COSEWIC
Assessment and Status Report

on the

Victorin's Water-hemlock
Cicuta maculata var. *victorinii*

in Canada

SPECIAL CONCERN
2022

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Previous report(s):

COSEWIC 2004. COSEWIC assessment and update status report on the Victorin's water-hemlock, *Cicuta maculata* var. *victorinii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 21 pp. (https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html).

Legault, A. 1987. Status report on Victorin's water-hemlock, *Cicuta maculata* var. *victorinii*, in Canada. Committee on the Status of Endangered Wildlife in Canada. 46 pp.

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Victorin's Water-hemlock — Photograph by Audrey Lachance..

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COSEWIC
Assessment Summary

Assessment Summary – May 2022

Common name
Victorin's Water-hemlock

Scientific name
Cicuta maculata var. *victorinii*

Status
Special Concern

Reason for designation
This geographically highly-restricted perennial herbaceous plant is endemic to Canada and occurs only in tidal freshwater or brackish shoreline habitats of the St. Lawrence River estuary in Quebec. Over 16,000 mature plants are presently known from 54 small localized subpopulations. It is at risk from a range of threats, including competition with invasive plants, habitat destruction by off-road vehicles and other recreational activities, and habitat loss from erosion and inundation that result from the effects of climate change. This taxon is near to qualifying for Threatened status, and failure to effectively mitigate these threats could result in it becoming Threatened.

Occurrence
Quebec

Status history
Designated Special Concern in April 1987. Status re-examined and confirmed in May 2004 and May 2022.

COSEWIC
Executive Summary

Victorin's Water-hemlock
Cicuta maculata var. *victorinii*

Wildlife Species Description and Significance

Victorin's Water-hemlock (*Cicuta maculata* var. *victorinii*) is a perennial plant belonging to the family Apiaceae (parsnip family). The variety *victorinii* is distinguished from variety *maculata* by its curved to ovoid fruit that have prominent lateral ribs and obscure dorsal ribs, and by its linear-lanceolate leaflets.

Victorin's Water-hemlock belongs to a group of plants that are endemic to estuarine shorelines of the lower St. Lawrence River.

Aboriginal (Indigenous) Knowledge

All species are significant and are interconnected and interrelated. There is no species-specific ATK in the report.

Distribution

Victorin's Water-hemlock is found only in the lower St. Lawrence estuary of southern Quebec. Its range stretches along the shores of the St. Lawrence River from Sainte-Anne-de-la-Pérade in the southwest to Saint Roch-des-Aulnaies in the northeast.

Habitat

Victorin's Water-hemlock occurs in tall, open Prairie Cordgrass beds in freshwater and slightly brackish tidal marshes. It prefers thick (over 15 cm), fine- or mixed-grained (never coarse) river mud. Plant densities are much lower in areas dominated by gravel and pebbles.

Biology

Victorin's Water-hemlock is an herbaceous perennial that flowers from June to early September. Fruiting begins in August. The seeds are temporarily buoyant, which aids dispersion. The plants mature and can bear fruit in their second year, but may live several decades. Generation time is unknown but estimated to be seven years. Victorin's Water-hemlock grows only in highly dynamic, tidal-dependent habitats.

Population Sizes and Trends

Victorin's Water-hemlock is known from 58 subpopulations, 53 of which are extant. The total population (>21,000 plants) includes at least 16,637 mature individuals. Sixteen of the 58 subpopulations have been discovered since the last update status report. Most subpopulations appear to be relatively stable; however, declines are projected due to threats.

Threats

The most serious threats to Victorin's Water-hemlock are encroachment by invasive alien plant species, recreational activities, and the impacts of climate change, particularly erosion due to storms and flooding. Contradictory provincial agricultural regulations also require property owners to uproot all *Cicuta maculata* plants (without exception) growing on their property, regardless of the variety.

Protection, Status and Ranks

COSEWIC assessed Victorin's Water-hemlock as Special Concern in April 1987. The status was re-examined and confirmed in May 2004, and the species is listed by the *Species at Risk Act* as a species of Special Concern. The Centre de Données sur le Patrimoine Naturel du Québec has assessed the variety under the NatureServe global rank of Vulnerable (G5T3), a Canadian rank of Vulnerable (N3), and a subnational (Quebec) rank of Vulnerable (S3).

Victorin's Water-hemlock is designated as Threatened in Quebec and is currently listed under the *Loi sur les espèces menacées ou vulnerable* (Act respecting threatened or vulnerable species). The taxon's habitat is afforded protection from off-road vehicles by provincial regulations respecting motor vehicle traffic in fragile environments. Regulations alone, however, are inadequate to protect the taxon in the absence of adequate enforcement measures. A majority of extant subpopulations are mostly in protected areas affording some measure of habitat protection.

