

<b>MN NWAC Risk Assessment Worksheet (04-2017)</b>	<b>Common Name</b>	<i>Latin Name (Full USDA Nomenclature)</i>
	<b>Siberian peashrub</b>	<b><i>Caragana arborescens Lam.</i></b>
<b>Original Reviewer: Laura Van Riper</b>	<b>Affiliation/Organization: Minnesota Department of Natural Resources</b>	<b>Original Review: 07/05/2019</b>

### Species Description:

- Siberian peashrub is a shrub that is being evaluated due to its observed naturalization in Minnesota woodlands.
- Reasons for concern:
  - Spreads in forest understories, savannas, and edge habitats
  - Native to cold regions (hardy in zones 2-7, Morton Arboretum 2018)
  - Adapted to many soil conditions including salt and poor soils (Morton Arboretum 2018)
  - A nitrogen-fixing species that can alter soil conditions
  - Has chemical properties that can be allelopathic to other plants
- Planted throughout much of the Midwest for shelterbelt and ornamental uses
- Member of the legume family
- Appearance:
  - Size: shrub or small tree up to 18 feet high
  - Leaves: alternate, compound, 2-4 inches long with 8-12 pairs of leaves
  - Flowers: yellow pea shaped flowers, bloom in May and June
  - Fruit: brown seed pods 1-2 inches long
- See the [Minnesota DNR](#) and [Wisconsin DNR](#) Siberian peashrub webpages for additional photos and descriptions.



Photo 1. Siberian peashrub flowers, photo by [Bonsak Hammeraas, NIBIO - The Norwegian Institute of Bioeconomy Research, Bugwood.org](#)



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Photo 2. Siberian peashrub seed pods, photo by [Robert Vidéki, Doronicum Kft., Bugwood.org](#)

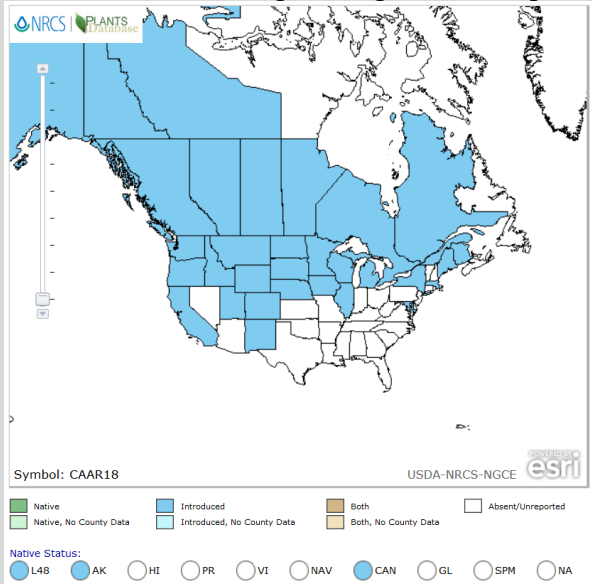


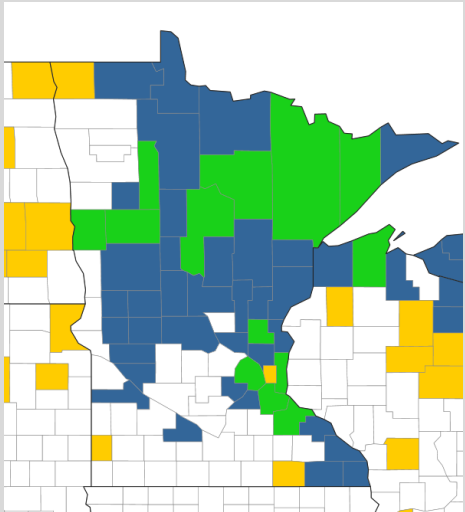
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Photo 3. Siberian peashrub infestation, photo by [John M. Randall, The Nature Conservancy, Bugwood.org](#)

**Current Regulation:** Not regulated in Minnesota or by the federal government. Listed as a Restricted Invasive Species in Wisconsin, with exemptions for the cultivars *Lorbergii*, *Pendula*, and *Walkerii* (Walker) (Wisconsin Department of Natural Resources 2018).

