PROPOSED

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Illinois Tick-trefoil (*Desmodium illinoense*) in Canada

Illinois Tick-trefoil

2017

Government of Canada
Gouvernement du Canada

Canada

Recommended citation:

Environment and Climate Change Canada. 2017. Recovery Strategy for the Illinois Tick-trefoil (*Desmodium illinoense*) in Canada [Proposed]. *Species at Risk Act* Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. viii + 20 pp.

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

Cover illustration: Flowering raceme of Illinois Tick-trefoil in Michigan (B.S. Walters, Michigan Flora Online).

Également disponible en français sous le titre
« Programme de rétablissement de la desmodie d'Illinois (*Desmodium illinoense*) au Canada [Proposition] »

ISBN
Catalogue no.

[1] http://sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1

Preface

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

The Minister of Environment and Climate Change is the competent minister under SARA for the Illinois Tick-trefoil and has prepared this recovery strategy, as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the Province of Ontario, as per section 39(1) of SARA.

It was determined that the recovery of the Illinois Tick-trefoil in Canada is not technically or biologically feasible. The species still may benefit from general conservation programs in the same geographic area and will receive protection through SARA and other federal, and provincial or territorial, legislation, policies, and programs.

The feasibility determination will be re-evaluated as part of the report on implementation of the recovery strategy, or as warranted in response to changing conditions and/or knowledge.

The recovery strategy sets the strategic direction to support recovery of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When critical habitat is identified, either in a recovery strategy or an action plan, SARA requires that critical habitat then be protected.

In the case of critical habitat identified for terrestrial species including migratory birds SARA requires that critical habitat identified in a federally protected area[3] be described in the *Canada Gazette* within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry. A prohibition against destruction of critical habitat under ss. 58(1) will apply 90 days after the description of the critical habitat is published in the *Canada Gazette*.

For critical habitat located on other federal lands, the competent minister must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies.

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

[3] These federally protected areas are: a national park of Canada named and described in Schedule 1 to the *Canada National Parks Act*, The Rouge National Park established by the *Rouge National Urban Park Act*, a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Bird Convention Act, 1994* or a national wildlife area under the *Canada Wildlife Act* see ss. 58(2) of SARA.

If the critical habitat for a migratory bird is not within a federal protected area and is not on federal land, within the exclusive economic zone or on the continental shelf of Canada, the prohibition against destruction can only apply to those portions of the critical habitat that are habitat to which the *Migratory Birds Convention Act, 1994* applies as per SARA ss. 58(5.1) and ss. 58(5.2).

For any part of critical habitat located on non-federal lands, if the competent minister forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament, or the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to prohibit destruction of critical habitat. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

Acknowledgments

The initial draft of this document was prepared by Judith Jones (Winter Spider Eco-Consulting). Development of the recovery strategy was facilitated by Judith Girard and Justine Mannion. Wasyl Bakowsky (Ontario Natural Heritage Information Centre), Graham Buck (Ontario Ministry of Natural Resources and Forestry), Jarmo Jalava (Carolinian Canada Coalition), and Bradford Slaughter (Michigan Natural Features Inventory) are thanked for providing useful information. Tim Dickinson (University of Toronto), Deborah Metsger (Royal Ontario Museum) and Anton Reznicek (University of Michigan) are thanked for their help in providing information about and confirming the identification of the Thamesville record of Illinois Tick-trefoil. The recovery plan benefited from input, review, and suggestions from the following individuals: Ken Corcoran, Angela Darwin, Allison Foran, Krista Holmes, Angela McConnell, Karolyne Pickett, Christina Rohe, Kathy St. Laurent, Ken Tuininga (Environment and Climate Change Canada, Canadian Wildlife Service – Ontario), Véronique Brondex, Paul Johanson, Marie-Andrée Carrière (Environment and Climate Change Canada, Canadian Wildlife Service – NCR), Eric Snyder, Jay Fitzsimmons, Leanne Jennings, Glenn Desy Vivian Brownell,Michael Oldham and representatives of the Aylmer District office (Ontario Ministry of Natural Resources and Forestry). B.S. Walters (Michigan Flora Online) is gratefully acknowledged for allowing the use of the photographs.

Acknowledgement and thanks is given to all other parties that provided advice and input used to help inform the development of this recovery strategy including various Indigenous organizations and individuals, individual citizens, and stakeholders who provided input and/or participated in consultation meetings.

Executive Summary

Illinois Tick-trefoil is a perennial, herbaceous plant in the bean family with compound leaves on an upright, unbranched stem, with white, pink, or purple flowers.

Illinois Tick-trefoil is listed as Extirpated on Schedule 1 of the *Species at Risk Act* (SARA) and is also listed as Extirpated in Ontario under the *Endangered Species Act, 2007* (ESA). It has been recorded only twice in Canada; at Komoka, Ontario in 1888, and north of Thamesville, Ontario in 1978. The species is found in the U.S. from southern Michigan and southern Wisconsin, to Oklahoma and northern Texas, and NatureServe ranks it as globally Secure (G5).

Based on reports from the U.S., the general habitat for Illinois Tick-trefoil is dry, upland prairies and roadsides, fields, railways, and borders and openings in oak forests which support remnant prairie habitat. Suitable habitat for Illinois Tick-trefoil in Canada is likely to occur in a range of vegetation types including both prairie and old field communities.

