COSEWIC
Assessment and Status Report

on the

Slender Bush-clover
Lespedeza virginica

in Canada

ENDANGERED
2013

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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Cedar, K. 1999. Update COSEWIC status report on the slender bush-clover *Lespedeza virginica* in Canada, *in* COSEWIC assessment and update status report on slender bush *Lespedeza virginica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-9 pp.

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COSEWIC
Assessment Summary

Assessment Summary – May 2013

Common name
Slender Bush-clover

Scientific name
Lespedeza virginica

Status
Endangered

Reason for designation
This perennial species occupies small patches of remnant tallgrass prairie and savanna at just one location in southern Ontario, where it is at risk from the combined impacts of a lack of natural disturbance by periodic fires and the presence of invasive plant species. There is a continuing decline in the quality and area of habitat available for the plant.

Occurrence
Ontario

Status history
Designated Endangered in April 1986. Status re-examined and confirmed Endangered in April 1999, May 2000, and May 2013.

COSEWIC
Executive Summary

Slender Bush-clover
Lespedeza virginica

Wildlife Species Description and Significance

Slender Bush-clover (*Lespedeza virginica* (L.) Britt.) is an erect perennial herb in the pea family (Fabaceae). It is generally less than 1 m tall, and occasionally branched, arising from a woody, nodule-bearing rhizome. Its stem, leaves, branches, stalks and fruit are covered with short, appressed hairs. The trifoliate, compound leaves are strongly ascending with leaflets ranging in size from 1.5 to 3 cm. Flowers are pea-like in appearance, normally pink to purple. Fruits are single-seeded 4-7 mm pods produced by either chasmogamous (open) or cleistogamous (closed) flowers. Canadian populations of Slender Bush-clover are near the northern range limit for the species (some U.S. populations are frrther north); populations at the edge of a species' range may be genetically distinct.

Distribution

Slender Bush-clover ranges from eastern Texas and northern Florida to central New England, southern Ontario, and southern Michigan. Disjunct populations occur in central Wisconsin, southern Minnesota, and northern Mexico. In Canada, it is currently known from a single subpopulation in southwestern Ontario in the City of Windsor, representing less than 1% of its global range.

Habitat

Slender Bush-clover is found in a wide variety of open habitats across its range from old fields, prairies, roadsides and clearings, to savannas, pine barrens, dry upland woods, and woodland borders. In Ontario, it is restricted to tallgrass prairie and savanna habitat of the Ojibway Prairie complex.

Biology

Slender Bush-clover produces flowers and fruits many times over its lifespan, and plants have been shown to live up to 17 years elsewhere in its range. It flowers mainly in August and September in Ontario. Plants can produce both chasmogamous (open) flowers, pollinated mainly by bees and butterflies, and cleistogamous (closed) flowers that self-pollinate in bud. Slender Bush-clover is drought- and fire-tolerant, possessing woody rhizomes with nodules that fix nitrogen because of symbiotic interactions with bacteria. Seeds have hard coatings and germination may be enhanced through scarification, either by ground fires or passage through the digestive tracts of animals, and seeds have been shown to remain viable for at least 54 years. It is a food plant for a variety of insects and a nectar source for many others.

Population Sizes and Trends

Two subpopulations have been documented in Canada, and of these, only one is extant. In 2011 the Ojibway Prairie Complex subpopulation consisted of 165 mature individuals limited to one site (Ojibway Park), down from 168 mature individuals in 2 sites (Ojibway Park and Tallgrass Heritage Park) documented during the previous status assessment. Black Oak Heritage Park, a third site within the Ojibway Prairie Complex subpopulation, previously supported Slender Bush-clover, but it has not been documented there since 1993. Both the Tallgrass Heritage and Black Oak Heritage sites have likely succumbed to succession resulting from lack of disturbance, though a viable seedbank may still exist. The Leamington subpopulation has not been seen since 1892, and is presumed extirpated due to destruction of habitat.

Threats and Limiting Factors

The destruction of much its original habitat has severely fragmented the southern Ontario landscape, isolating the remaining subpopulations from other areas of suitable habitat, and thus limiting the species' ability to expand. The tallgrass prairie and savanna habitats that the species currently occupies are critically imperiled in Ontario.

Current threats to Slender Bush-clover are: 1) altered disturbance regime resulting in successional changes to habitat, reducing open areas for germination and overall growth and survival; and 2) interspecific competition from invasive species, namely Crown-vetch, Spotted Knapweed, and Autumn Olive.

Protection, Status, and Ranks

Slender Bush-clover is currently listed as Endangered in Canada and is on Schedule 1 of the federal *Species at Risk Act*. In Ontario, it is also Endangered, listed on Schedule 1 of Ontario's *Endangered Species Act*, 2007. It has a state-level Threatened status in Wisconsin and New Hampshire. Non-legal status ranks indicate Slender Bush-clover is critically imperiled (S1) in Ontario and New Hampshire, imperiled (S2) in Wisconsin and may be vulnerable (S3?) in New York.

TECHNICAL SUMMARY

Lespedeza virginica
Slender Bush-clover Lespédèze de Virginie
Range of occurrence in Canada (province/territory/ocean): Ontario

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines (2008) is being used). *Individuals can reach maturity within 1-2 years, but may take longer at more northern latitudes, or in suboptimal habitat. Individuals have been found to be long-lived, up to 17 years based on growth ring counts of woody rhizomes. If the average age is taken from the youngest (1 yr) and oldest (17 yr) known plants, a range of 8-10 is suggested.*	Unknown, but > 1 year and perhaps 8-10 years
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals? *Apparent loss of all individuals from the Tallgrass Heritage Park and Black Oak Heritage sites due to succession, but decline does not appear to be ongoing at the Ojibway Park site (i.e. 160 plants in 1997; 165 plants in 2011)*. This inference rests on knowledge of generation time. Using shorter generation times (2-5 years) suggests little evidence of decline, but longer generation times (10 years) would lead to an inference of decline (over the period 1983-2013).	Uncertain
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]. *No other survey data within last 5 years. Applying a generation time of 8-10 years would result in no declines.*	Likely no reduction
[Observed, estimated, inferred, or suspected] percent reduction in total number of mature individuals over the last [10 years, or 3 generations]. *No other counts in the last 10 years, though presumably no reduction as the last full count conducted in 1997 recorded 160 plants, 5 fewer plants than 2011 when 165 plants were counted. This would hold true if an 8-10 year generation time was used.*	Likely no reduction
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations]. *Unknown but suspected that losses of mature individuals will occur if threats are not addressed.*	Decline of unknown magnitude
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased? *Habitat succession could be slowed / halted / reversed with prescribed burns or some other form of management. Prescribed burns or other management could also assist with control of invasive species. Thus, while the causes of decline are understood and reversible, they have not ceased.*	No

Are there extreme fluctuations in number of mature individuals? *The 2000 COSEWIC status report stated there was a fluctuating subpopulation. It seems this may be the result of ATV traffic at one site, and differing sampling efforts over the years versus an actual observed fluctuating trend in numbers of individuals. Given Slender Bush-clover possesses deep woody rhizomes, is long-lived, and has a seed bank, this seems unlikely.*	Unknown, but unlikely

Extent and Occupancy Information

Estimated extent of occurrence *The estimate is actually less than 1 km^2, but is set to be equal to the IAO in accordance with guidelines.*	8 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value).	8 km²
Is the total population severely fragmented? *Only one subpopulation is considered extant.*	No
Number of locations∗ Defined by threat of altered disturbance regime and invasive species. *All three sites at the Ojibway Park subpopulation share common threat of habitat succession stemming from cessation of natural disturbance regime (i.e., fire).*	1
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence? *EO will follow IAO for this species.*	Yes
Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy? *Both Black Oak Heritage Park and Tallgrass Heritage Park sites treated as possibly extant, and the (likely) loss of either of these sites would contribute to a projected decline in area of occupancy*	Yes
Is there an [observed, inferred, or projected] continuing decline in number of populations? *If Tallgrass Heritage Park and Black Oak Heritage Park sites are considered extirpated, there has been a loss of 2 of 3 known sites, but the single Ojibway Park subpopulation has persisted.*	No
Is there an [observed, inferred, or projected] continuing decline in number of locations*?	No
Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat? *Future declines anticipated if mechanisms required to maintain open habitat are not put into place. Also, several problematic invasive species present at the Ojibway Park site are increasing interspecific competition.*	Yes
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations∗?	No
Are there extreme fluctuations in extent of occurrence?	No

∗ See Definitions and Abbreviations on COSEWIC website and IUCN 2010 for more information on this term.

Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population (1 subpopulation composed of 3 sites)	**N Mature Individuals**
Ojibway Prairie Complex (3 sites)	
Ojibway Park site (plants last seen in 2011)	165
Tallgrass Heritage Park site (plants last seen in 1997)	0
Black Oak Heritage Park site (plants last seen in 1993)	0
Total	165

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	N/A

Threats (actual or imminent, to populations or habitats)

1) Altered disturbance regime
2) Invasive species

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? U.S.A.: not currently of conservation concern throughout its core range; of conservation concern in portions of its northern limits in New Hampshire, New York and Wisconsin	
Is immigration known or possible?	Possible from Michigan
Would immigrants be adapted to survive in Canada?	Likely
Is there sufficient habitat for immigrants in Canada?	Limited
Is rescue from outside populations likely?	Unlikely

Status History

COSEWIC: Designated Endangered in April 1986. Status re-examined and confirmed Endangered in April 1999, May 2000, and May 2013.

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Endangered	B1ab(i,ii,iii)+2ab(i,ii,iii); D1

Reasons for designation:
This perennial species occupies small patches of remnant tallgrass prairie and savanna at just one location in southern Ontario, where it is at risk from the combined impacts of a lack of natural disturbance by periodic fires and the presence of invasive plant species. There is a continuing decline in the quality and area of habitat available for the plant.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. Lack of evidence for decline.
Criterion B (Small Distribution Range and Decline or Fluctuation): Meets Endangered B1 and B2, because of small EO and IAO, occurs at a single location, with projected declines in habitat quality (iii), extent of occurrence (i), and area of occupancy (ii).
Criterion C (Small and Declining Number of Mature Individuals): Not met. Lack of evidence for decline in mature individuals.
Criterion D (Very Small or Restricted Total Population): Meets Endangered D1 with fewer than 250 mature individuals.
Criterion E (Quantitative Analysis): Not done.

PREFACE

Since the 2000 assessment of Slender Bush-clover, habitat continues to degrade through succession from lack of disturbance, and this degradation remains the most serious threat at all three sites that comprise the Ojibway Prairie complex subpopulation. Of these three sites, a second has likely been lost as a result of over shading, leaving only one site with mature plants. Slender Bush-clover has not likely suffered from large population fluctuations as previously suggested. Rather, ATV disturbance at two sites likely physically damaged plants influencing counts, and insufficient survey effort likely limited the ability to detect declines or attribute them to any particular threat at the third site. A previously undocumented threat identified in 2011 at the Ojibway Park site includes interspecific competition from a number of exotic species invading open sandy habitat. The present report reflects field survey work conducted in 2011 in Ontario.

COSEWIC HISTORY

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

COSEWIC MANDATE

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

COSEWIC MEMBERSHIP

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

DEFINITIONS
(2013)

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

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

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

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

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

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Lespedeza virginica

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2013

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific Name: *Lespedeza virginica* (L.) Britt. [Trans. N.Y. Acad. Sci. 12: 64 (1893)]

Synonyms: *Medicago virginica* L.
Hedysarum reticulatum Muhl. in Willd.
Lespedeza sessiliflora Michx.
Hedysarum sessiliflorum Lam.
Lespedeza reticulata Pers.
Lespedeza angustifolia Dar.
Lespedeza violacea var. *reticulata* G. Don.
Lespedeza violacea var. *angustifolium* T. & G.
Lespedeza reticulata var. *angustifolia* Maxim.

Common Name: English: Slender Bush-clover, Wand-like Bush Clover, Slender Lespedeza
French: Lespédèze de Virginie

Family: Fabaceae (Pea family)

Major Plant Group: Eudicot flowering plant

Type Specimen: Virginia: without date, Clayton 191 (lectotype: BM)

Slender Bush-clover is a member of the Pea Family (Fabaceae), an exceedingly large group of 650 genera and nearly 20,000 species (Doyle 1994), many with tremendous ecological, scientific and economic importance. There are three subfamilies within the Pea Family; *Lespedeza* is in the subfamily Papilionoideae. Ohashi (1982) recognized two subgenera within the genus including *Macrolespedeza* and *Lespedeza*. Species in subgenus *Lespedeza* are herbs with both cleistogamous (closed) and chasmogamous (open) flowers, distributed in eastern North America and East Asia.

Of the 40 (e.g., Isely 1990, Xu *et al.* 2011) to 60 (Puhua *et al.* 2010) recognized species of *Lespedeza*, 11 are native to North America (NatureServe 2012). In addition, at least seven species of *Lespedeza* originating from Asia have been reported from North America, three of which are known to occur in Canada (NatureServe 2012). North American native *Lespedeza* are perennial herbs; those introduced from Asia are shrubs, annual herbs, or occasionally perennial herbs.

According to Clewell (1966b), all eleven native North American species of *Lespedeza* are capable of hybridizing where they occur in sympatry. Slender Bush-clover hybridizes with nearly all other native North American *Lespedeza* under natural conditions, with at least eight reported hybrid combinations involving this species (Clewell 1966a, Clewell 1968). Six of these hybrid combinations have been provided formal names (e.g., Fernald 1950, Gleason and Cronquist 1991, Kartesz 1994). No hybrids involving Slender Bush-clover have been formally reported from Canada, though W. Botham made a collection from Windsor in 1977 from the Tallgrass Heritage site (specimen at LKHD) that he thought might be a hybrid with Intermediate Bush-clover (*Lespedeza violacea*). Round-headed Bush-clover (*Lespedeza capitata*) also grows with Slender Bush-clover at Ojibway Park, and hybridization may be possible at this site, as they share the same habitat and have overlapping flowering periods.

No infraspecific taxa are presently recognized for Slender Bush-clover.

Morphological Description

Slender Bush-clover is a 30 to100 cm ascending to erect, strigose or puberulent, single-stemmed or branched perennial herb, arising from a woody rhizome bearing nodules (Clewell 1966a) (Figure 1). Stipules are filiform to narrowly subulate, up to 6 mm long. Leaves are numerous, strongly ascending, born on petioles to 1 cm long, consisting of three linear to narrowly oblong, strigose leaflets, mostly 1.5-3 cm long. Inflorescences are born on short, 4-10 flowered, apically congested racemes that arise in the axils of leaves. The calyx is 3-4.5 mm long, strigulose, noticeably shorter than the corolla and the fruit (a legume). The corollas are pink to purple (rarely white), 4-7 mm long, the wings nearly equal or slightly shorter than the standard. Fruit consist of single-seeded, appressed-pubescent, indehiscent pods; those produced by chasmogamous flowers are 4-7 mm long, and those produced by cleistogamous flowers are 3.5-5.5 mm long (Clewell 1966a).

Figure 1. Slender Bush-clover (*Lespedeza virginica*) at Ojibway Prairie in Windsor, Essex County, Ontario (Photo by P. Allen Woodliffe, August, 2007).