**NOTE:** (Additional supporting information may be added to a box even when the decision tree process bypasses that question. Text used for the Answer box for this non-required text should be **BOLD AND ITALIC**. Furthermore, whenever text is entered for an answer to a question not required by the risk assessment decision tree process, the outcome box should contain the following statement: **This text is provided as additional information not directed through the decision tree process for this particular risk assessment.**)

Box	Question	Answer	Outcome
1	Is the plant species or genotype non-native?	Yes. Native to China, Kazakhstan, Mongolia, and Siberia (Russia) (Wu et al. 2010).	Go to Box 3
3	Is the plant species, or a related species, documented as being a problem elsewhere?	Yes. Listed as a restricted invasive plant in Wisconsin (WI DNR 2018). Managers in Calgary, Canada are removing plants from natural areas (Tighe 2016).	Go to Box 6
6	Does the plant species have the capacity to establish and survive in Minnesota?		
	A. Is the plant, or a close relative, currently established in Minnesota?	<p>Yes. The plant is currently established in Minnesota</p> <p>USDA Plants map of distribution (USDA Plants 2018) shows distribution in Minnesota and neighboring states and provinces:</p>  <p>EDDMaps (2018) shows presence in most Minnesota counties, especially those in the central, northern, and southeastern parts of the state:</p>	Go to Box 7

Box	Question	Answer	Outcome
		 <p data-bbox="688 686 1297 824"> Legend:  Yellow: literature report only  Blue: observational report only  Green: both literature and observational reports </p>	
7	Does the plant species have the potential to reproduce and spread in Minnesota?		
	A. Does the plant reproduce by asexual/vegetative means?	No. The plant can resprout if cut, but does not reproduce vegetatively (Shortt and Vamosi 2012).	Go to 7C
	C. Does the plant produce large amounts of viable, cold-hardy seeds?	Yes. From Shortt and Vamosi 2012, “The flowers form linear pods during June and July. <i>Caragana arborescens</i> is well known for its prolific seed production (Martine et al., 2008). Seed pods are 2-5 cm in length and each contain around six seeds that vary in shape from oblong to spherical (Dietz et al., 2008). When fully grown, the seed pods crack and burst, releasing the seeds. Seed dispersal of <i>C. arborescens</i> begins in July and is typically completed by mid-August (Dietz et al., 2008).”	Go to 7F
	E. Is this species self-fertile?	Yes. From Shortt and Vamosi (2012): “The flowers of <i>C. arborescens</i> are bisexual and self-compatible, emerging from April to late June (Gregory and Allen, 1953; Dietz et al., 2008).”	<i>This text is provided as additional information not directed through the decision tree process for this particular risk assessment.</i>

Box	Question	Answer	Outcome
	F. Are sexual propagules – viable seeds – effectively dispersed to new areas?	Yes. Seeds are dispersed by birds and animals (LeClair 2011).	Go to 7I.
	G. Can the species hybridize with native species (or other introduced species) and produce viable seed and fertile offspring in the absence of human intervention?	No information found on this. There are no native <i>Caragana</i> species in Minnesota.	<i>This text is provided as additional information not directed through the decision tree process for this particular risk assessment.</i>
	H. If the species is a woody (trees, shrubs, and woody vines) is the juvenile period less than or equal to 5 years for tree species or 3 years for shrubs and vines?	No. The species is woody and it takes approximately 10 years to mature (Shortt and Vamosi 2012). It is also reported that when grown commercially it takes 3 to 5 years to reach maturity (LeClair 2011).	<i>This text is provided as additional information not directed through the decision tree process for this particular risk assessment.</i>
	I. Do natural controls exist, species native to Minnesota, that are documented to effectively prevent the spread of the plant in question?	No. While there are herbivores, pathogens, and fungi that have reported to be associated with Siberian peashrub, there is no documentation that they effectively prevent the spread of the plant (Shortt and Vamosi 2012).	Go to Box 8.
8	Does the plant species pose significant human or livestock concerns or has the potential to significantly harm agricultural production, native ecosystems, or managed landscapes?		
	A. Does the plant have toxic qualities, or other detrimental qualities, that pose a significant risk to livestock, wildlife, or people?	No. No evidence was found for toxic qualities. Shortt and Vamosi (2012) note: “The pods and seeds of <i>Caragana arborescens</i> are edible and are cultivated as a vegetable (Meng et al., 2009). The plant is used as nutritional livestock forage and in the arctic/subarctic it is used as fodder for reindeer herds (Duke, 1983).	Go to 8B
	B. Does, or could, the plant cause significant financial losses associated with	No evidence was found for this.	Go to 8C