Recovery in Canada for Illinois Tick-trefoil is not considered to be biologically or technically feasible at this time. There are no known extant occurrences in Canada, and while the species is common in parts of the U.S., it is unknown if U.S. populations are genetically similar to the extirpated Canadian population. The specific habitat that Illinois Tick-trefoil used in Canada is unknown, so it is unknown if suitable habitat is available to support the species. In the U.S. this species is closely associated with tall-grass prairie, but given the limited amount of tall-grass prairie habitat available in southern Ontario, it is unlikely that enough habitat could be made available to support a resilient and redundant Canadian population within a reasonable timeframe. The feasibility of recovery may be revised if population(s) are discovered in Canada, or if reintroduction from U.S. populations becomes appropriate.

There is no specific information on the threats to Illinois Tick-trefoil in Canada. However, historical threats, indirect or cumulative effects of the threats, as well as threats that can be hypothesized to affect potential existing population or future reintroduced populations are presented. These include: conversion of habitat to agriculture or urban or industrial development; lack of disturbance; invasive species; over-grazing; and inappropriate use of off-road vehicles.

Since there is no direct information available on suitable habitat for Illinois Tick-trefoil in Canada, and there are no known populations of Illinois Tick-trefoil growing in Canada at the current time, no critical habitat is identified in this recovery strategy. Specific activities to be undertaken for the species in Canada are presented in the Conservation Approach section (Section 6).

Recovery Feasibility Summary

Based on the following four criteria that Environment and Climate Change Canada uses to establish recovery feasibility, recovery of the Illinois Tick-trefoil has been determined not to be biologically or technically feasible at this time. Recovery is considered not feasible when the answer to any of the following questions is “no”. The feasibility of recovery may be revised if population(s) are discovered in Canada, or if reintroduction from U.S. populations becomes appropriate.

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.

Unknown. Illinois Tick-trefoil is known from two records in Canada; from the Komoka area in 1888 and from the Thamesville area in 1978. There are currently no known populations in Canada; the Komoka population is considered extirpated (Klinkenberg 1991), and the status of the Thamesville population is unknown as no surveys are known to have been conducted in the area of the record since the specimen was collected.

Despite its small historical distribution in Canada, Illinois Tick-trefoil is common in parts of its range in the U.S. (NatureServe 2015), and does grow at similar latitude to the Canadian records in parts of Michigan and Wisconsin (Kartesz 2015). U.S. populations produce seeds and are capable of reproduction, but it is unknown if U.S. populations are genetically similar to the extirpated Canadian population. If plants of different genetic strains are introduced into Canada from the U.S., they may either not be adapted to the local climate, and therefore not survive or thrive, or if they do thrive, may swamp the genetics of any remaining populations of native Canadian plants.

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

No. Due to the combination of lack of currently available suitable habitat, lack of information about suitable habitat requirements in Canada, and the low likelihood that sufficient habitat could be restored in a timely manner it is considered that sufficient suitable habitat is not currently available, nor can it be made available in a reasonable timeframe to support the recovery of Illinois Tick-trefoil.

The specific habitat that Illinois Tick-trefoil used in Canada is unknown, as there is no habitat information associated with either of the Canadian records; therefore suitable habitat cannot be said to be available at this time. It is unlikely that the exact location at Komoka where Illinois Tick-trefoil was recorded in 1888 still supports prairie vegetation, as the loss of prairie habitat in this region has been extensive. Since the area of the Thamesville record has not been surveyed since the plant was found there in 1978 it is unknown if suitable habitat remains at this site. However, given that this record was found along a railway line, even if suitable habitat exists

there, the amount of habitat is likely to be very small, and therefore insufficient to support a self-sustaining population of Illinois Tick-trefoil.

There are small remnants of tall-grass prairie habitat, which is used by this species in its U.S. range, available in southern Ontario, including in the general area of the Komoka record. However, since no information is available on the specific habitat this plant used in Ontario, it is unknown if these would provide suitable habitat. Little is known about how variable the habitat requirements for this species are, so it is not clear if habitat requirements on the northern edge of its range in southern Ontario are different from habitat requirements in the U.S. In addition, given the limited amount of tall-grass prairie habitat available in southern Ontario, it is unlikely that enough habitat could be made available to support a resilient[4] and redundant[5] Canadian population in a reasonable timeframe.

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

Unknown. Threats to Illinois Tick-trefoil in Canada are unknown, but can be hypothesized based on threats faced by other prairie plants in southern Ontario and threats affecting Illinois Tick-trefoil populations in the U.S. These include: loss of habitat due to conversion of land to agriculture, or urban or industrial development; lack of disturbance (e.g. fire) required to maintain open prairie habitat; invasive species; over-grazing; and inappropriate use of recreational vehicles which can damage prairie plants and habitat. If populations of Illinois Tick-trefoil are rediscovered in Canada, it may be possible to mitigate these hypothesized threats, but a threat assessment will need to be completed to assess threats at that time.

