival of winter in the rest of Ontario may be a natural limitation to the expansion of this species beyond its current range. Whether climate change may reduce limitations for Willowleaf Aster is unknown but may be a possibility if increased temperature increases the number of frost-free days.

Willowleaf Aster also is limited by a lack of suitable habitat. Of the hundreds of square kilometres of tallgrass prairie and savanna documented in early settlement times, only about 2100 ha or 0.5% remains, with the majority lost to agricultural and residential development (Bakowsky and Riley 1994). Today, apart from areas on the Walpole Island First Nation and in the Ojibway Prairie Complex, most remnant patches are small (<2 ha) and isolated. The natural ecological processes that would create and maintain habitat for Willowleaf Aster, such as wildfire, are compromised in such small patches.

1.6 Threats to Survival and Recovery

Residential, Commercial and Industrial Development

Habitat loss due to development is a significant threat, especially where prairie remnants are within urban areas (P.A. Woodliffe, pers. comm. 2011, R. Gould, pers. comm. 2012). These lands can be perceived as vacant and may be valuable to developers (see for example, City of Windsor 2002). As well, on Walpole Island First Nation, the needs of a rapidly growing community with a small land base continue to put pressure on tallgrass prairie habitat (Bkejwanong Natural Heritage Program 2006, Walpole Island Land Trust 2012).

Development may change soil moisture levels, and Willowleaf Aster prefers moist soils. Development may also replace natural vegetation with lawns which dry out more quickly. In addition, construction of new roads and ditches may re-route surface water flow and cause adjacent land to dry out. Seasonal fluctuation of soil moisture levels is also one of the natural processes that curtail the growth of woody species (Ambrose and Waldron 2005). Changes in soil moisture may cause habitat to become unsuitable.

Altered Disturbance Regime

Habitat degradation and loss from natural succession is a threat to Willowleaf Aster in many locations. Without fire or some other type of disturbance, natural succession proceeds, resulting in a dense growth of shrubs and trees that shade habitat and make it unsuitable for Willowleaf Aster. Where Willowleaf Aster occurs in an urban landscape, and where habitat patches are small and isolated, restoring the natural wildfire regime is not practical because there are people and infrastructure close by. Even the opportunities to use controlled burning may be limited. However, periodic burning is conducted in some parts of the Ojibway Prairie Complex and Walpole Island First Nation to deter the growth of trees and shrubs, but in other parts of these two areas, Willowleaf Aster is still threatened by succession from lack of natural disturbance (C. Jacobs, pers. comm. 2012, G.E. Waldron, pers. comm. 2012).

Invasive Species

Competition from invasive species is a threat. These non-native species have the capacity to spread quickly, take over open ground and eliminate most other surrounding plants by out-competing them for resources, shading them or harming them by secreting toxins into the soil. Invasive species present in prairie habitats include Black Locust (*Robinia pseudoacacia*), Common Buckthorn (*Rhamnus cathartica*), Sweet Clover (*Melilotus alba*) and, in moist areas, Common Reed (*Phragmites australis* ssp. *australis*) (Ambrose and Waldron 2005, WEMG 2012).

Invasive species are a threat even in protected areas. In a 2011 survey for another prairie species, Slender Bush-Clover (*Lespedeza virginica*), in a savanna in Ojibway Park (COSEWIC 2012) Crown Vetch (*Securigera varia*), Autumn Olive (*Elaeagnus umbellata*) and Spotted Knapweed (*Centaurea stoebe* ssp. *micranthos*) were present, yet none were listed in earlier studies of the same opening (Pratt 1986, COSEWIC 2000). This shows invasive species to be a recent and increasing threat. However, some hand-removal of invasive species has been done in selected areas of the Ojibway Prairie Complex (P.D. Pratt, pers. comm. 2012). Common Reed is present within 10 m of Willowleaf Aster in many of the restoration areas along the DRIC-WEP, and work is being done to control this invasive species (WEMG 2012).

Conversion to Agricultural Use

Historically, most tallgrass prairie habitat was lost when the land was converted to agricultural use in early settlement times. Conversion to agriculture continues to be a current, modern threat at Walpole Island First Nation because prairie land there has never been sprayed with chemicals and can thus be used for certified organic crops. In addition, “virgin” or little-used prairie is more fertile than land that has already been utilized for crops. Agricultural producers are willing to pay higher than normal rental fees for such land (C. Jacobs, pers. comm. 2012).