Box	Question	Answer	Outcome
	decreased yields, reduced crop quality, or increased production costs?		
	C. Can the plant aggressively displace native species through competition (including allelopathic effects)?	<p>Yes.</p> <p>Shortt and Vamosi (2012) reference displacement of native species: “Since its introduction, it has been able to spread from shelterbelt plantings on farms to natural areas adjacent to it, invading the natural forests of North America (Henderson and Chapman, 2006). Records show that 50 planted individuals were able to grow to a population of approximately 60,000 plants over 75 years in the Great Plains of Canada, indicating a rapid growth rate and the risk of extensive colonization and displacement of native species in North America (Henderson and Chapman, 2006).”</p> <p>“Henderson and Chapman (2006) studied the effects of a non-native <i>C. arborescens</i> population on native shrub species in Elk Island National Park, Canada [Saskatchewan]. Native shrub diversity, but not species richness, was affected by <i>C. arborescens</i> density.”</p> <p>“Because the adult plants reach heights of 3-5 m, they may decrease light availability to native plants (Henderson and Chapman, 2006). <i>Caragana arborescens</i> has a long life history strategy, maturing at 10 years of age and living up to 90 years of age as a canopy dominant (Henderson and Chapman, 2006). Populations have large numbers of recruits per year, taking advantage of forest canopy gaps. Henderson and Chapman (2006) noted that <i>C. arborescens</i> may reach these gaps before many native canopy dominant plants (e.g., <i>Populus tremuloides</i>, <i>Populus balsamifera</i>, <i>Salix</i> spp.). Finally, its long leaf-out period may lead to high recruitment rates and increased survival through increased intake of solar energy compared to many native species (Henderson and Chapman, 2006).”</p> <p>Shortt and Vamosi (2012) reference allelopathy: “At least ten species of <i>Caragana</i> contain esters, cardiac glycosides, steroids, terpenoids and phenolic compounds, but almost no traces of alkaloids (Wang et al., 2005). Phenolic compounds have been found in the water of drainage basins near <i>C. arborescens</i> populations. The compounds, due to their inhibitory properties, may disturb vital functions in plants such as <i>Agropyron repens</i>, supporting evidence that <i>C. arborescens</i> is detrimental to the growth of many grass species (Zolotukhin, 1980).”</p> <p>“<i>C. arborescens</i> is a prolific producer of the toxic non-protein amino acid, L-Canavanine (Rosenthal, 2001), which is an allelochemical that provides a barrier to herbivore predation and pathogen uptake. L-Canavanine is structurally similar to L-Arginine and is</p>	Go to Box 9

Box	Question	Answer	Outcome
		<p>taken up by insects that cannot differentiate between the two amino acids (Rosenthal, 2001).”</p> <p>“<i>Caragana arborescens</i> secretes phenolic compounds into the soil, which inhibit the growth and germination of native plants and are highly toxic to microorganisms (Zolotukin, 1980; Whitehead et al., 1982). Phenolic compounds influence many physiological processes, including nutrient uptake, protein synthesis, respiration, photosynthesis, and membrane permeability (Reigosa et al., 1999).”</p>	
	D. Can the plant hybridize with native species resulting in a modified gene pool and potentially negative impacts on native populations?	No information found on this. There are no native <i>Caragana</i> species in Minnesota.	<i>This text is provided as additional information not directed through the decision tree process for this particular risk assessment.</i>
	E. Does the plant have the potential to change native ecosystems (adds a vegetative layer, affects ground or surface water levels, etc.)?	<p>Shortt and Vamosi (2012) note it can add nitrogen to a system:  “<i>Caragana arborescens</i> is a nitrogen-fixing plant and, furthermore, it initiates nitrogen fixation at temperatures of 3-5°C, which is considerably lower than in many other species (Hensley and Carpenter, 1979). With the ability to initiate nitrogen fixation at such low temperatures, <i>C. arborescens</i> has a greater northern hardiness limit than most other studied species (Hensley and Carpenter, 1979).”</p> <p>“Nitrogen fixation also alters local soil characteristics, potentially altering normal successional pathways.”</p>	<i>This text is provided as additional information not directed through the decision tree process for this particular risk assessment.</i>
	F. Does the plant have the potential to introduce or harbor another pest or serve as an alternate host?	No information found on this.	<i>This text is provided as additional information not directed through the decision tree process for this particular risk assessment.</i>
9	Does the plant species have clearly defined benefits that outweigh associated negative impacts?		
	A. Is the plant currently being used or produced and/or sold in Minnesota or native to Minnesota?	<p>Yes.</p> <p>The plant is not native to Minnesota.</p> <p>The plant is currently being sold in Minnesota.</p> <p>In 2017 the MDA sent a survey to 1,402 Minnesota nursery certificate holders. In the questions on Siberian peashrub, the survey found that 13</p>	Go to 9B