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

Unknown. Specific recovery techniques are unknown for Illinois Tick-trefoil. While recovery techniques exist and have been tested for other at risk prairie plants; especially due to the large amount of work that has been done to mitigate impacts from the construction of the Rt. Hon. Herb Grey Parkway in Windsor, Ontario (e.g. habitat restoration, transplantation and reintroduction to extirpated locations), it is uncertain whether these techniques could be applied to Illinois Tick-trefoil. Despite its rarity in Canada, this species is common in parts of the U.S. and techniques for growing Illinois Tick-trefoil from seed are available (e.g. Blessman et al. 2001). In addition, there are examples of prairie restorations in the U.S. that have included Illinois Tick-trefoil (e.g. Illinois Tick-trefoil is included in seed mix recommended for restoring dry-mesic prairies; Packard and Mutel 1997). However, as it is not currently known if Illinois Tick-trefoil persists at the Thamesville location, it is not appropriate to proceed with establishing any new Canadian populations at

[4] Population is sufficiently large to recover from periodic disturbance and avoid demographic and genetic collapse

[5] Population consists of enough (sub) populations or locations to withstand catastrophic events and to facilitate rescue if necessary.

this time, as plants would be need to be sourced from populations native to the U.S. and might be genetically differentiated from a potential existing Canadian population. A lack of clear understanding of the specific habitat used by this plant in Canada, and the rarity of remaining tall-grass prairie habitats in southern Ontario, will further complicate any future reintroduction efforts, even if the Thamesville population is confirmed as extirpated. Conservation actions that can benefit this species, including additional surveys are outlined in Section 6.

Illinois Tick-trefoil has only been recorded twice in Canada, and there is no information available about its population size in Canada. In addition, the Canadian records are at the northern edge of this species' range. Even if a population of Illinois Tick-trefoil is discovered in Canada, Illinois Tick-trefoil will likely always be rare and vulnerable to human-induced and natural stressors, due to its naturally limited distribution at the northern edge of its range, and its apparent dependence on a rare community type (tall grass prairie).

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1. COSEWIC* Species Assessment Information

Date of Assessment: May 2000

Common Name (population): Illinois Tick-trefoil

Scientific Name: *Desmodium illinoense*

COSEWIC Status: Extirpated

Reason for Designation: Seemingly extirpated from the site of the single historical record and presently unknown from other suitable habitats[a].

Canadian Occurrence: Ontario

COSEWIC Status History: No site records since 1888[a]. Designated Extirpated in April 1991. Status re-examined and confirmed in May 2000.

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

[a] A second Canadian record of Illinois Tick-trefoil from 1978 was confirmed in 2016 (Green Plant Herbarium 2013; Reznicek and Metsger pers. comm. 2016).

2. Species Status Information

Illinois Tick-trefoil is listed as Extirpated[6] on Schedule 1 of the *Species at Risk Act* (SARA) and is also listed as Extirpated[7] in Ontario under the *Endangered Species Act, 2007* (ESA). In Ontario the species has recently been re-ranked as Possibly Extirpated (SH[8]) from Presumed Extirpated (SX[9]) due to the discovery of a record from 1978. A similar change in the national ranking is expected in the near future. The conservation status of Illinois Tick-trefoil globally and in the U.S. is described in Table 1. In Michigan, the closest part of the range to the known locations of this species in southern Ontario, the species has not been ranked, but is usually locally common (Slaughter pers. comm. 2014).

[6] a wildlife species that no longer exists in the wild in Canada, but exists elsewhere in the wild

[7] a wildlife species that lives somewhere in the world, and at one time lived in the wild in Ontario, but no longer lives in the wild in Ontario

[8] Possibly Extirpated – Known from only historical records but still some hope of rediscovery. There is evidence that the species or ecosystem may no longer be present in the jurisdiction, but not enough to state this with certainty. (Master et al. 2012).

[9] Presumed Extirpated - Species or ecosystem is believed to be extirpated from the jurisdiction (Master et al. 2012)

Table 1. List and description of conservation ranks for Illinois Tick-trefoil (NatureServe 2015).

	Global (G) Rank[a]	**National (N) Rank[a]**	**Sub-national (S) Rank[a]**
Illinois Tick-trefoil (*Desmodium illinoense*)	G5 (Secure)	United States (N5?)	Arkansas (S2), Illinois (SNR), Indiana (SNR), Iowa (S4), Kansas (SNR), Michigan (SNR), Minnesota (S4S5), Missouri (SNR), Nebraska (SNR), Ohio (SH), Oklahoma (SNR), South Dakota (SNR), Texas (SNR), Wisconsin (SNR)

[a] *The conservation status of a species is designated by a number from 1 to 5, preceded by a letter reflecting the appropriate geographic scale of the assessment (G = Global, N = National, and S = Subnational). The numbers have the following meaning: 1 = critically imperiled, 2 = imperiled, 3 = vulnerable, 4 = apparently secure, 5 = secure, NR = Unranked (Master et al. 2012).*

3. Species Information

3.1 Species Description

Illinois Tick-trefoil, also called Prairie Tick-trefoil or Illinois Tickclover, is a perennial[10], herbaceous[11] plant in the bean or legume family (*Fabaceae*) (Figure 1). It has compound leaves[12] composed of three oval-shaped leaflets each 6 – 10 cm long with slightly pointed tips, growing alternately along an upright, usually unbranched stem 1.0 – 1.5 m tall. The terminal leaflet is somewhat longer and wider than the side leaflets (Gray et al. 1970). The entire plant is sparsely hairy, and the leaflets may be rough on both sides or the underside may be slightly sticky (Gray et al. 1970; Gleason and Cronquist 1991; Klinkenberg 1991). Flowers are produced from July to early September (Klinkenberg 1991) in a single, raceme[13]. As with some other species of this genus, the flowers of Illinois Tick-trefoil are white when they open but may gradually turn purple after pollination (Klinkenberg 1991; Willmer et al. 2009), and thus may be found in white or shades of pink to purple.

The fruit is a small, flattened pod 4 – 8 mm long by 3.5 – 5 mm wide with a roughened surface. The pod has constrictions along its length which allow it to break apart into 3 to 6 rounded segments or loments, each 4 – 6.5 mm long (Gleason and Cronquist 1991; Reznicek et al. 2011). Hooked hairs on the pod surface allow the loments to stick to animal fur and human clothing, leading to the colloquial name of hitchhikers or stick-tights.