Slender Bush-clover maybe confused with Silky Bush-clover (*Lespedeza juncea*), an aggressive species introduced from Asia now widely naturalized throughout much of Slender Bush-clover's North American range, though not currently known from Ontario. The flowers of Silky Bush-clover are white vs. pink or purple (although Slender Bush-clover rarely has white flowers), and the leaflets of the introduced species have pinnate veins and an acute tip, whereas Slender Bush-clover has net-like veins and an obtuse tip.

Slender Bush-clover hybridizes with nearly all other native North American *Lespedeza*, obscuring species delimitation in the genus, and plants representing most of the hybrid combinations possible have been collected in natural environments (Clewell 1966b).

Population Spatial Structure and Variability

No information exists on population spatial structuring and variability for Slender Bush-clover in Canada. Plants in the Ojibway Prairie complex are isolated from the next nearest population in Michigan by roughly 26 km (Reznicek pers. comm. 2012). While this is largely the result of habitat loss through land conversion since European settlement, the Detroit River also forms a physical barrier and is roughly 800 m wide at Windsor.

Cole and Biesboer (1992) examined population genetic structure in the widespread Round-headed Bush-clover, and Prairie Bush-clover (*L. leptostachya*), a more restricted species of the American Midwest, using isozyme variation. Across the 32 loci examined they found no genetic variation in the 12 studied population of Prairie Bush-clover, and very low diversity within but high diversity among populations of Round-headed Bush-clover. They inferred that outcrossing rates were very low, and that chasmogamous flowers contributed little to reproductive output. Round-headed Bush-clover is ecologically similar to Slender Bush-clover, and patterns of genetic diversity may be similar in Slender Bush-clover, though this has not been tested.

Xu *et al.* (2012) analyzed the phylogenetic relationships of all *Lespedeza* species using sequence data from five plastid and one nuclear DNA regions. They found Slender Bush-clover formed a clade with several North American species including *L. violacea*, Trailing Bush-clover (*L. procumbens*), and Tall Lespedeza (*L. stuevei*), all of which have purple flowers.

Designatable Units

Plants in the Ojibway Prairie complex comprise the only extant Canadian subpopulation and are considered a single designatable unit, falling within the Great Lakes Plains Ecological Area as defined by COSEWIC (2009). The extirpated subpopulation in Leamington also falls within the same ecological area and hence would be a part of the same designatable unit.

Special Significance

In Canada, Slender Bush-clover is extremely rare, where it approaches its northern North American range limit, though a few scattered disjunct populations occur in Wisconsin, New York and New England further north. Populations at or near the edge of a species' range may be genetically distinct and are important to the diversity of the species (Lesica and Allendorf 1995, Sachiko *et al.* 2009).

While few references in the literature pertain directly to Slender Bush-clover, human uses of *Lespedeza* species are diverse. Many bush-clover species have been used in soil conservation practices, forage production, and in wildlife habitat improvement. Becker and Crockett (1976) investigated the nitrogen fixing capacity of five native legumes and found *L. capitata* to have comparable efficiencies to other well-known cultivated legumes such as Soybean (*Glycine max*), Common Bean (*Phaseolus vulgaris*), and Alfalfa (*Medicago sativa*). It also was similar to other non-leguminous species used for soil remediation such as European Alder (*Alnus glutinosa*). *L. capitata* has also recently been examined as a potential source of carbon-negative biofuel (Tilman *et al.* 2006).

The medicinal value of Bush-clovers has also been investigated. *Lespedeza capitata* has been used to treat kidney disease in France, Germany, and Poland (Wang *et al.* 2009), and several Asian species have been used in Chinese herbal medicine for treating coughs, fevers, and diarrhea (Yao *et al.* 2002). Bush-clovers have been shown to contain useful compounds that can contribute to human health. Certain beneficial flavonoids, a class of plant metabolites known to modify allergens, viruses, and carcinogens, have been found in the leaves and roots of *L. capitata* (Wagner 1972). Miyase *et al.* (1999a, 1999b) isolated antiallergic and antioxidative compounds from two Asian species of bush-clover, *L. homoloba* and *L. bicolor*.

Bush-clovers are also purported to have traditional First Nations uses, though none of these have been recorded for Slender Bush-clover. According to Moerman (2003), the roots and stems of *L. capitata* were used as antidotes for poison and to treat symptoms of neuralgia and rheumatism, and the leaves were boiled for teas. The Iroquois created a compound decoction of *Lespedeza* species to be taken for “stricture caused by bad blood” (Morman 2003). Because of Slender Bush-clover’s restricted distribution in Canada, these types of uses are likely minimal.

DISTRIBUTION

Global Range

The global range of Slender Bush-clover extends in eastern North America from central New England, west to southern Minnesota, south to Kansas and eastern Texas, to northern Florida (Figure 2). Disjunct occurrences exist in central Wisconsin, southern Minnesota, and Nuevo León, Mexico.

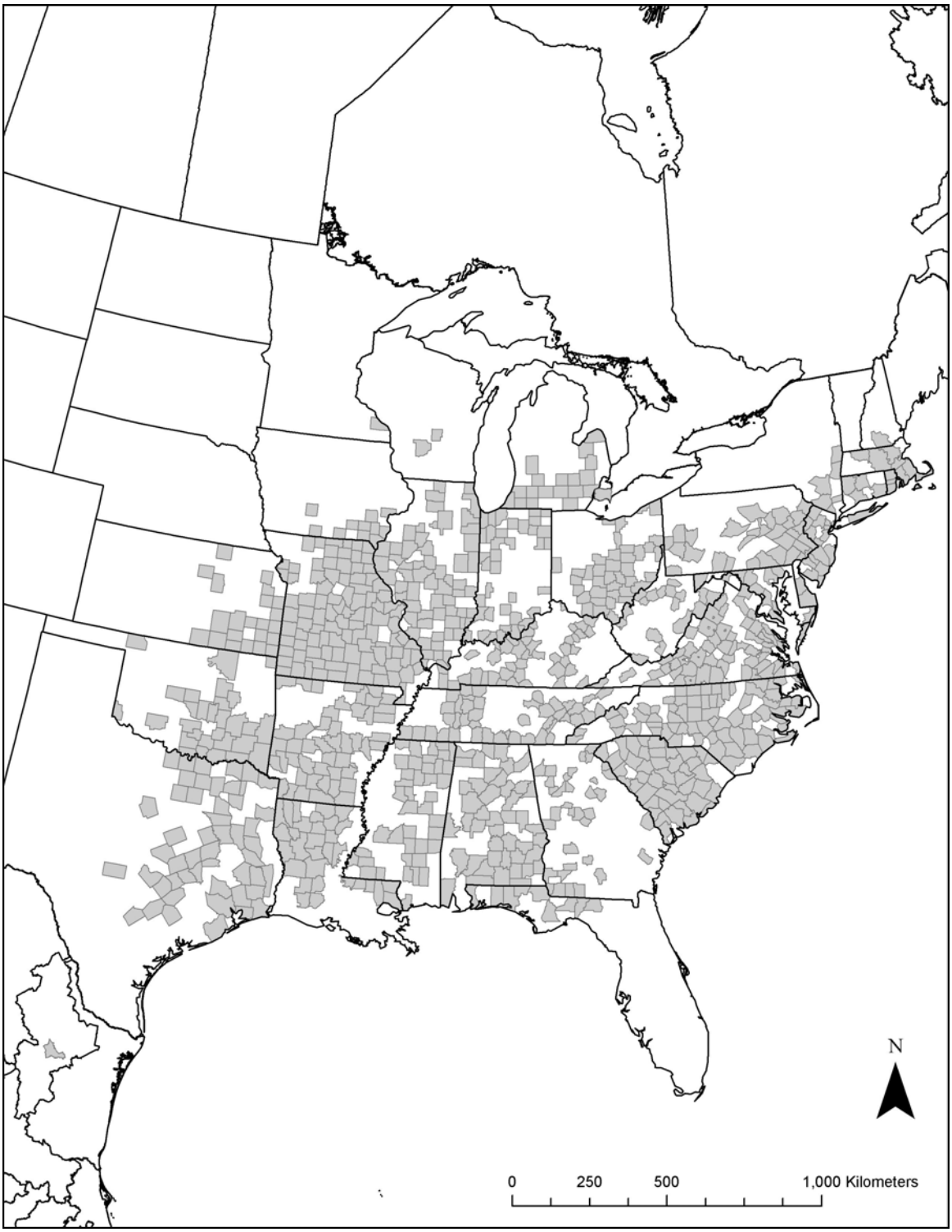

Figure 2. North American distribution by county of Slender Bush-clover (*Lespedeza virginica*) (modified after Clewell 1966a and Kartesz 2011).