Mowing and Herbicide Use

Mowing of habitat is done at some sites around Windsor, usually in some of the anthropogenic habitats (e.g., roadsides, railway embankments, old fields, etc) (P.A. Woodliffe, pers. comm. 2010). Although Willowleaf Aster does not grow well with encroaching vegetation, mowing does not necessarily result in suitable habitat conditions, and it may harm Willowleaf Aster plants. In one area in Windsor, the number of Willowleaf Aster stems doubled when mowing was discontinued (E. Reimer, pers. comm. 2012). Herbicide is also used occasionally in anthropogenic habitats. In addition to damaging Willowleaf Aster plants directly, indiscriminate herbicide use can degrade habitat by preventing future germination and growth of other prairie-associated plants. Herbicide treatment is sometimes used to control invasive species, but careful planning of the timing and method of application is required when used in the habitat of Willowleaf Aster. Timing of mowing may also be an important consideration as mowing in early spring may reduce woody growth without harming later blooming prairie species.

Habitat Degradation

Many of the patches of open land where Willowleaf Aster occurs in the City of Windsor are perceived as vacant land that no one cares about. In some of these areas people dump refuse, walk dogs and drive ATVs and dirt bikes (WEMG 2012). A lack of knowledge or understanding of the habitat may result in people trampling Willowleaf Aster and degrading the habitat.

Deer Browsing

Monitoring of Willowleaf Aster in restoration sites along the DRIC-WEP corridor found evidence of deer browse and deer preferentially eating Willowleaf Aster over other species-at-risk plants (WEMG 2012). The restoration sites are within 1 km of other Willowleaf Aster subpopulations in the Ojibway Prairie Complex, so deer may be browsing Willowleaf Aster in those areas as well as other sites.

1.7 **Knowledge Gaps**

Several natural limitations for Willowleaf Aster have been hypothesized but have not been studied. These include productivity (i.e., amount of seed set in relation to weather and flowering time), seed germination rates, availability of pollinators, current rates and distances of seed dispersal. In addition, the mechanisms causing microsatellite DNA variability among sites and the viability of extant occurrences (especially small ones) are knowledge gaps. Furthermore, greater knowledge of the severity of threats posed by white-tailed deer and by invasive species, as well as understanding the mechanism by which invasive species cause harm (e.g., shading, allelopathy, etc.) would be beneficial to focus threat reduction activities. Finally, the soil moisture levels required by the species and the relationship of moisture to groundwater is not known.

Some Willowleaf Aster populations or subpopulations have not been visited since the 1990s, and it is unknown whether they are still extant. It would be useful to know the

status of these populations in order to see the full geographic range of the species and to be able to include those populations in recovery efforts if necessary. In addition, Willowleaf Aster is probably under-reported due to its late flowering date.

Traditional ecological knowledge (TEK) has not been sought and is a knowledge gap. TEK could be useful for the recovery of Willowleaf Aster if it provides information on historical populations, the past extent of habitat or the occurrence and frequency of wildfire, all of which would be useful in trying to recover and maintain suitable habitat.

1.8 Recovery Actions Completed or Underway

On Walpole Island First Nation, many recovery actions have begun, including: raising awareness in the community about species at risk; distributing outreach materials such as newsletters and educational materials; mapping and monitoring of species at risk; and removal of invasive species. The First Nation is also currently developing an ecosystem protection plan based on the community's TEK (C. Jacobs, pers. comm. 2012). In addition, Walpole Island Land Trust (2012) was formed in 2008 with the goal to conserve land in the Walpole Island First Nation/Bkejwanong Territory. The land trust has already secured more than 300 acres of prairie and wetland habitat for conservation (Jacobs 2011). As well, approximately 70% of the prairie and savanna habitat on Walpole Island First Nation is burned annually (C. Jacobs, pers. comm. 2012).

Several populations of Willowleaf Aster are protected within the Ojibway Prairie Complex and already have protective management to conserve tallgrass prairie plants and habitat. Ojibway Park, Tallgrass Heritage Park, Ojibway Prairie Provincial Nature Reserve and Spring Garden Natural Area have active burn programs (P.D. Pratt, pers. comm. 2012).