Hoary Tick-trefoil (*D. canescens*) and Canada Tick-trefoil (*D. canadense*) are similar in appearance to Illinois Tick-trefoil and may grow in the same habitats. Illinois Tick-trefoil

[10] a plant that lives for more than two years
[11] a non-woody plant whose leaves and stems die back following the growing season
[12] A leaf whose blade is divided into two or more distinct leaflets, with the buds at the base of the leaf, not at each leaflet.
[13] A flower cluster with separate flowers attached by short stalks along a central stem.

can be distinguished from these two species by the following traits (Gray et al. 1970; Gleason and Cronquist 1991; Reznicek et al. 2011):

Loments oval-shaped with rounded edges, not triangular
Loments small, 4 – 6.5 mm long
A prominent network of raised veins on the backs of the leaflets
Stem usually unbranched, with a single inflorescence[14]

Figure 1 Features of Illinois Tick-trefoil showing (upper) compound leaf with three leaflets and (lower) rounded aspect of the fruits. (Photos: B.S. Walters, Michigan Flora Online, used with permission).

[14] The complete flower head of a plant including stems, stalks, bracts and flowers.

3.2 Species Population and Distribution

Illinois Tick-trefoil is found only in North America. This species is closely associated with tall-grass prairie habitat, and its distribution is similar to the former extent of tall-grass prairie (Klinkenberg 1991). In the U.S., the range of this species forms a band that runs southwest from southern Michigan and southern Wisconsin, to Oklahoma and northern Texas (Kartesz 2015). In Michigan, the closest part of the range to the historical records in Ontario, the species is present in 18 counties, occurring across the southern part of the state (Reznicek et al. 2011).

Illinois Tick-trefoil has been recorded twice in Canada (Figure 2). A specimen was collected in August 23, 1888 by J. Dearness at Komoka, in Middlesex County, Ontario, just west of London. The specimen is housed at the Canadian Museum of Nature and identification of the specimen has been confirmed by at least two experts, as noted in the herbarium files (Jones pers. comm. 2014). As was common at the time of collection, no location or habitat data was recorded other than the name of the nearest town, so nothing is known about the exact location of the plant, the number of Illinois Tick-trefoil individuals present, or about the habitat in which it was growing.

A second specimen was collected along a railway line about 5 km north of Thamesville, Chatham-Kent County, Ontario by R.E. Whiting, P.M. Catling and R. Brown in 1978. Similar to the Komoka record, no additional information is available about the habitat (other than it was collected alongside a railway) or the number of plants present at the time of collection. The specimen is housed at the Green Plant Herbarium at the Royal Ontario Museum (ROM), and has been verified by A. Reznicek (Green Plant Herbarium 2013; Reznicek and Metsger pers. comm. 2016). This specimen was unknown until revealed by a search of the online Canadensys biodiversity database[15] in November 2015.

The collection of the Thamesville record alongside a railway raises the possibility that the individual collected was adventive[16] (for example, seeds might be deposited in the area by a passing train). However, Illinois Tick-trefoil is known from railway habitats in the U.S. (Raveill 2005) and prairie remnants do exist along railways in southern Ontario (Bakowsky and Riley 1994), so without further surveys of the area it is difficult to judge whether this record is likely to be from an established or adventive population.

There are no other known historical or current records of this species from anywhere else in Canada, including the historical prairies in western provinces or well-studied, extant Ontario prairies such as Walpole Island or the Ojibway Prairie Complex in Windsor. As such, there is no evidence that the species was ever wide-spread or abundant in Canada.

[15] http://www.canadensys.net/
[16] not native to and not fully established in a new habitat or environment

The Komoka area has been searched for Illinois Tick-trefoil several times since the original record in 1888, but the species has not been found again. A targeted search for the species in 1985 found no presence (Klinkenberg 1991). Untargeted surveys of other prairie habitats in southern Ontario have also not found Illinois Tick-trefoil including: a prairie theme study (Bakowsky and Oldham unpublished data 1992; Gore and Storrie 1993); surveys involved in the proposal, development and management of Komoka Provincial Park (Klinkenberg 1985; Ambrose et al. 2003); and surveys by both prairie experts and local naturalists (Tallgrass Ontario 2014). Nevertheless, several undocumented patches of remnant prairie have been discovered recently in the Komoka area (Buck pers. comm. 2014; Jalava pers. comm. 2014), where it is possible that Illinois Tick-trefoil persists. It is unknown whether any further surveys have taken place at the location of the Thamesville record since 1978, so the persistence of either the species or of suitable habitat for the species at this location is unknown.

It is unknown why Illinois Tick-trefoil is no longer found at Komoka; whether the loss was due to human activities, natural changes in conditions, or other reasons; however the extensive loss of prairie habitat in southern Ontario is the most likely explanation (see 4.2 Description of threats). Hypotheses for the small historical distribution of this species in Canada include: intentional maintenance of prairie habitat by Indigenous people (e.g. Reznicek 1983; Bakowsky and Riley 1994), which may have allowed Illinois Tick-trefoil to persist in small areas; transplantation of this species to a specific location by Indigenous people, due to its medicinal properties (e.g. Morton and Venn 2000); or chance, long-distance dispersal events at the time of its collection.