Canadian Range

Less than 1% of the global range of Slender Bush-clover extends into Canada. Slender Bush-clover is known in Canada from Essex County, in the extreme southwestern portion of southern Ontario (Figure 3), in the City of Windsor, and formerly the Leamington area. No records have been documented near Leamington since 1892, when John Macoun collected it. This area is heavily urbanized / agricultural, and past searches have never relocated it (Pratt 1986). Dodge (1914) reported Slender Bush-clover from “thickets along the Detroit River” which may suggest additional historical site(s) in Essex County; however, this could also be in reference to the Windsor area which borders the Detroit River. A report also exists from the Niagara Regional Municipality in Ontario, though it is considered erroneous as it remains unverified and the species does not occur in adjacent areas of New York State (see section on **Search Effort**).

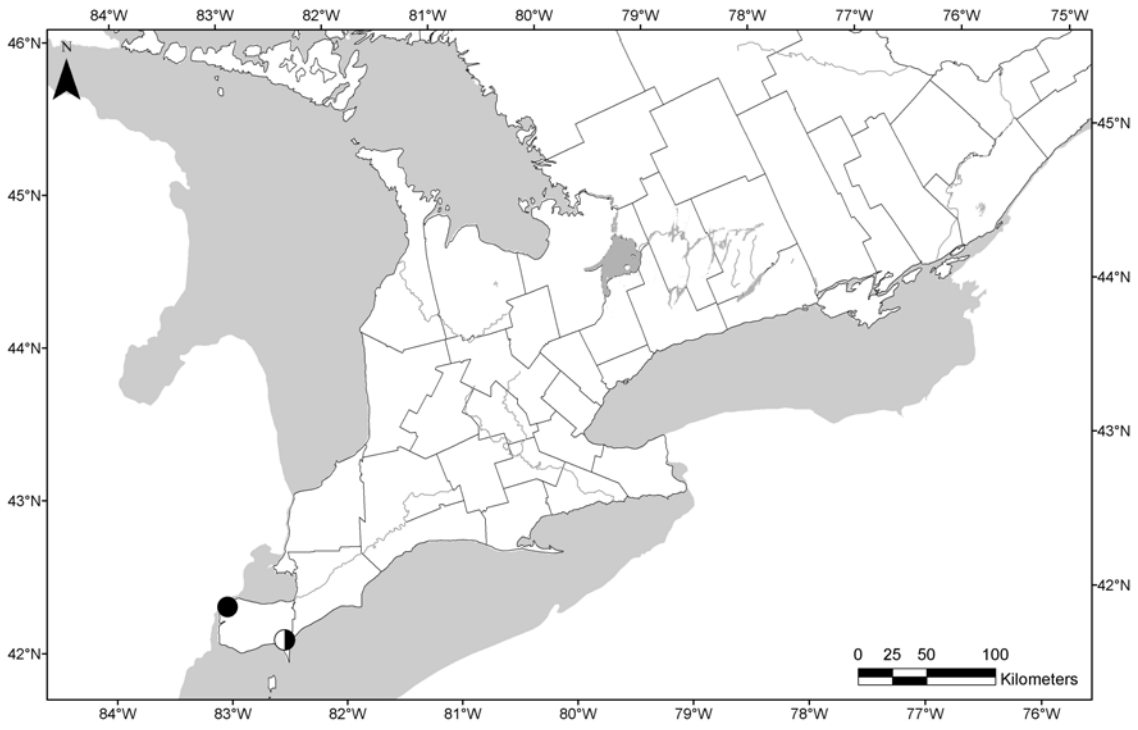

Figure 3. Ontario distribution of Slender Bush-clover (*Lespedeza virginica*). Solid circle represents extant subpopulation in Essex County; partial circle represents extirpated subpopulation in Essex County.

Extent of Occurrence and Area of Occupancy

The estimated extent of occurrence (EO) of the extant Slender Bush-clover subpopulation (including all three sites) in Canada (excluding the presumed extirpated subpopulation at Leamington), is < 1 km². If the extirpated subpopulation at Leamington is included, the EO value is 23 km². The actual area occupied by all plants at the Ojibway Park site as visually estimated by the observed total patch size is approximately 36 m². The index of area of occupancy (IAO) (including all three sites) derived using a 2x2 km grid is 8 km².

Delimitation of Subpopulations and COSEWIC Locations

COSEWIC defines subpopulations as geographically distinct groups within the entire Canadian population (the total number of individuals) with which there is little demographic or genetic exchange. Because rates of genetic exchange for Slender Bush-clover are unknown, subpopulations are defined in this report using NatureServe (2004). In this case, all observations are grouped into a single subpopulation on the basis of a separation of less than 1 km, or if 1-3 km, with no break in suitable habitat. There are three clusters of recent (<20 yrs) observations in the Windsor area, referred to individually as sites. The Ojibway Park and Black Oak Heritage Park sites are 600 m apart and therefore are considered part of the same subpopulation. The Tallgrass Heritage Park site is 1.1 km away from the Ojibway Park site, though no breaks in suitable habitat greater than 1 km exist, so all three sites meet the criteria for a single subpopulation. Additionally, there are no major barriers to dispersal between sites. Seeds could conceivably travel a kilometer or more with the aid of an animal vector, and vagile insect pollinators (those in the order Hymenoptera or Lepidoptera) could also potentially disperse pollen among sites, furthering the argument for one subpopulation.

Only the Ojibway Park site contains mature plants. While no plants have been seen at the Tallgrass Heritage Park and Black Oak Heritage Park sites in over ten years, they are treated as possibly extant based on the potential presence of a viable seedbank, as Slender Bush-clover seeds obtained from herbarium specimens have been to shown to remain viable for at least 54 years (Clewell 1966b) and plants were observed as recently as 1993 (Black Oak Heritage Park) and 1997 (Tallgrass Heritage Park). Therefore, the Canadian population of Slender Bush-clover comprises one extant subpopulation, the Ojibway Prairie complex, and one extirpated subpopulation at Leamington (with no observations since 1892).

For the purposes of COSEWIC assessment, locations are defined as distinct areas sharing a single and most immediate threat (COSEWIC 2011). Successional changes to habitat resulting from cessation of disturbance at the extant Ojibway Park site as well as the other two possibly extant sites (Tallgrass Heritage Park and Black Oak Heritage Park) is the most immediate threat and therefore are all treated as one location.

Search Effort

Reports of Slender Bush-clover in Canada are summarized in Table 1. The first Canadian record of Slender Bush-clover was a collection by John Macoun from Leamington in 1892 (specimen at CAN). The collection details are not specific enough to locate, and despite years of botanical investigations in the area by experienced botanists (e.g., W. Botham, P.D. Pratt, M.J. Oldham, P.A. Woodliffe), Slender Bush-clover has never been relocated near Leamington. This subpopulation is likely extirpated as suitable habitat has been virtually eliminated with human population growth and development in the area since 1892. Dodge (1914) reported Slender Bush-clover from "thickets along the Detroit River" which may be in reference to the Windsor area, but no other supporting documentation exists.