Box	Question	Answer	Outcome
		<p>of the 43 respondents sell Siberian peashrub. Three of the 43 respondents indicated that it was a significant source of income.</p> <p>Summary of the survey results with the percent (of 43 respondents) that agreed with the statement:</p> <ul style="list-style-type: none"> <li>• I/we currently sell this species or one or more named cultivars of this species. 30%</li> <li>• This species provides significant income for my/our business. 7%</li> <li>• If this species were regulated as a noxious weed and not allowed to be sold in Minnesota, it would have a significant negative impact on my/our business. 9%</li> <li>• There are good alternatives available with desirable traits that are similar to this species. 51%</li> <li>• There are no good alternatives available with desirable characteristics that are similar to this species. 14%</li> </ul> <p>In 2018, the Minnesota Nursery and Landscape Association reached out to wholesalers in an attempt to get an estimate of the wholesale value of Siberian peashrub (the following is from James Calkins, Minnesota Nursery and Landscape Association; personal communication, August 22, 2018). It is important to note that wholesale value does not represent the full value of a particular species because retail value is not accounted for and is a significant component of the value equation. For Siberian peashrub (<i>Caragana arborescens</i>; including the species and all cultivars; there are only a few named cultivars, including weeping cultivars that are grown as ground-covers or on standards) the wholesale value is estimated at \$14,339.00/year (about 0.1% of total annual sales for these growers). As a wholesale value based on only the biggest wholesalers of this species, although these growers probably account for the majority of the wholesale production of Siberian peashrub in Minnesota, this estimate of wholesale value is not representative of every grower and is, therefore, a rough and conservative estimate of the wholesale value. The value of Siberian peashrub to these wholesale growers is also much higher when out-state sales are considered. Multiplying the wholesale value by a factor of 1.5 to 2.0 would probably provide a rough, but reasonable, estimate of the ultimate retail value of the Siberian peashrub</p>	



Box	Question	Answer	Outcome
		<p>plants sold by these wholesalers. Based on this information the estimated value (wholesale plus value-added retail) of Siberian peashrub plants sold in Minnesota would be in the range of \$35,848 to \$43,017/year (once again, this would be a conservative estimate because the data set is not complete). These estimated monetary values also do not account for the unique landscape value of Siberian peashrub in designed landscapes.</p>	
	<p>B. Is the plant an introduced species and can its spread be effectively and easily prevented or controlled, or its negative impacts minimized through carefully designed and executed management practices?</p>	<p>No. The species is introduced. There are not easy control measures.</p>	<p>Go to 9C</p>
	<p>C. Is the plant native to Minnesota?</p>	<p>No.</p>	<p>Go to 9D</p>
	<p>D. Is a non-invasive, alternative plant material commercially available that could serve the same purpose as the plant of concern?</p>	<p>Yes. There are alternative flowering shrubs that can be sold. Respondents to the 2017 MDA survey had concerns that it is challenging to find flowering shrubs for northern Minnesota.</p> <p>There is a hybrid of <i>Caragana arborescens</i> and <i>Caragana frutex</i> that is likely sterile. It is sold as the Siberian peashrub cultivar ‘Jefarb’ / Green Spires®.</p> <p>Dr. Gregory Morgenson, woody plant research specialist at North Dakota State University, provided the following information on ‘Jefarb’ / Green Spires® sterility (June 2019):</p> <p style="padding-left: 40px;">Below are my observations regarding Green Spires Caragana and observations of Dr. Wilbert Ronald of Jeffries Nurseries, Manitoba. I selected Green Spires Caragana and Jeffries Nurseries commercialized its use in the nursery industry. This is not a release from the NDSU Tree Improvement and Research Program.</p>	<p>Go to Box 10</p>