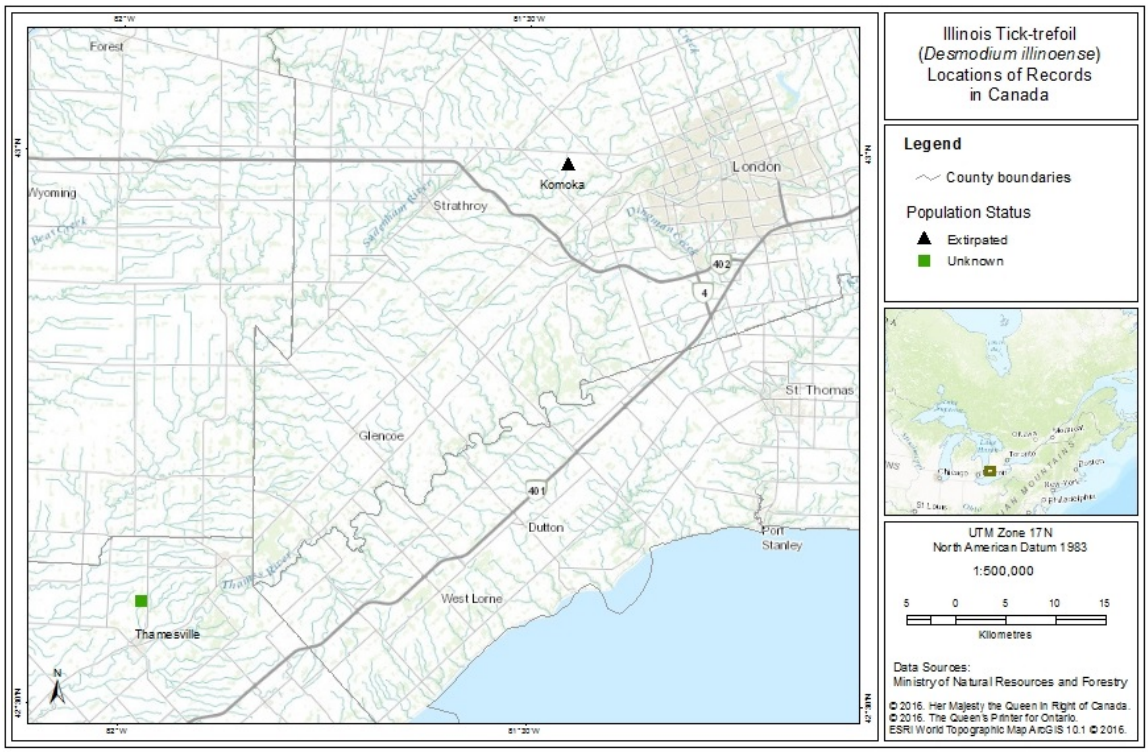

Figure 2. The Canadian distribution of Illinois Tick-trefoil.

3.3 Needs of the Illinois Tick-trefoil

Biological Needs

No specific information on reproduction was found for Illinois Tick-trefoil. Some species of genus *Desmodium* are known to be self-fertile[17] (Chow and Crowder 1973), but other species predominantly use cross-pollination[18] to reproduce (Smith 1975). Illinois Tick-trefoil is mainly pollinated by bumble bees, other bees and butterflies (Klinkenberg 1991), and like other *Desmodium* has explosive blossoms that shoot a cloud of pollen at the pollinator when it lands on the flower (Willmer et al. 2009).

Many legumes have symbiotic relationships with soil microbes (bacteria, called rhizobia) that fix atmospheric nitrogen and turn it into a form usable by the plant. *Desmodium* species including Illinois Tick-trefoil have specialized nodules (out-growths) on the upper part of the tap root that house rhizobia (Burton 1972), allowing the plants to live in nutrient-poor soils. Some legumes are highly specific in their rhizobial associations, but *Desmodium* species have been found to grow with widely available rhizobial inocula[19] (Burton 1972). Thus, a lack of soil nutrients or rhizobiae are unlikely to limit Illinois Tick-trefoil.

Several species of *Desmodium* are known to maintain a seed bank (Auld 1996) although no information was available specifically for Illinois Tick-trefoil. Auld and O'Connell (1991) reported that in fire-prone habitats, fire is the main stimulus for seed germination, and they found that dry heat was capable of breaking seed dormancy in 32 species of legumes including Australian species of *Desmodium*. Bradstock and Auld (1995) report that soil temperatures reached after burning influence germination of buried legume seeds, and that low-intensity fires in controlled burns may not reach sufficient temperatures to permit germination of legumes. While an estimate of the length of time Illinois Tick-trefoil seeds can persist in the soil is unavailable, it seems unlikely that seeds could still be viable at Komoka after more than 100 years, a lack of fire to break seed dormancy or promote germination, and an extensive history of soil cultivation which could destroy or remove seeds. It is possible that seeds remain in the seedbank at the Thamesville location, but germination may not be possible without fire to break seed dormancy.

The fruits of *Desmodium* species are adapted to be dispersed by animals (e.g. Rosas et al. 2008). In this genus, the surface of the fruits have stiff, hooked hairs that adhere to animal fur or human clothing, similar to the way hook and loop (Velcro) fasters work. Fruits can be carried over great distances, if they stick to larger animals, such as White-tailed Deer (*Odocoileus virginianus*), Coyotes (*Canis latrans*), or to human clothing.