Table 1. Canadian records of Slender Bush-clover (*Lespedeza virginica*) by subpopulation based on literature reports and herbarium specimens.

Subpopulations	Date	No. plants	Observer(s)	Evidence	Remarks
Leamington (extirpated)					
Leamington	1892-07-30	unknown	J. Macoun	specimen (CAN, DAO)	
Ojibway Prairie Complex (extant)					
Detroit River area	Pre-1914	unknown	C.K. Dodge	literature report	Maybe in reference to Windsor / Ojibway area
Tallgrass Heritage Park	1977-?-?	unknown	Joe Johnson	sight record	
Tallgrass Heritage Park	1977-08-28	unknown	W. Botham	specimen (LKHD)	might be a hybrid with *L. violacea*
Tallgrass Heritage Park	1978-09-19	unknown	P.D. Pratt	specimen (CAN)	
Tallgrass Heritage Park	1979-08-25	unknown	W. Botham	specimen (DAO)	
Tallgrass Heritage Park	1979-09-02	unknown	D.F. Brunton	specimen (DFB; CAN)	
Tallgrass Heritage Park	1982-08-23	unknown	M.J. Oldham	specimen (3383)	
Tallgrass Heritage Park	1984-?-?	~150	P.D. Pratt	sight record	
Tallgrass Heritage Park	1997-09-27	8	K. Cedar	sight record	8 fruiting (mature), 14 vegetative; in a 15 m² area
Tallgrass Heritage Park	2000-08-24	0	D. Jacobs, P.A. Woodliffe, K. Cedar		
Tallgrass Heritage Park	2011-09-08	0	S.R. Brinker, M.J. Oldham, C.D. Jones		habitat lost through succession
Black Oak Heritage Park	1993-06-15	a few	P.D. Pratt and K. Cedar	sight record	
Black Oak Heritage Park	1997-09-27	0	K. Cedar		
Black Oak Heritage Park	2011-09-08	0	S.R. Brinker, M.J. Oldham, C.D. Jones		habitat disturbed, weedy

Subpopulations	Date	No. plants	Observer(s)	Evidence	Remarks
Ojibway Park	1979-08-30	~50	P.D. Pratt	sight record	
Ojibway Park	1984-?-?	0	P.D. Pratt		potentially extirpated
Ojibway Park	1986-07-10	“a few”	M.J. Oldham	specimen (NHIC, MICH)	
Ojibway Park	1997-09-27	160	K. Cedar	sight record	mostly fruiting; in a 15 m² area
Ojibway Park	2000-08-24	24+	D. Jacobs, P.D. Pratt, P. A., Woodliffe, K. Cedar	sight record	some in flower
Ojibway Park	2011-09-08	165	S.R. Brinker, M.J. Oldham, C.D. Jones	sight record	mostly fruiting; in a 36 m² area
Erroneous Reports					
Queenston Heights	1896-09-05	-	Wm. Scott	Unverified specimen	Considered erroneous by Oldham (2010)

A report also exists from the Niagara Regional Municipality in Ontario, though it is likely erroneous as it remains unverified. Heimburger (1955) reported a Slender Bush-clover collection at TRT from an 1896 collection by Wm. Scott at Queenston Heights. However, it is likely that this collection has been revised to another species (M.J. Oldham pers. comm.), because a) the known North American range is not close to the Niagara area; b) other local floristic works do not mention the record (e.g. Zenkert 1934); c) the specimen wasn’t included in the Atlas of Rare Vascular Plants in Ontario (ARVPO) (Argus *et al*. 1982-1987) project; and d) was excluded from the Niagara flora checklist compiled by Oldham (2010).

The first contemporary record of Slender Bush-clover from the Ojibway Prairie complex was by J. Johnson in 1977, and became known as the Tallgrass Heritage Park site. The site was visited again in 1984 by P.D. Pratt during the preparation of the original status report (Pratt 1986). The next attempt (successful) to locate plants here was in 1997 by K. Cedar as part of an update status report. Another targeted search was conducted again in 2000 by D. Jacobs, P.D. Pratt, P.A. Woodliffe and K. Cedar, but the species was not relocated and has not been seen at the site since 1997.

The first collection from the Ojibway Park site was made in 1979 by P.D. Pratt during a preliminary life science inventory of the area. A targeted visit was made again by Pratt in 1984 during the preparation of the original status report, though no plants were seen. In 1986, M.J. Oldham made a collection after successfully relocating plants. In 1997, P.D. Pratt and K. Cedar made detailed notes on individuals and associated habitat as part of an update status report (Cedar 1999). In 2000, the site was visited by D. Jacobs, P.D. Pratt, P.A. Woodliffe and K. Cedar (P.A. Woodliffe pers. comm. 2012), again to document its status where roughly 24 plants were counted, though extensive damage from ATVs were cited as the likely cause of the low plant count.

A third site was documented in the Ojibway Prairie complex in 1993 at Black Oak Heritage Park by P.D. Pratt and K. Cedar. A single plant was observed growing adjacent to a trail used by ATVs in a disturbed open area. The site was visited again in 1997 by K. Cedar but the species was not relocated. Continued ATV traffic likely destroyed any remaining plants (P.D. Pratt pers. comm. 2012).

Specific efforts to locate Slender Bush-clover in 2011 are summarized in Table 2. A total of 16 hectares of suitable habitat was searched in the Ojibway Prairie complex and Spring Garden Road Prairie on September 9, 2011, incorporating 16.5 person hours. Surveys for Slender Bush-clover involved informal, unstructured traverses of suitable habitat. Once individuals were found, more patterned searches were carried out involving detailed counts of all mature individuals. Information on the size, extent, habitat, associated species, and possible threats was collected. Only the Ojibway Park site was found to support plants. No individuals were found at Tallgrass Heritage Park, Black Oak Heritage Park, or the nearby Spring Garden Road Prairie.

Table 2. Summary of 2011 Slender Bush-clover (*Lespedeza virginica*) search effort in Ontario.

Date	Location	Surveyors	Person hours	Approx. area surveyed (ha)
2011-09-08	Ojibway Park	S.R. Brinker, M.J. Oldham, C.D. Jones	4.5	0.5
2011-09-08	Tallgrass Heritage Park	S.R. Brinker, M.J. Oldham, C.D. Jones	3	4.9
2011-09-08	Black Oak Heritage Park	S.R. Brinker, M.J. Oldham, C.D. Jones	6	8.7
2011-09-08	Spring Garden Road Prairie	S.R. Brinker, M.J. Oldham, C.D. Jones	3	1.9
Total			16.5	16

While no other specific efforts have been made to search for Slender Bush-clover in Ontario, there has been a fairly substantial body of fieldwork conducted by competent field botanists within its range. Prairie and savanna habitat in Windsor and the Lake St. Clair region has been well botanized over the last thirty years (e.g., Pratt 1979, Botham 1981, Goddard 1983, Oldham 1983, Faber-Langendoen and Maycock 1987, Oldham 1992, Bakowsky and Riley 1994), and most, if not all Canadian populations of Slender Bush-clover are probably known.

HABITAT

Habitat Requirements

Range wide, Slender Bush-clover occupies a broad ecological amplitude within open and semi-open habitats. Clewell (1966a) described Slender Bush-clover as a colonizer of dry old fields, prairies, borders of woods, and roadsides. Isely (1990) described its habitat in the southeastern United States as dry upland woods and borders, pine barrens, moist savannas, clearings, old fields, and roadsides. In Michigan, Slender Bush-clover is found in oak ecosystems ranging from disturbed sandy openings to high quality savanna and woodland habitats (B. Slaughter pers. comm. 2012), as well as prairies, shores, fields, railroad banks and open hills where it is mapped from 17 southern Lower Peninsula counties (Reznicek *et al.* 2011). Elsewhere at its northern limit, Slender Bush-clover is more limited to dry open woods and slopes in the southern portion of New Hampshire (Crow and Storks 1980). In Wisconsin, it is found in dry prairies and open upland woods, as well as Eastern Red Cedar (*Juniperus virginiana*) glades on quartzite (Wisconsin DNR 2011).