TECHNICAL SUMMARY

Cicuta maculata var. *victorinii*

Victorin's Water-hemlock

Cicutaire de Victorin

Range of occurrence in Canada (province/territory/ocean): Quebec

Demographic Information

Generation time (usually average age of parents in the population)	Estimated 7 years (from >2 years to several decades).
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Yes, projected.
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations, whichever is longer up to a maximum of 100 years].	Population appears to have been stable over the last 10-15 years; however, threats project future declines.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations, whichever is longer up to a maximum of 100 years].	None.
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations, whichever is longer up to a maximum of 100 years].	Projected 10-70% decline in the next 20+ years based on the impact of threats.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any period [10 years, or 3 generations, whichever is longer up to a maximum of 100 years], including both the past and the future.	Projected 10-70% decline in the next 20+ years based on the impact of threats. Since 1987, the size of the known population has increased owing to the search efforts employed. New discoveries are still possible.
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	a. n/a, except for three subpopulations where causes are not reversible (extensive storm erosion) b. Yes, marsh recession owing to erosion c. No
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence (EOO)	1856 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value).	348 km²

Is the population “severely fragmented” i.e., is >50% of its total area of occupancy in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?	a. No b. No
Number of “locations”* (use plausible range to reflect uncertainty if appropriate)	More than 10 locations with up to 54.
Is there an [observed, inferred, or projected] decline in extent of occurrence?	No
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	No
Is there an [observed, inferred, or projected] decline in number of subpopulations?	No
Is there an [observed, inferred, or projected] decline in number of “locations”*?	No
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat?	Yes, a decline has been observed in habitat quality and is projected to continue based on threats.
Are there extreme fluctuations in number of subpopulations?	No
Are there extreme fluctuations in number of “locations”*?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each subpopulation)

Subpopulations (give plausible ranges)	**N Mature Individuals**
Portneuf RCM, Pointe-aux-Trembles-Ouest	12
Lotbinière, 200 m east of wharf	40
Saint-Michel-de-Bellechasse and Saint-Vallier: Pointe à Labrecque and eastern shoreline of Saint-Vallier Cove	0
Berthier-Montmagny	100
Beaupré–Ste-Anne-de-Beaupré	827
Augustin-de-Desmaures-Neuville	5249
Cap-Rouge, Anse du Cap-Rouge	73
Saint-Nicolas, Ross Cove	17
Saint-Laurent	1384

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

Saint-Jean, Rivière-Lafleur	1028
Grosse-Île	200
Pointe-Platon, Sainte-Croix	177
Saint-Jean-Port-Joli, wharf	396
Saint-Jean, Dauphine Point	16
Saint-Romuald	1
Beaumont-Lévis	4487
Grondines, Chez Therrien Cove	100
L'Islet-sur-Mer, cove east of wharf, shoreline of St. Lawrence River	23
Cap-Saint-Ignace, Vincelotte River	131
Saint-Michel-de-Bellechasse	392+
Saint-Nicolas, Saint-Nicolas Point	3
Deschambault-Grondines	50
Sainte-Pétronille, Chez Royer Point	33+
Île aux Grues: wharf	686
Saint-Antoine-de-l'Isle-aux-Grues, northeast of La Grande Rivière	193 (may include hybrids and variety *maculata*)
Saint-Jean-Port-Joli, Anse de Trois-Saumons	641
Saint-François, Île d'Orléans	1
Cap Tourmente National Wildlife Area	2
Pointe-de-Saint-Vallier	10
Beaumont	730
Cap-Saint-Ignace, Petit Cap trail	1000
Anse de Bellechasse, Berthier-sur-Mer	34
Château-Richer	301
Portneuf RCM, municipality of Deschambault-Grondines, west of Cap Lauzon and near Octave-Delisle Brook; west of Belle-Isle River	2
Île aux Oies	Unknown
Sainte-Anne-de-la-Pérade	5
Sainte-Croix, southeast of the mouth of Barbin Brook	5
Île de la Corneille	4
Longue Island	Unknown
Le Haut Marais, Île aux Grues	3
Île aux Grues, Pointe aux Pins	683
Île au Ruau	15
Saint-François-de-l'Île-d'Orléans, Argentenay Point	200
Château-Richer, Cazeau River	337
Île d'Orléans, east of bridge to island	3+

St-Antoine-de-Tilly	10
Ste-Famille, Île d'Orléans	Unknown
Île de Bellechasse	10
Île aux Grues–Boulanger property	230
Saint-Jean-Port-Joli–Saint-Roch-des-Aulnaies	269
Cap-Santé	149
Montmagny RCM, St. Lawrence River shoreline, up to Montmagny Airport	11
Lévis–Saint-Nicolas area, Gingras Cove	8
L'Islet, Panet Rock	200-500
Total	20481 individuals with at least 16,637 mature

Quantitative Analysis

Is the probability of extinction in the wild at least [20% within 20 years or 5 generations whichever is longer up to a maximum of 100 years, or 10% within 100 years]?	Not done.

Threats (direct, from highest impact to least, as per IUCN Threats Calculator)

Was a threats calculator completed for this species? Yes, 17 November 2020 with an assigned threat impact of High

i. 8.1 Invasive alien species (Medium Impact)
ii. 11.4 Climate change and temperature extremes (Medium Impact)
iii. 6.1 Recreational activities (Medium Impact)
iv. 7.3 Other ecosystem modifications (Low Impact)

What additional limiting factors are relevant?
Possible introgression with Spotted Water-hemlock may result in loss of genetic diversity. Its dependence on a limited and dynamic habitat niche prevents it from colonizing other sites outside the freshwater and slightly brackish intertidal zone and exacerbated by low viability of seed.