[17] Plant is able to use its own pollen to reproduce
[18] Transfer of pollen from one plant to another of a different genotype
[19] Additive that contains the rhizobia bacteria needed for the plant to grow

Habitat Needs

Based on occurrences in the U.S., the general habitat for Illinois Tick-trefoil is reported to be dry, upland prairies and roadsides, fields, railways, and borders and openings in oak forests which support remnant prairie habitat (Raveill 2005; Reznicek et al. 2011). Illinois Tick-trefoil is commonly found in rich prairie soil (Gleason 1968; Gleason and Cronquist 1991), or in dry soils (Gray et al. 1970). However, one study in Illinois found it had higher biomass and heavier stems in lowland than upland prairie (Towne and Knapp 1996). In Michigan, Illinois Tick-trefoil persists and even thrives along roadsides and railroad rights-of-way through former prairie and savanna, often being one of the only native prairie species to persist among large patches of Smooth Brome (*Bromus inermis*) and other non-native species. It is especially common on loamy sands and sandy loams in dry-mesic sites (Slaughter pers. comm. 2014).

Illinois Tick-trefoil is a pioneer species, colonizing burned or eroded soil (Klinkenberg 1991). Periodic disturbance, especially from fire, is required to reduce competition from other species. However, the species is vulnerable to grazing pressure and seldom occurs in pastures.

It is likely that suitable habitat for Illinois Tick-trefoil may occur in a range of vegetation types including both prairie and old field communities. There is no information on the size of habitat required, or whether Illinois Tick-trefoil may persist in small openings surrounded by regenerating woodland. If so, it is possible that some savanna vegetation types may also provide suitable habitat, but this is currently unknown.
Plant species commonly growing with Illinois Tick-trefoil in Michigan include a number of prairie species such as Ohio Spiderwort (*Tradescantia ohiensis*), Butterfly Milkweed (*Asclepias tuberosa*), Whorled Milkweed (*A. verticillata*), Wild Bergamot (*Monarda fistulosa*), Culver's Root (*Veronicastrum virginicum*), Frostweed Aster (*Symphyotrichum pilosum*), Sky Blue Aster (*S. oolentangiense*), Giant Solomon's Seal (*Polygonatum biflorum*), Grey-headed Prairie Coneflower (*Ratibida pinnata*), False Sunflower (*Heliopsis helianthoides*), Stiff Goldenrod (*Solidago rigida*), Yellow Pimpernel (*Taenidia integerrima*), Big Bluestem (*Andropogon gerardii*), Little Bluestem (*Schizachyrium scoparium*), Indiangrass (*Sorghastrum nutans*), American Hazelnut (*Corylus americana*), Prairie Willow (*Salix humilis*), and Dwarf Chinquapin Oak (*Quercus prinoides*) (Slaughter pers. comm. 2014). All of these species occur in Ontario (Brouillet et al. 2014), and many are indicator species for prairie habitat in southern Ontario (Gore and Storrie 1993).

There is a high probability that the exact location at Komoka, where Illinois Tick-trefoil was collected in 1888, no longer supports prairie vegetation. The Komoka area was settled early, starting in 1794, and agriculture was already well developed by 1859 (Goodspeed and Goodspeed 1889). It is unknown how much prairie was originally present or the amount that was converted to agriculture at Komoka, but Goodspeed and Goodspeed (1889) reported that in 1889 there were 30,000 acres of prairie between the Thames River and Lake St. Clair. Today only scattered remnants are still present, mostly on poor soils, because areas with better soils were almost wholly converted to

agriculture (Gore and Storrie 1993). For Ontario as a whole, it is estimated that only about 2100 ha or 0.5% of the tallgrass prairie and savannah present in the 19th century remains today (Bakowsky and Riley 1994), and that 95% of that is concentrated in Windsor, Walpole Island, and Pinery Provincial Park (Gore and Storrie 1993). Outside of those three areas, Gore and Storrie (1993) estimated that most remnants were less than 2 ha in size.

Despite this history, some suitable habitat for Illinois Tick-trefoil could remain in the Komoka area (and potentially in other prairies in southwestern Ontario), especially if Illinois Tick-trefoil can persist in degraded habitat. In 2003, in Komoka Provincial Park, there were still openings with some prairie species present (Ambrose et al. 2003) and prairie vegetation also persists in a few places outside the provincial park (Jones pers comm 2014).

In addition, unknown prairie remnants continue to be discovered around Komoka, for example in Mount Brydges (approximately 6 km west of Komoka (Buck pers. comm. 2014) and on the Chippewas of the Thames First Nation (Jalava pers. comm. 2014). Thus, there remains a chance that Illinois Tick-trefoil could be present in these unsurveyed remnants or in some yet-unknown location.

Since the discovery of the Thamesville record is so recent, the habitat potential for Illinois Tick-trefoil in this area remains unclear.

For a species to have an acceptable chance of survival or recovery in Canada, it must have a resilient and redundant population (Government of Canada 2016). Due to lack of knowledge of the features of suitable habitat for this species in Canada, combined with the rarity of tall-grass prairie habitat in southern Ontario, it is considered unlikely that enough suitable habitat could be created to support reintroduction of Illinois Tick-trefoil in a manner that could support a resilient and redundant population in a reasonable timeframe.

4. Threats

Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational). Limiting factors are not considered during this process.

A threat assessment[20] is not presented for Illinois Tick-trefoil as no extant locations are known for this species in Canada, and therefore threats cannot be scored for scope[21] or

[20] Threat assessments presented in Recovery Strategies are based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system

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

severity[22] to determine individual threat impacts[23], nor is it possible to calculate the overall threat impact[24] for this species at this time.