In Canada, Slender Bush-clover is limited to dry-mesic sand prairie and openings of oak woodland and savanna of the Ojibway Prairie complex in the extreme southern portion of the Mixedwood Plains Ecoregion of Ontario. The climate here is one of the mildest in Canada and has one of the most diverse floral and faunal assemblages in the country. Soils of the Ojibway Prairie complex are poorly drained sands of the Granby Series, which occur up to a depth of one metre overlying impermeable clays. The water table is reportedly near the surface seasonally but flooding is rarely evident (Hoffman 1975), and seasonal droughts still occur. These sands were formed from well-sorted outwash materials deposited as sand bars, outwash plains and beaches of post-glacial lakes and meltwater that covered much of Essex County during the early Holocene. Parent materials are derived from limestone and are neutral in pH to slightly alkaline (Richards *et al.* 1949).

Associated species found growing within 1 metre of Slender Bush-clover at Ojibway Park (part of the Ojibway Prairie complex population) in 2011 are listed in Appendix 1. The relative abundance of each species observed is also summarized based on visual estimates.

Habitat Trends

Tallgrass prairie and oak savanna habitat was locally extensive in southern Ontario along the nearshore areas of Lake St. Clair and the Detroit River at the time of European settlement. It has been estimated that approximately 82,000 hectares of this vegetation was present in southern Ontario at that time (Bakowsky 1999). Today, these habitats are critically imperiled in Ontario, vastly reduced with perhaps 0.5% of the original extent remaining (Bakowsky and Riley 1994). Much of Essex County is made up of flat, very productive land and accordingly, more than three-quarters of the county has been converted to agriculture, mainly cash crops and specialty crops. Much of the area along the Detroit River has been developed for residential and industrial/commercial uses. Most of the remaining prairie and savanna habitat in the Windsor-Ojibway area is protected, though portions are declining in quality through succession and invasive species.

BIOLOGY

Much of the information pertaining to the biology of Slender Bush-clover presented here is summarized from Clewell (1964, 1966a, 1966b).

Life Cycle and Reproduction

Sexual reproduction in bush-clovers can involve both outcrossing and selfing. Plants can produce showy chasmogamous flowers as well as reduced, obligately self-pollinated, cleistogamous flowers. Although plants can bear both kinds of flowers simultaneously, Clewell (1966b) suggests only one kind of flower is produced in a particular year, depending on environmental conditions. Both flower types can produce viable seed.

Flowering occurs in August and September in the northern portion of its range, with flowering periods farther south extending into October. Fruits remain on the plants for most of the winter and eventually fall from the dehiscing seed pods. The timing of germination is not documented, but presumably occurs in the spring, following periodic ground fires or other disturbances that expose mineral soil. Seeds of bush-clovers are long-lived and have been demonstrated to remain viable for at least 5 decades. In a test of seed longevity, Clewell (1966b) reported a 40 percent germination rate of Slender Bush-clover seeds from herbarium material that was 54 years old. The seed coats of bush-clovers are thick and relatively impervious, allowing them to pass through animal digestive systems while retaining their viability. In fact, this likely enhances germination success rates, as Clewell (1966b) found Slender Bush-clover had a 100 percent germination success rate after scarifying the testas (hard coating surrounding embryo) of individual seeds with a scalpel, versus a zero percent germination success rate with no scarification during garden trials.

Plants can reach seed-bearing stage within one year of germination. Clewell (1966b) observed that first year plants reach maturity in one year under controlled conditions in garden experiments. He noted this in natural populations as well, but with less frequency. Vegetative propagation is also reportedly possible through the formation of short underground stolons, or longitudinal fragmentation of woody rhizomes (Clewell 1966b). Plants are typically long-lived (Clewell 1964), and like all other North American bush-clovers, stems of Slender Bush-clover arise from stout, woody rhizomes. Clewell (1964) counted annual growth rings in the rhizomes of *L. hirta* and *L. intermedia*, and revealed plants near Washington D.C. to be 13 to 17 years old. Although demographic information needed to determine the generation time for Slender Bush-clover is unavailable, it is greater than 1 year with a potential upper limit of 17 years.

Physiology and Adaptability

Slender Bush-clover is drought- and fire-adapted, possessing stout, woody rhizomes with nodules containing nitrogen-fixing bacteria, which may provide a competitive advantage in nitrogen-limited environments. The thick seed coats may also provide adaptation to ground fires, allowing the seeds to remain viable.

Plants can bear both cleistogamous and chasmogamous flowers, and both produce viable seed. Each flowering mode is likely triggered by different environmental cues or shifts in the plant's own status (e.g., size, age), and therefore may appear at different times during the growing season, the plant's life cycle, or under different environmental conditions. This may help plants adjust to unsuitable conditions in a given year, investing energy into one or the other type, thus allowing plants to cope with environmental heterogeneity. Because cleistogamous flowers are reduced, the amount of energy required to produce them would be less than for chasmogamous flowers, resulting in more resources available for seed production. Hanson (1943), working with Korean Clover (*Kummerowia stipulacea*; previously *L. stipulacea*), demonstrated that lower temperatures and light levels favoured the production of cleistogamous flowers, which he described as similar to those of the North American Creeping Lespedeza (*L. repens*) and *L. stuevei*. Cleistogamy may also provide reproductive assurance, allowing seed set to occur when pollinators are rare or absent, as has been shown, for example in Large-flower Mountain-Trumpet (*Collomia grandiflora*) (Albert *et al.* 2011).

Dispersal and Migration

According to Clewell (1966b), native bush-clovers are primarily dispersed by animals that consume the seeds and passively disperse them in fecal matter as they travel. The seed coats are thick and relatively impervious, allowing them to pass through digestive systems while retaining their viability. Clewell (1966b) tested the germination rates of several bush-clover species and found that Slender Bush-clover had a 100 percent success rate with scarification, and a zero percent success rate without scarification in garden experiments. Davison (1945) noted Northern Bobwhite (*Colinus virginianus*), Wild Turkey (*Meleagris gallopavo*) and White-tailed Deer (*Odocoileus virginianus*) as consumers of bush-clover seeds. Otherwise, seed dispersal is likely limited to a few metres from parent plants as the seeds fall from the dehiscing seed pods.

Interspecific Interactions

Pollinators of chasmogamous flowers likely include a variety of insects, but those in the order Hymenoptera and Lepidoptera are likely major contributors. Clewell (1964) observed mainly bees visiting bush-clovers in Indiana including the honeybee (*Apis mellifera*), a bumblebee (*Bombus* sp.), and a species of leaf-cutter bee (Megachilidae). Southern Plains Bumblebee (*Bombus fraternus*) was observed visiting *L. virginica* and *L. capitata* in Alabama (Clewell 1966b).

Bush-clovers are food plants for a variety of insects as well, most notably the larvae of several butterflies including the Eastern Tailed-Blue (*Cupido comyntas*) and Silver-spotted Skipper (*Epargyreus clarus*) (COSEWIC 2000), in addition to (but likely not limited to) Black-spotted Prominent (Dasylophia anguina) and Bella Moth (*Utetheisa bella*) (Riotte 1992). Slender Bush-clover is not known as an obligate host plant for any insect species.