Mitigation measures for the DRIC-WEP, according to the ESA permit, include transplanting individuals as well as transplanting rhizome cuttings. This is intended to increase the overall number of stems and mitigate any losses due to the transplant process. Initial monitoring of Willowleaf Aster at restoration sites and at a handful of natural monitoring sites in the corridor has begun. Monitoring includes stem counts and assessments of overall plant health, flowering and reproductive success. In addition, habitat management is already underway to control invasive species, especially Common Reed (WEMG 2012), at all sites. Control methods include a combination of herbicide application and cutting and rolling of dead stalks. These methods are part of accepted best management practices (BMPs) for Common Reed control (OMNR 2011). Initial assessments showed the treatments were beginning to be effective. The use of controlled burning and manual removal of woody species to maintain suitable conditions are also planned.

2.0 RECOVERY

2.1 Recovery Goal

The recovery goal is to maintain the current distribution, number and viability of all extant populations and corresponding subpopulations of Willowleaf Aster by maintaining, improving, and protecting habitat and reducing other threats.

Rationale for Recovery Goal

Willowleaf Aster was designated threatened by COSEWIC (2003) and COSSARO (2003) based on a restricted geographic range and a fragmented habitat of remnant prairie patches. The species has few occurrences and ongoing risks from habitat loss in urban areas (COSEWIC 2003, COSSARO 2003). The geographic range of the species is unlikely to expand much due to the lack of tallgrass prairie habitat and probably due to climatic factors. Therefore, recovery will focus on halting habitat loss and declines to existing populations and on reducing other threats. There is good potential for an increase in population size from restoration work in the City of Windsor, and most populations are already within protected or managed areas. Even without increasing the size of the geographic range, if habitat declines are halted and the number of individuals is increased, the species could become eligible for downlisting with the existence of a stable, viable population.

Note that part of the Windsor-LaSalle North population will not be maintained *in situ* since restoration work in the DRIC-WEP corridor will result in relocation of some parts of this population. However, most of the transported plants still end up within the limits of the original population. As well, after mitigation the overall distribution of the species in Ontario is somewhat augmented and can still be maintained.

2.2 Protection and Recovery Objectives

Table 2. Protection and recovery objectives

No.	Protection or Recovery Objective
1	Assess threats and plan measures for mitigation and reduction.
2	Maintain or improve habitat suitability at all existing sites.
3	Ensure adequate habitat and species protection by monitoring and initiating recovery actions when necessary.
4	Fill knowledge gaps.

2.3 **Approaches to Recovery**

Table 3. Approaches to recovery of the Willowleaf Aster in Ontario

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
1. Assess threats and plan measures for mitigation and reduction.				
Critical	Short-term	Monitoring and Assessment	**1.1** Assess status of habitat and current threats at all sites. – Assess openness and degree of active disturbance, both natural and human-made. – Assess types of improvement needed.	• Natural succession • Invasive species • Deer browse • Mowing and herbicide use • Indiscriminate land use
Critical	Short-term	Management	**1.2** Assess threat from invasive species. – Consider BMPs for individual invasives. – Plan control work for appropriate time of year.	• Invasive Species
Critical	Short-term	Outreach	**1.3** Seek partners and volunteers, and secure funding for habitat improvement actions.	• Any and all threats
Critical	On-going	Management	**1.4** Assess feasibility of controlled burning at sites where it is not yet occurring. – Plan and schedule burns where possible.	• Natural succession • Invasive species
Critical	Short-term	Management	**1.5** Based on 1.1 – 1.4, plan required actions to improve habitat and reduce threats, such as cutting of shrubs, fencing out deer, erecting signage, etc. Prepare site-specific management plans to guide actions.	• Natural succession • Invasive species • Deer browse • Mowing and herbicide use • Indiscriminate land use
Necessary	Short-term	Outreach	**1.6** Contact corporate owners to discuss Willowleaf Aster and its habitat. – Assist owners with planning other methods of habitat maintenance or appropriate timing of actions.	• Mowing and herbicide use • Indiscriminate land use • Invasive species