Historical threats, indirect or cumulative effects of the threats, as well as threats that can be hypothesized to affect potential existing population or future reintroduced populations (based on both threats facing other at risk prairie plants in southern Ontario; Walpole Island Heritage Centre 2006; Environment Canada 2014, 2015, and threats affecting Illinois Tick-trefoil populations in the U.S.) are presented in the Description of Threats section.

4.1 Description of Threats

Conversion of habitat to agriculture or urban or industrial development

The historical conversion of prairie to agriculture caused the loss of most of the prairie ecosystem in Ontario and caused many prairie species to become extremely restricted in location and population size (Gore and Storrie 1993). Loss of habitat has certainly occurred in the Komoka area since 1888 (Gore and Storrie 1993), and it also remains a current threat. For example, a major prairie of more than 50 ha at Komoka was converted to a golf course between 2003 and 2007 (Bakowsky pers. comm. 2014; Buck pers. comm. 2014), and other areas have been lost to residential development (based on comparisons of maps from 1980 – 1993 (Hanna and Lindsay 1980; Bakowsky 1993; Bakowsky pers. comm. 2014) and current satellite imagery). Severity of this threat to any newly discovered populations of Illinois Tick-trefoil would likely be high. However, the selection of habitat for any future reintroduction of the species should take this threat into account, so the severity to future reintroduced populations may be reduced.

Lack of disturbance

Prairie ecosystems require periodic disturbance of some type, especially fire, to maintain open, herbaceous-dominated vegetation. Without fire or other disturbance,

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

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

[24] The overall threat impact is calculated following Master et al (2012) using the number of Level 1 Threats assigned to this species. The overall threat considers the cumulative impacts of multiple threats.

open areas eventually grow up with shrubs and trees shading out prairie plants. This can cause habitat loss very quickly, even in as little as 10 years (Gore and Storrie 1993; Jones unpublished data 2014). Depending on the intensity, burning may also facilitate germination or colonization of new ground for some species (Auld and O'Connell 1991; Environment Canada 2015). Lack of disturbance is implicated in the extirpation of populations of other southern Ontario prairie plants listed as species at risk (e.g. White and Oldham 2000; COSEWIC 2010).

Invasive species

Invasive species have the ability to reproduce and spread quickly and copiously, and to reduce or eliminate the presence of native species (Ontario Ministry of Natural Resources 2011). Invasive species pose a significant threat to a number of at risk prairie plants in southern Ontario (e.g. Environment Canada 2013, 2014, 2015). At Komoka Provincial Park, 47 species considered invasive were present in 2003 (Ambrose et al. 2003), and openings dominated by prairie species in 1982 had invasive Purple Loosestrife (*Lythrum salicaria*) and Spotted Knapweed (*Centaurea stoebe* ssp. *micranthos*) as co-dominants in 2003 (Ambrose et al. 2003). Many prairies in Windsor are currently threatened by non-native Common Reed (*Phragmites australis*) (Catling and Mitrow 2011; Environment Canada 2015), which is also present at Komoka (Ambrose et al. 2003). The extent and severity of this threat to any newly discovered populations would be likely to be very high, based on the extent of invasive species in the southern Ontario landscape and the speed at which the spread has occurred. Whether Illinois Tick-trefoil would be able to persist with Purple Loosestrife, Spotted Knapweed or non-native Common Reed is unknown, but it seems unlikely as there are now numerous examples of places where these invasive species have eliminated all other plant species (Ontario Ministry of Natural Resources 2011, reviewed by Bellard et al. 2016).

Over - grazing

White-tailed Deer have been found to preferentially select Illinois Tick-trefoil as a food plant from among a variety of prairie forbs in the U.S. (Anderson et al. 2001). Grazing by deer is a serious problem for many rare prairie plants in Windsor prairies, where unusually high densities of deer are present in the urban area (LGL 2013), and was formerly a problem at prairie sites in Rondeau and Pinery Provincial Parks prior to deer densities being controlled (Gore and Storrie 1993). Grazing by deer could be a threat for both newly discovered populations of Illinois Tick-trefoil, and any future reintroduced populations, if control methods are not used.

Klinkenberg (1991) reports that on Great Plains' rangelands, Illinois Tick-trefoil is usually grazed by livestock in the plant's early growth stages and soon disappears from grazed areas. Historically, livestock were pastured on the prairies around Komoka and elsewhere in Ontario (Goodspeed and Goodspeed 1889; Gore and Storrie 1993), so it is possible that grazing by livestock may have contributed to the loss of the species.

Inappropriate use of off-road vehicles

Off-trail use of all-terrain vehicles (ATVs), heavy equipment, and other vehicles may be a threat to prairie plants and prairie habitats (Environment Canada 2014, 2015). When operated away from designated trails or roads, these vehicles can crush plants, disturb or destroy vegetation, create ruts in the soil, and bring in weed species. Any of these actions could harm Illinois Tick-trefoil directly as well as contributing to degrading habitat at any newly discovered or any future reintroduced populations.

Other potential threats

Desmodium species are a natural host of the bean pod mottle virus, which affects soya and other bean crops. The virus is transmitted by the Bean Leaf Beetle (*Cerotoma trifurcata*), a native species that attacks the leaves of bean plants (Waldbauer and Kogan 1976). Illinois Tick-trefoil is also affected by a fungal parasite *Elsinoe wisconsinensis* which causes spot anthracnose[25] in the leaves (Mason and Backus 1969). This disease was discovered in Wisconsin in the early 1960s. It is unknown whether these diseases contributed to the loss of Illinois Tick-trefoil from the Komoka location.