Box	Question	Answer	Outcome
		<p>Green Spires Caragana is a single plant selection from an older shelterbelt planting of <i>Caragana arborescens</i>. I first noted the plant in the early 1990's when I was observing shelterbelts for individuals showing resistance to leaf spot which can occasionally defoliate <i>C. arborescens</i> by late summer in North Dakota. This plant was propagated vegetatively and grown in several locations, Bismarck, ND and Portage la Prairie, Manitoba for further observation. The plant was found to have high leaf disease resistance, minimal to no basal suckering, and most importantly, no seed pod formation though flowering is typical for the species. The original plant which I was able to observe yearly had zero pod/seed formation during the 20+ years of observation.</p> <p>A propagated and now mature individual plant in Bismarck planted with <i>C. arborescens</i> and <i>C. frutex</i> has remained seedless for 18+ years and additional plants at the NDSU Horticulture and Research Farm planted with 4 species of Caragana nearby have remained seedless for 7+ years. Flowering will occur which is utilized by native bees, cedar waxwings, gold finches, and orioles but then aborts before pod formation. Other Caragana species nearby do typically form pods yearly under these conditions so I am confident that after several decades of observation, Green Spires Caragana is sterile. Additionally, attempted hand pollination of Green Spires by two other species met with zero success. Dr. Ronald feels that the cultivar is a putative hybrid of <i>C. arborescens</i> and <i>C. frutex</i> and I would tend to agree with that based on its much higher tolerance of leaf spot diseases which <i>C. frutex</i> tolerates to a higher degree.</p> <p>Dr. Wilbert Ronald, Jeffries Nurseries, provided the following information on 'Jefarb' / Green Spires® sterility (June 2019):</p> <p>I believe that the Green Spires is such a wide interspecific cross that sterility is a result. We have watched 25 plus trees for upward</p>	

Box	Question	Answer	Outcome
		of 15 years and have never seen fruit although there would have been other common caragana around.	
	E. Does the plant benefit Minnesota to a greater extent than the negative impacts identified at Box #8?		
10	Should the plant species be enforced as a noxious weed to prevent introduction &/or dispersal; designate as prohibited or restricted?		
	A. Is the plant currently established in Minnesota?	Yes.	Go to 10B
	B. Does the plant pose a serious human health threat?	No.	Go to 10C
	C. Can the plant be reliably eradicated (entire plant) or controlled (top growth only to prevent pollen dispersal and seed production as appropriate) on a statewide basis using existing practices and available resources?	<p>No.</p> <p>There are management techniques for Siberian pea shrub, similar to other woody shrubs. The plant is too widely spread to be added to the Eradicate List. The plant could be added to the Control List, but generally woody plants have not been added to the due to the labor and expense required for control.</p> <p>Control methods from Shortt and Vamosi (2012):  “Physical removal can involve: mowing, hand-pulling, stabbing, soil solarisation, burning, bull-doing surface material to remove root crowns from the soil, cutting, girdling, flooding or mulching (Hobbs and Humphries, 1995; Heiligmann, 1997; Tu et al., 2001; Shafroth et al., 2005; Meloche and Murphy, 2006; Delanoy and Archibold, 2007; White, 2007). Physical removal is likely the most environmentally friendly method, but it is labour intensive (Hobbs and Humphries, 1995). Burning is effective for killing seedlings and can also top-kill adult shrubs. However, it must be repeated annually or biennially over several years (Delanoy and Archibold, 2007). There have been combinations of hand pulling and mulching, which results in a reduced juvenile population because light penetration to the seedlings is reduced (Meloche and Murphy, 2006, Tu et al., 2001). This control technique is only effective over a one-year span because the mulch eventually gets dispersed (Meloche and Murphy, 2006). If implemented, hand-pulling and mulching need to be repeated each year to be effective (Meloche and Murphy, 2006). In addition, there are problems with the effect of mulching stunting the growth of native plant species (Tu et al., 2001). The least</p>	<p>List as a Restricted Noxious Weed with an exemption for the cultivar ‘Jefarb’ / Green Spires®.</p> <p>Information on sterility of other cultivars is lacking. If there is evidence for additional sterile cultivars, the information can be presented to the Noxious Weed Advisory Committee for their consideration of an exemption for those cultivars.</p>

Box	Question	Answer	Outcome
		<p>effective physical control method is the cut-stump method with no application of herbicide (Meloche and Murphy, 2006). On its own, this method leaves open canopy areas, which may promote regrowth and seed germination, increasing the overall number of juveniles present and worsening the problem (Meloche and Murphy, 2006; Delanoy and Archibold, 2007).”</p> <p>“A variety of commercial (e.g., Garlon™ 4) and traditional (e.g., vinegar- and clove oil-based) herbicides have been applied in shrub control programs (e.g., Shafroth et al., 2005; Meloche and Murphy, 2006; Tyler et al., 2006; Delanoy and Archibold, 2007; Heiligmann, 1997; Chirillo, 2008). Although herbicides have largely been applied to other invasive plant species to date (e.g., buckthorn, <i>Rhamnus cathartica</i> L.), one potentially effective strategy is a combination of stump cutting or girdling followed by the immediate application of herbicides. Unfortunately, there are challenges to using environmentally friendly traditional methods as alternatives to commercial herbicides because of safety concerns for people working with vinegar and clove oil (Chirillo, 2008).”</p>	
11	Should the plant species be allowed in Minnesota via a species-specific management plan; designate as specially regulated?		