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
2. Maintain or improve habitat suitability at all existing sites.				
Critical	On-going	Management and Outreach	**2.1** After assessment and planning (steps 1.1 to 1.6 above) begin work to improve habitat and reduce threats with the following, as appropriate: – controlled burning; – cutting or clipping of shrubs; – control of invasive species; – fencing to keep out deer; – signage to inform habitat users; – designation of trails to eliminate trampling; and – assisting with actions on Walpole Island First Nation if requested.	• Natural succession • Invasive species • Deer browse • Indiscriminate land use • Mowing and herbicide use
Critical	On-going	Outreach	**2.2** Liaise with and support Walpole Island First Nation in recovery actions developed by the community. – Assist with threats reduction and mitigation work as requested by the community. – Support the community in efforts to secure funding for ongoing work.	• Conversion to agriculture • Development • Invasive species • Natural succession • Indiscriminate land use
Necessary	On-going	Outreach	**2.3** Liaise with municipal planners to discuss ways to protect Willowleaf Aster during development and to ensure protection of habitat patches.	• Development
Necessary	On-going	Outreach	**2.4** Assist with leasing of land for conservation on Walpole Island First Nation if requested.	• Conversion to agriculture
Necessary	On-going	Outreach	**2.5** Liaise and develop partnerships with agricultural operators on Walpole Island.	• Conversion to agriculture

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
3. Ensure adequate habitat and species protection by monitoring and initiating recovery actions when necessary.				
Necessary	On-going	Monitoring and assessment	**3.1** Set up monitoring at sites where it is not yet in place. – Work with different jurisdictions: municipalities, conservation authorities, private and corporate landowners, etc. – Develop protocol and appropriate time intervals between assessments.	• Any or all threats
Necessary	On-going	Outreach	**3.2** Partner with landowners in and around Willowleaf Aster patches to help with monitoring and reducing threats. – Undertake outreach to help landowners identify and understand Willowleaf Aster and its needs.	• Any or all threats
Critical	On-going	Outreach	**3.3** Liaise with and support Walpole Island First Nation in recovery actions developed by the community. – Assist with threats reduction and mitigation work as requested by the community. – Support the community in efforts to secure funding for ongoing work.	• Conversion to agriculture • Development • Invasive species • Natural succession • Indiscriminate land use
4. Fill knowledge gaps.				
Beneficial	Long-term	Assessment; Research	**4.1** Survey and monitor sites where population status is unknown. – Ensure work is done in fall when Willowleaf Aster is in flower.	• Unknown population status
Beneficial	Long-term	Research	**4.2** Survey other known prairie and savanna sites for Willowleaf Aster in late fall.	• Species range
Beneficial	Long-term	Research	**4.3** Conduct research on pollination, seed set, and other natural limitations, as well as on threat mechanisms from invasive species and White-tailed Deer.	• Natural limitations • Threat mechanisms

Relative Priority	Relative Timeframe	Recovery Theme	Approach to Recovery	Threats or Knowledge Gaps Addressed
Beneficial	Long-term	Research	**4.4** Gather TEK whenever possible. – Potential informants may be Aboriginal elders, Windsor homeowners, farmers, etc.	• Better understanding of species movements • Biological needs • Threats

Narrative to Support Approaches to Recovery

Many populations already have some degree of protective management, either through being within a park, conservation area or restoration site or by having a land use designation, such as an environmentally sensitive area or candidate natural heritage site. Still, despite some type of protection, many sites continue to be threatened by a lack of disturbance (leading to closing in of the vegetation) and by invasive species. Therefore, all sites should have a detailed threats assessment (as per steps 1.1 and 1.2) and planning for appropriate actions to reduce threats (as per steps 1.4 and 1.5), and then actions should be undertaken (as per step 2.1 and other steps).

In addition, ensuring adequate habitat protection for some Willowleaf Aster sites may be challenging because many are small patches of open ground in residential areas between or behind housing blocks. On-going monitoring is already in place for the patches that are DRIC-WEP restoration sites, but a protocol should be standardized and put in place for as many other subpopulations as possible to allow timely responses to threats and to ensure no patches are lost.

Furthermore, Willowleaf Aster habitat must have disturbance because without it, the habitat will eventually disappear. Unless there is a way for some type of disturbance (either natural or human-made) to occur, the habitat is probably not adequately protected. In anthropogenic habitats, to ensure habitat is maintained it is likely that most human activities will need to continue. Outreach and monitoring will be needed to ensure the right levels of disturbance are maintained without damaging Willowleaf Aster plants. As well, outreach will be important to keep adjacent landowners informed and included in the recovery process.