5. Critical Habitat

5.1 Identification of the Species' Critical Habitat

Section 41(2) of SARA requires that if the recovery of a listed wildlife species is not feasible, the recovery strategy must include an identification of the species' critical habitat to the extent possible. Under SARA, critical habitat is "the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species".

Critical habitat for the Illinois Tick-trefoil in Canada is not identified in this federal recovery strategy due to the need to confirm habitat occupancy and habitat suitability at Canadian locations. Illinois Tick-trefoil has only been recorded twice in Canada; at Komoka, Ontario in 1888, and north of Thamesville, Ontario in 1978. Despite repeated surveys, the species has never been re-confirmed in the Komoka area. The Thamesville location is not known to have been surveyed since 1978, and the status of this population is unknown.

There is no direct information available on the habitat in which Illinois Tick-trefoil grows in Canada, but it is likely that suitable habitat for Illinois Tick-trefoil may occur in a range of vegetation types including both prairie and old field communities. It is unlikely that the location where Illinois Tick-trefoil was recorded in Komoka still supports suitable habitat, although there are prairie vegetation patches in the surrounding area. It is unknown whether prairie vegetation persists at the location of the Thamesville record. Due to the

[25] A disease that causes small spots of dead tissue in leaves and flowers.

lack of knowledge of the features of suitable habitat for this species in Canada, combined with the rarity of tall-grass prairie in southern Ontario, it is considered unlikely that enough habitat could be made available to support a resilient and redundant Canadian population in a reasonable timeframe.

6. Conservation Approach

The recovery of the Illinois Tick-trefoil is not considered technically and biologically feasible at the present time. Recovery of the species may become feasible if a population is found in Canada and/or if reintroduction from an external source is deemed feasible and appropriate. The conservation approach table (Table 2.) provides guidance on activities that would be beneficial for the species in Canada.

Table 2: Conservation approach for Illinois Tick-trefoil in Canada.

Description of Activity	Rationale
Conduct targeted surveys for the species at the location of the Thamesville record and in potential suitable habitats close to the Thamesville location (e.g. prairie and old field communities) and at newly discovered prairie remnants near Komoka. Document suitable habitat use if and where it occurs.	Confirm presence and distribution of the species and its suitable habitat in Canada.
Survey museum records for additional records of Illinois Tick-trefoil.	Potential to discover additional records of the species in Canada and/or additional information on historical population characteristics or habitat use.
If Illinois Tick-trefoil is rediscovered in Canada, or sufficient suitable habitat is found in Canada to support a viable population: - Conduct research to quantify habitat requirements (biophysical attributes of suitable habitat). - Determine whether other similar habitats are present in southern Ontario. If so, conduct targeted searches for the species there, prioritizing areas close to existing populations. - If reintroduction is determined to be necessary and feasible, identify suitable habitat for potential reintroduction and identify a U.S. source populations that is genetically compatible and that will survive and thrive in Canada.	Fill knowledge gaps including, suitable habitat biophysical attributes, extent of suitable habitat and species presence and distribution. Ensure critical habitat is identified.
Investigate potential for self-fertilization in Illinois Tick-trefoil.	This information will be valuable for planning reintroduction efforts if required; it is currently unclear if this plant is self-fertile or requires cross-pollination. If cross-pollination is required for successful reproduction, it is likely that a greater number of genetically distinct individuals will be required to be included during reintroduction efforts to reduce potential inbreeding and genetic drift.

Limited information is available on the historic population characteristics and distribution of Illinois Tick-trefoil, and no information is available on the habitat it occupied in Ontario. However, while there are currently no known populations of Illinois Tick-trefoil in Canada, the Thamesville location is not known to have been surveyed since a specimen was collected there in 1978. In addition, newly discovered prairie patches in the Komoka area have not been surveyed for the species. Therefore surveys for the species in historic locations and in newly discovered prairie patches in southern Ontario will help confirm the current status of this species in Canada. If the species is found, it

will be important to maintain the existing population and support natural population expansion through maintenance of habitat and sustaining environmental processes, threat mitigation, and protection measures. Collection of habitat information will be important to identify the biophysical attributes of the suitable habitat used by this species in Canada. If information on suitable habitat in Canada is collected, this information can be used to target additional surveys for the plant. In addition, a threat assessment will be needed to inform the recovery process.

Given that the Thamesville record was recently discovered in the ROM plant collection, further surveys of museum records may provide more information on the historic population and distribution of Illinois Tick-trefoil.

Reintroduction would be recommended only if determined to be biologically and technically feasible (e.g. this would involve surveying potential source populations in the U.S. to find plants genetically compatible and likely to survive and thrive in Canada), and if it was determined that there is sufficient suitable habitat to support a redundant and resilient Canadian population that could be secured or created in a reasonable timeframe.

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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*[26]. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[27] (FSDS) goals and targets.

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

The tall-grass prairie habitat with which Illinois Tick-trefoil is closely associated in the U.S. supports a number of at risk plants and invertebrates in southern Ontario, including Colicroot (*Aletris farinosa*), Dense Blazing Star (*Liatris spicata*), Pink Milkwort (*Polygala incarnata*) and Rusty-patched Bumble Bee (*Bombus affinis*). If a population of Illinois Tick-trefoil is discovered and/or reintroduction of the species is considered, recovery planning impacts on non-target species in southern Ontario will need to be taken into account. Any recovery planning activities for the Illinois Tick-trefoil will be implemented with consideration of all co-occurring species at risk, such that there are no negative impacts to these species or their habitats.

[26] www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1
[27] www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1