Bush-clovers, as with many other legumes, are known for their formation of root nodules, which act as hosts for various microsymbionts. Yao *et al*. (2002) analyzed protein electrophoretic and DNA hybridization data to characterize rhizobial strains isolated from Lespedeza species. They found bush-clovers to be promiscuous hosts for several rhizobia, and that bush-clovers were non-selective for the microsymbionts detected. Strains of *Bradyrhizobium* were isolated from soil associated with several species of Lespedeza including *B. japonicum* and *B. elkanii* from the United States. Slender Bush-clover was not part of the study however, and it is not known whether it forms any specific or obligate interactions with these or other microsymbionts.

Rusts (order Pucciniales), including Uromyces lespedezae-procumentis, *U. lespedezae* and *Colletotrichum* sp., caused by pathogenic fungi that require an external host for nutrients, growth, and reproduction, have been isolated from several species of bush-clover (Kellerman 1905; Cummins 1951; Clewell 1966b; Mitchell *et al*. 2002), but are not documented from Slender Bush-clover.

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

Efforts to locate Slender Bush-clover in Ontario over the last thirty years have largely involved incidental discoveries while conducting other survey work. More recently, targeted searches of known sites have been conducted. Sampling has normally coincided with peak flowering periods between August and September. Complete surveys of all known Canadian populations involving an estimate of mature individuals (i.e., flowering or fruiting) have been completed in 1997, 2000, and 2011.

Abundance

The current total number of mature Canadian individuals is estimated at 165, limited to a single extant subpopulation in the Ojibway Prairie complex, composed of three sites, with only one still appearing to support plants. At the Ojibway Park site, plants occur in a small open sandy area, occupying roughly 36 m². The next nearest site is Black Oak Heritage Park, roughly 600 m to the west. Plants have not been seen here since 1993, when a few individuals were observed. The Tallgrass Heritage site lies roughly 1.1 km east of the Ojibway Park site, and plants have not been observed there since 1997, when 8 mature individuals were documented. These two sites may have been lost as a result of successional change and cessation of disturbance, though a viable seedbank may still exist. The Leamington subpopulation is presumed extirpated.

Fluctuations and Trends

Although significant population fluctuations (whereby individuals die off and are rapidly replaced with new individuals) were cited in the previous COSEWIC assessment (COSEWIC 2000), available survey data (Table 1) are too limited to confidently verify that fluctuations occur. Namely, comparable long-term population data at each of the three sites that make up the Ojibway Prairie complex subpopulation are lacking. Up until 1997, surveys were largely unsystematic and fortuitous. For example, at the Tallgrass Heritage Park site, numerous observations were made between 1977 and 1983, though no actual counts were recorded until 1984, when P. Pratt counted 150 individuals. It was not until 1997 that another full count was conducted by K. Cedar who reported 22 individuals, 8 of which were mature. No plants were seen in 2000 or 2011 during additional intentional searches. Trends here likely reflect actual declines based on gradual loss of habitat through natural succession, versus large population fluctuations.

At the Black Oak Heritage Park site, a few individuals were first documented in 1993 along the edge of an active ATV trail, though no plants have been found here since then despite focused searches in 1997 and 2011. Plants may have succumbed to damage from ATV traffic, though this activity has since stopped. Recent systematic surveys at the Ojibway Park site actually suggest a stable population. In 1997, 160 plants were counted and in 2011 165 plants were observed. The low count here in 2000 is likely the result of point-in-time ATV disturbance to habitat which likely damaged plants, but later recovered as ATV use halted here shortly thereafter (P.A. Woodliffe pers. comm. 2012).

Rescue Effect

The nearest population of Slender Bush-clover is in adjacent Michigan at the Middlebelt Prairie in the Greater Detroit area, roughly 26 km southwest of Ojibway Park (T. Reznicek, pers. comm. 2012). Due to the degree of development in areas between the two populations and the physical barrier of the Detroit River, the likelihood of recruitment is low. The dry pods and smooth seeds have no obvious structural adaptations for long-distance dispersal (e.g. barbs, hooks, wings etc.), though they are known to remain viable if passed through the digestive tracts of animals and could passively disperse to new areas if passed through fecal matter into other suitable habitat. The continued existence of Slender Bush-clover in Canada largely depends on the maintenance of the existing population.

LIMITING FACTORS

The specialized prairie and savanna habitat of Slender Bush-clover limit the species' range in Canada. Slender Bush-clover was likely always rare and local, occurring near the northern edge of its range, and confined by its physiological and ecological requirements to warm, dry, open sites with some form of natural disturbance. Its advancement into Ontario likely occurred during a period of climatic warming known as the Hypsithermal some 8,000 to 4,000 years ago, when warmer and drier conditions altered the composition of vegetation and favoured the northeast migration of the prairie biome (Transeau 1935, Stuckey 1981). Where suitable site conditions existed, areas of prairie and savanna persisted in southern Ontario upon subsequent cooling, until settlement and the associated alteration of the landscape by the first Europeans.

The gradual loss of these prairie ecosystems in Ontario has resulted mainly from fire suppression, conversion to agriculture and intensifying urban development. The remnant prairie and savanna habitat remaining in Ontario now is very rare (Bakowsky 1999), and its degree of fragmentation limits potential for re-colonization or expansion of Slender Bush-clover's Canadian range. Spring Garden Road Prairie is the nearest natural area with potentially suitable habitat roughly 2.2 km to the east. It is separated by a mix of remnant woodland, prairie and forest and a narrow swath of residential development and secondary road. Propagules could naturally be transported here via an animal disperser. The next nearest natural area containing suitable prairie and savanna habitat is Walpole Island, roughly 56 km to the northeast and is separated largely by unsuitable habitat in the form of rural agricultural land and the open water of Lake St. Clair. Otherwise, the next nearest area of suitable habitat occurs in Pinery Provincial Park, roughly 145 km to the northeast, and also separated by rural agricultural land and the open waters of Lake St. Clair and Lake Huron.

THREATS

Altered Disturbance Regime

Periodic disturbance is necessary to maintain the open habitat in which Slender Bush-clover grows in Ontario. Clewell (1966b) states that bush-clovers are colonizers of relatively open habitats and are unable to reproduce or survive for more than a few years unless habitat remains open through either fire or some other disturbance.

Lack of disturbance is the most serious and pervasive threat to Slender Bush-clover at all three sites within the Ojibway Prairie complex subpopulation. It appears to be the key factor in the elimination of plants at the Tallgrass Heritage Park site. The original opening occupied by Slender Bush-clover here has completely closed in by woody vegetation and does not appear to support any plants, though it may still have a viable seed bank. All-terrain vehicle traffic that formerly occurred at the Black Oak Heritage Park and Ojibway Park sites likely aided in the maintenance of open sandy habitat, though this activity also damaged / destroyed individual plants (P.A. Woodliffe pers. comm. 2012). The termination of this activity at both sites has reduced the amount of open sand patches and has permitted succession of woody and herbaceous species, resulting in reduced overall site quality. Encroachment of oaks (*Quercus* spp.) at the Ojibway Park site continues to reduce the amount of open habitat there. While prescribed burns have been initiated in the Ojibway Prairie complex, none have occurred at any sites currently or previously occupied by Slender Bush-clover.

Invasive Species

A number of invasive species were observed at the Ojibway Park site in 2011 growing adjacent (within 1 metre) to Slender Bush-clover, as well as in adjoining open habitat. The fact that none of these were mentioned by Pratt (1986) or Cedar (1999) suggests they may be recent invaders. Crown-vetch (*Securigera varia*) appears to pose the most immediate threat of any, and was observed to be a common component of occupied Slender Bush-clover habitat forming a low ground cover that carpeted otherwise open sand patches. This species, often used for erosion control, is known for its ability to rapidly colonize open areas, and has become well established elsewhere (Reznicek *et al.* 2011). Symstad (2004) investigated the effect of Crown-vetch in a remnant sand prairie in Illinois and found its presence significantly increased soil nitrogen availability and significantly decreased native species richness and cover. At the Ojibway Park site, it poses a serious concern, as it has eliminated the majority of small open sandy patches adjacent to Slender Bush-clover plants, reducing suitable germination sites and degrading open habitat via interspecific competition. Without some form of management, it will likely continue to spread and cover more open sand patches in the small remnant prairie opening where Slender Bush-clover is found.