It may be possible to combine recovery work with actions required for other species at risk, especially other prairie-associated plants such as Colicroot (*Aletris farinosa*) and Dense Blazing Star (*Liatris spicata*) which may share the same habitat patches as Willowleaf Aster.

2.4 **Area for Consideration in Developing a Habitat Regulation**

Under the ESA, a recovery strategy must include a recommendation to the Minister of Natural Resources on the area that should be considered in developing a habitat regulation. A habitat regulation is a legal instrument that prescribes an area that will be protected as the habitat of the species. The recommendation provided below by the author will be one of many sources considered by the Minister when developing the habitat regulation for this species.

Willowleaf Aster grows in a variety of habitats, including tallgrass prairie and oak savanna communities, as well as anthropogenic habitats such as abandoned agricultural lands, railway embankments, roadsides, ditches, woodland edges and other open disturbed grounds (COSEWIC 2003). Habitat for Willowleaf Aster may be found as a large open area or as a smaller opening within another vegetation type. It may

also be found as a small patch of open ground surrounded by developed land such as lawns and houses.

The vegetation community types of the natural habitat of Willowleaf Aster according to the ELC (Lee et al. 1998) have not been documented, but Fresh-Moist Tallgrass Prairie (TPO2-1), Fresh-Moist Pin Oak – Bur Oak Tallgrass Savanna (TPS2-1), and parts of Fresh-Moist Tallgrass Woodland (TPW2) communities are likely the types that provide suitable habitat. Other suitable habitats, such as damp meadows, utility corridors and woodland edges, have not been characterized although they may fit into a cultural meadow, thicket, savannah or woodland vegetation type (CUM1, CUT1, CUS1, or CUW1). However, suitable growing conditions have been described in detail. As such, it is recommended that suitable habitat for Willowleaf Aster be characterized as:

- Fresh-moist Tallgrass Prairie (TPO2-1);
- Fresh-Moist Pin Oak – Bur Oak Tallgrass Savanna (TPS2-1);
- edges and openings of Fresh-moist Tallgrass Woodland (TPW2);
- an anthropogenic habitat, such as an old field, wet meadow, roadside, railway embankment, utility corridor, drainage ditch, dike, thicket, vacant city lot or other area where:
  - the habitat is open (< 50% tree or shrub cover) and not shaded in the growing season;
  - the habitat is predominantly (>50 %) covered with herbaceous plants or unvegetated, and;
  - most of the vegetation (>50%) is the same height or shorter than Willowleaf Aster plants that are in flower.

It is recommended that the area to be prescribed for a habitat regulation include all sites where Willowleaf Aster has been reported, unless the species has been documented to be extirpated from the site. There is a lack of recent field work at some sites and the species is easily overlooked. As well, the ability of this species to colonize some types of disturbed lands, such as old fields, shows that it may tolerate fairly high levels of disturbance. Thus, it should not be assumed that the species has disappeared unless it is confirmed to be absent from reported sites.

Therefore, it is recommended that the habitat to be considered for regulation be prescribed as follows:

1) In natural tallgrass prairie and oak savanna vegetation, it is recommended that the entire ELC vegetation type polygon in which Willowleaf Aster is present be prescribed, as well as a protective zone of 50 m around the outside of the polygon boundary, excluding situations listed in #4 below, such as active agricultural areas, lawns, and gardens. The entire ELC polygon should be protected to allow dispersal and establishment of the species and to allow space for burning (or other disturbance that maintains suitability of habitat) to take place. As well, the natural habitat is needed to support the biological requirements of pollinators. Finally, suitable natural habitat is extremely limited.

Therefore, it is recommended that where the species occurs all known existing habitat be protected.

A distance of 50 m has been shown to provide a minimum critical function zone to ensure microhabitat properties for rare plants. A study on micro-environmental gradients at habitat edges (Matlack 1993) and a study of forest edge effects (Fraver 1994) found that effects could be detected as far as 50 m into habitat fragments. Forman and Alexander (1998) and Forman *et al.* (2003) found that most roadside edge effects on plants resulting from construction and repeated traffic have their greatest impact within the first 30 m to 50 m.