Final Results of Risk Assessment		
Review Entity	Comments	Outcome
NWAC Listing Subcommittee	The subcommittee agreed on 07/18/19 to present the risk assessment with Restricted Noxious Weed as the outcome with an exemption for the cultivar ‘Jefarb’ / Green Spires®.	Restricted with exemption for cultivar ‘Jefarb’/Green Spires®
NWAC Full Committee	Vote on 12/03/19 was 14:1 in favor of Restricted with exemption.	Restricted with exemption for cultivar ‘Jefarb’/Green Spires®
MDA Commissioner	Commissioner order was signed on 01/15/20 and effective on 01/17/20.	Restricted with exemption for cultivar ‘Jefarb’/Green Spires®

## Risk Assessment Current Summary (*Current Year – 07/05/2019*):

- Siberian peashrub is a shrub that is forming dense cover in Minnesota forest understories, savannas, and edge habitats. It is a nitrogen-fixing species that can alter soil conditions and it has chemical properties that can be allelopathic to other plants.
- Siberian peashrub has been planted in Minnesota for shelterbelt and ornamental uses.
- Siberian peashrub is too widespread to be on the Prohibited Invasive Species Eradicate List and woody species have generally not been added to the Prohibited Invasive Species Control List.
- The NWAC Listing Subcommittee recommends listing Siberian peashrub as a Restricted Noxious Weed with an exemption for the sterile cultivar ‘Jefarb’ / Green Spires®.

## References:

- EDDMapS. 2018. Early Detection & Distribution Mapping System. The University of Georgia - Center for Invasive Species and Ecosystem Health. Siberian peashrub. <https://www.eddmaps.org/distribution/uscounty.cfm?sub=9925>. Accessed 12 April 2018.
- Henderson, D. C. and R. Chapman. *Caragana arborescens* invasion in Elk Island National Park, Canada. *Natural Areas Journal* 26(3): 261-266.
- LeClair, C. 2011. Wisconsin literature review for *Caragana arborescens*. [http://dnr.wi.gov/topic/Invasives/documents/classification/LR\\_Caragana\\_arborescens.pdf](http://dnr.wi.gov/topic/Invasives/documents/classification/LR_Caragana_arborescens.pdf). Accessed 19 Jan 2018.
- Minnesota Department of Natural Resources 2018. Siberian peashrub. <http://www.dnr.state.mn.us/invasives/terrestrialplants/woody/siberianpeashrub.html>. Accessed 19 Jan 2018.
- Morton Arboretum 2018. Siberian pea-shrub. <http://www.mortonarb.org/trees-plants/tree-plant-descriptions/siberian-pea-shrub>. Accessed 19 Jan 2018.
- Shortt, K. B., Vamosi, S. M. 2012. A review of the biology of the weedy Siberian peashrub, *Caragana arborescens*, with an emphasis on its potential effects in North America. *Botanical Studies*, 53:1-8.
- Tighe, T. 2016. *Caragana* shrub invades Calgary’s natural areas as city starts removal program. *Global News*. <https://globalnews.ca/news/2696028/caragana-shrub-invades-calgarys-natural-areas-as-city-starts-removal-program/>. Accessed 19 Jan 2018.
- USDA Plants 2018. *Caragana arborescens* Lam. <https://plants.usda.gov/core/profile?symbol=caar18>. Accessed 19 Jan 2018.
- Wisconsin Department of Natural Resources 2018. Siberian peashrub. <http://dnr.wi.gov/topic/Invasives/fact/SiberianPeashrub.html>. Accessed 19 Jan 2018.
- Wu, Z. Y., P. H. Raven & D. Y. Hong, eds. 2010. *Flora of China*. Vol. 10 (Fabaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis. *Caragana arborescens*, page 537. [http://www.efloras.org/florataxon.aspx?flora\\_id=2&taxon\\_id=200011995](http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200011995). Accessed 22 Dec 2017.