Spotted Knapweed (*Centaurea stoebe* ssp. *micranthos*) was noted as a rare associate growing adjacent to Slender Bush-clover at Ojibway Park in several patches of open sand. While not well established yet, it also poses a serious concern. Recent studies concerning this species suggest that its invasive success may be related to its stronger allelopathic effects on native North American species, increasing its competitive advantages over non-conspecifics (e.g., LeJeune and Seastedt 2001, Wei-Ming *et al.* 2009). Like Crown-vetch, it can quickly spread and will no doubt severely reduce areas of open sandy soil if left to spread, and further degrade habitat via interspecific competition and reducing beneficial soil microbes through allelopathy.

Several sizable clumps of the introduced shrub Autumn Olive (*Elaeagnus umbellata*) were also observed growing in the open prairie remnant occupied by Slender Bush-clover at the Ojibway Park site. This species is fast-growing, and has been planted frequently in Ontario for food and cover for wildlife, as well as for soil stabilization. More recently, it has spread becoming well established, and is now considered a problematic weed of dry sandy soil in Ontario, and is known to degrade natural sandy openings (Catling *et al.* 1997). Although only a few individuals were noted in 2011, they appeared well established and are contributing to the reduction of suitable open habitat. If allowed to spread, Autumn Olive will continue to reduce the habitat suitability and quality for Slender Bush-clover here.

Other introduced species observed that could be a threat via interspecific competition (but are of perhaps less of a concern in the long term) in the open area include Canada Bluegrass (*Poa compressa*), Orchard Grass (*Dactylis glomerata*), Redtop (*Agrostis gigantea*), and Wild Carrot (*Daucus carota*), all well-established weeds of open places. Tall Purple-top Fluffgrass (*Tridens flavus*), a large, robust perennial grass that can thrive in open, disturbed areas, is expanding at the northern periphery of its range.

PROTECTION, STATUS, AND RANKS

Legal Protection and Status

Slender Bush-clover was assessed as Endangered in Canada by COSEWIC in 1986 on the basis of its restricted geographic distribution, small population size, and threats that included habitat succession, and an ongoing loss of plants (Pratt 1986). Its status was reassessed in April of 1999 and May of 2000, and reconfirmed (COSEWIC 2000). In 2002, Slender Bush-clover was listed as Endangered on Schedule 1 of the federal *Species at Risk Act* (2002). A draft federal Recovery Strategy for Slender Bush-clover is near completion (SARA Registry 2012).

In Ontario, Slender Bush-clover is listed as Endangered in Schedule 1 (species declared to be threatened with extinction) of *Ontario's Endangered Species Act* (2007).

Elsewhere, Slender Bush-clover is listed as state Threatened in New Hampshire and Wisconsin (NatureServe 2012).

Non-Legal Status and Ranks

NatureServe (2012) state and provincial status ranks (SRanks) are provided in Table 3. Slender Bush-clover is not considered of conservation concern across the core of its range, but it is of concern along portions of its northern range limits, where populations tend to be small and isolated. It is listed as critically imperiled (S1) in Ontario and New Hampshire, imperiled (S2) in Wisconsin and maybe vulnerable (S3?) in New York. The General Status rank for Slender Bush-clover is "At Risk" for Ontario and Canada (Wild Species 2012).

Table 3. Slender Bush-clover (*Lespedeza virginica*) state and provincial SRanks based on NatureServe (2012).

Status	Jurisdiction
Canada	
S1 (Critically Imperiled)	Ontario
United States	
S1 (Critically Imperiled)	New Hampshire
S2 (Imperiled)	Wisconsin

Status	Jurisdiction
S3? (Maybe Vulnerable)	New York
S4 (Apparently Secure)	Iowa, Virginia, West Virginia
S5 (Secure)	Delaware, Kentucky, New Jersey, North Carolina
SNR (Unranked)	Alabama, Arkansas, District of Columbia, Florida, Georgia, Illinois, Indiana, Kansas, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas

Habitat Protection and Ownership

Much of Ojibway Park was acquired by the City of Windsor in 1957 and the 20-hectare area containing Slender Bush-clover known as the Windsor Raceway Woodlot was acquired in 1991. Black Oak Heritage Park was acquired by the City of Windsor in 1987 and the area north of Titcombe Road now known as Tallgrass Heritage Park was acquired in 1990 (History of Ojibway Prairie 2011). Collectively, these and other areas, along with the Ojibway Prairie Provincial Nature Reserve, form the Ojibway Prairie Remnants Provincially Significant Area of Natural and Scientific Interest (ANSI) identified by the Ministry of Natural Resources (Pratt 1979). All three areas that presently or recently contained Slender Bush-clover are currently administered by the Department of Parks and Recreation's Ojibway Nature Centre. The department's mandate includes management of conservation and recreational activities, as well as providing safe and clean park spaces.

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COLLECTIONS EXAMINED

Ontario collections were examined from the Natural Heritage Information Centre Herbarium (NHIC), Peterborough, ON.

Appendix 1. Vascular plants growing within 1 metre of Slender Bush-clover plants at the Ojibway Park site, Windsor, and their estimated abundance and status based on 2011 fieldwork.

Scientific name	Common name	Abundance*	Introduced
Achillea millefolium	Yarrow	rare	yes (?)
Agrostis gigantea	Redtop	rare	yes
Ambrosia artemisiifolia	Ragweed	rare	
Andropogon gerardii	Big Bluestem	rare	
Aristida purpurascens	Arrow Feather Three-awn	rare	
Asclepias tuberosa	Butterfly Milkweed	rare	
Carex granularis	Meadow Sedge	uncommon	
Carya glabra	Sweet Pignut Hickory	rare	
Centaurea stoebe	Spotted Knapweed	rare	yes
Coreopsis tripteris	Tall Coreopsis	rare	
Cornus sp.	Dogwood	rare	
Securigera varia	Crown Vetch	common	yes
Dactylis glomerata	Orchard Grass	rare	yes
Daucus carota	Wild Carrot	uncommon	yes
Desmodium canadense	Showy Tick-trefoil	uncommon	
Dichanthelium sphaerocarpon	Round-fruited Panic Grass	rare	
Elaeagnus umbellata	Autumn Olive	rare	yes
Erigeron strigosus	Common Eastern Fleabane	rare	
Euthamia graminifolia	Grass-leaved Goldenrod	rare	
Fragaria virginiana	Wild Strawberry	rare	
Lespedeza capitata	Round-headed Bush-clover	rare	
Liatris spicata	Dense Blazing-star	rare	
Monarda fistulosa	Wild Bergamot	rare	
Muhlenbergia mexicana	Leafy Satin Grass	rare	
Penstemon digitalis	Foxglove Beard-tongue	rare	
Poa compressa	Kentucky Bluegrass	rare	yes
Prunella vulgaris	Heal-all	rare	
Pycnanthemum virginianum	Virginia Mountain-mint	rare	
Quercus velutina	Black Oak	uncommon	
Rubus sp.	Raspberry	common	
Salix humilis	Upland Willow	rare	
Schizachyrium scoparium	Little Bluestem	uncommon	
Solidago altissima	Tall Goldenrod	rare	
Solidago nemoralis	Field Goldenrod	rare	

***Abundance based on visual estimations, rather than on any specific numerical thresholds.**