2) In anthropogenic habitats and in natural tallgrass woodland vegetation, it is recommended that all of the continuously open area around Willowleaf Aster that meets the above criteria be prescribed, as well as a protective zone of 50 m around the outside of the open area, excluding the situations listed in #4 below. This is recommended to protect the plants, to ensure suitable moisture conditions can be maintained and to allow space for disturbance and dispersal to occur. If the continuously open area is small, it is recommended that a minimum radial distance of 50 m around patches of Willowleaf Aster be prescribed even if some of the vegetation inside the circle does not meet the habitat criteria listed above. Again, situations listed in #4 should be excluded from the prescription. It is not recommended that the entire polygon of tallgrass woodland be prescribed (as per #1) because the majority of the vegetation polygon would likely not be suitable habitat. Willowleaf Aster occupies the edges and openings of woodlands, so it is recommended that the criteria for prescribing open area will be a more precise method to prescribe habitat in tallgrass woodland vegetation.

3) In linear habitats such as railway embankments, utility corridors, ditch banks, etc., where there may be no limit to the continuously open area, it is recommended that habitat be prescribed to a maximum distance of 100 m from the edge of the Willowleaf Aster patch running in the same direction as the rest of the embankment or corridor. This distance is recommended to allow adequate space for dispersal of seeds. A 50 m minimum protective zone is recommended in the direction perpendicular to the patches of Willowleaf Aster plants in these habitats, but with situations listed in #4 excluded.

4) It is recommended that the active, driveable surface of existing roads, railway tracks, driveways and parking lots, as well as trails, buildings, septic beds, dikes, active agricultural areas (e.g., crops or pasture) and manicured vegetation (e.g., lawns and gardens) not be prescribed as habitat. However, roadsides, roadside ditches, railway embankments and the edges of lawns and trails may still be prescribed to ensure that human actions continue to maintain the disturbance regime without harming the plants.

5) Should any new patches of Willowleaf Aster be discovered, it is recommended that the above criteria should apply to the habitat as applicable.

It is recommended that restoration sites for mitigation work in the DRIC-WEP and federal plaza area receive a habitat regulation based on #1, #2, or #3 as appropriate. One objective of mitigation is long-term habitat protection (WEMG 2012), so it is assumed that the intent is to manage these sites either to remain or to eventually become natural habitat with self-sustaining patches of Willowleaf Aster.

GLOSSARY

Allelopathy: The suppression of growth of one plant by another due to the release of toxic chemicals.

Clone: A cluster of stems deriving from the same rhizome and thus belonging to the same parent plant. All stems have the same genetic make-up.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): The committee established under section 14 of the *Species at Risk Act* that is responsible for assessing and classifying species at risk in Canada.

Committee on the Status of Species at Risk in Ontario (COSSARO): The committee established under section 3 of the *Endangered Species Act, 2007* that is responsible for assessing and classifying species at risk in Ontario.

Conservation status rank: A rank assigned to a species or ecological community to convey the degree of rarity at the global (G), national (N) or subnational (S) level. These ranks, termed G-rank, N-rank and S-rank, are not legal designations. Conservation status is ranked on a scale from 1 to 5 as follows:

1 = critically imperilled
2 = imperilled
3 = vulnerable
4 = apparently secure
5 = secure

Ecological Land Classification: A system for evaluating different types of vegetation, such as Sugar Maple Deciduous Forest, Cattail Mineral Shallow Marsh, etc. The current standard for Ontario is based on the work by Lee et al. 1998.

Endangered Species Act, 2007 (ESA): The provincial legislation that provides protection to species at risk in Ontario.

Extirpated: When a species is no longer present in an area where it once occurred.

Glaucous: Having a waxy or powdery coating that gives a whitish or bluish cast, such as on a plum.

Rhizome: A horizontal stem that grows along the ground.

Species at Risk Act (SARA): The federal legislation that provides protection to species at risk in Canada. This act establishes Schedule 1 as the legal list of wildlife species at risk. Schedules 2 and 3 contain lists of species that at the time the Act came into force needed to be reassessed. After species on Schedule 2 and 3 are reassessed and found to be at risk, they undergo the SARA listing process to be included in Schedule 1.

Species at Risk in Ontario (SARO) List: The regulation made under section 7 of the *Endangered Species Act, 2007* that provides the official status classification of species at risk in Ontario. This list was first published in 2004 as a policy and became a regulation in 2008.

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