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	n/a (Canadian endemic)
Is immigration known or possible?	n/a
Would immigrants be adapted to survive in Canada?	n/a
Is there sufficient habitat for immigrants in Canada?	n/a
Are conditions deteriorating in Canada?	Yes.
Are conditions for the source (i.e., outside) population deteriorating?	n/a
Is the Canadian population considered to be a sink?	n/a
Is rescue from outside populations likely?	Rescue is not possible, as this taxon is endemic to Canada

Data Sensitive Species

Is this a data sensitive species?	No

Status History

COSEWIC: Designated Special Concern in April 1987. Status re-examined and confirmed in May 2004 and May 2022.

Status and Reasons for Designation:

Status: Special Concern	**Alpha-numeric codes:** Not applicable
Reasons for Designation: This geographically highly-restricted perennial herbaceous plant is endemic to Canada and occurs only in tidal freshwater or brackish shoreline habitats of the St. Lawrence River estuary in Quebec. Over 16,000 mature plants are presently known from 54 small localized subpopulations. It is at risk from a range of threats, including competition with invasive plants, habitat destruction by off-road vehicles and other recreational activities, and habitat loss from erosion and inundation that result from the effects of climate change. This taxon is near to qualifying for Threatened status, and failure to effectively mitigate these threats could result in it becoming Threatened.	

Applicability of Criteria

Criterion A: Not applicable. There are insufficient data to reliably infer, project or suspect the magnitude of future population decline.
Criterion B: Not applicable. The EOO of 1856 km^2 and IAO of 348 km^2 are both below the threshold for Endangered, the habitat quality is in decline. It is found at more than ten locations (54), the population is not severely fragmented and does not undergo extreme fluctuations.
Criterion C: Not applicable. Population estimate of over 16,000 mature individuals exceeds the threshold for Threatened.
Criterion D: Not applicable. Population estimate of over 16,000 mature individuals exceeds thresholds for Threatened. Thresholds for IAO and number of locations are exceeded, and the population is not known to be vulnerable to rapid and substantial decline.
Criterion E: Not applicable. Analysis not conducted.

PREFACE

Since Victorin's Water-hemlock was last assessed in 2004, surveys have been conducted across its range to identify undocumented sites and to improve knowledge of the area of occupancy at known sites. From 2013 to 2016, subpopulation counts were performed. Sixteen new subpopulations have been confirmed. Substantial improvement in our knowledge of its habitat and threats to the taxon has also occurred. A federal management plan was completed (Environment Canada 2011).

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 (2022)

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.

Environment and Climate Change Canada
Canadian Wildlife Service
Environnement et Changement climatique Canada
Service canadien de la faune
Canada

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

COSEWIC Status Report

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Victorin's Water-hemlock

Cicuta maculata var. *victorinii*

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2022

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific name: *Cicuta maculata* Linnaeus var. *victorinii* (Fernald) Boivin
Pertinent synonym: *Cicuta victorinii* Fernald
English common names: Victorin's Water-hemlock, Spotted Water-hemlock
French common names: Cicutaire de Victorin, Cicutaire maculée variété de Victorin
Family: Apiaceae (parsnip family)

Victorin's Water-hemlock (*Cicuta victorinii*) was first described as a species by Fernald (1939). Mathias and Constance (1942) retained it at a species level in their synopsis of North American *Cicuta*. It was reassigned to variety status by Boivin (1966), an interpretation followed in the review of Canadian *Cicuta* by Mulligan (1980) in his review of the *Cicuta maculata* complex, based on fruit morphology features, and most recently followed in the draft Flora of North America treatment (Brouillet *et al*. 2010).

Description of Wildlife Species

Victorin's Water-hemlock is a glabrous herbaceous perennial (Figure 1), growing 0.5–2 m tall from a short rootstock. A bundle of 5–10 oblong tubers grows from the base of the rootstock. The inflorescence is composed of umbellets with unequal pedicels and with small white flowers. Each 3.5–4 mm long fruit is a double achene. The corky lateral ribs of each achene are more prominent than the obscure (or absent) dorsal ribs (Figure 2). All parts of the plant are toxic (Coursol 2001).

Both varieties *maculata* and *victorinii* of Spotted Water-hemlock, *Cicuta maculata*, that are present in Quebec, are found in the intertidal zone of the St. Lawrence River. The fruit of var. *victorinii* is reniform to ovoid-cordate with prominent lateral ribs and obscure dorsal ribs and the leaflets are linear-lanceolate. These features contrast with the ellipsoid, ovoid or subglobose fruit with pale, prominent dorsal and lateral ribs and alternating dark ridges of the typical variety (Mulligan 1980; Figure 2). The size of individual plants, morphological characteristics of the stem, leaf petiole and inflorescence, and micro-habitat distinctions also can be used to distinguish between the two varieties (Gilbert 2010).

Figure 1. Victorin's Water-hemlock plant (Audrey Lachance).

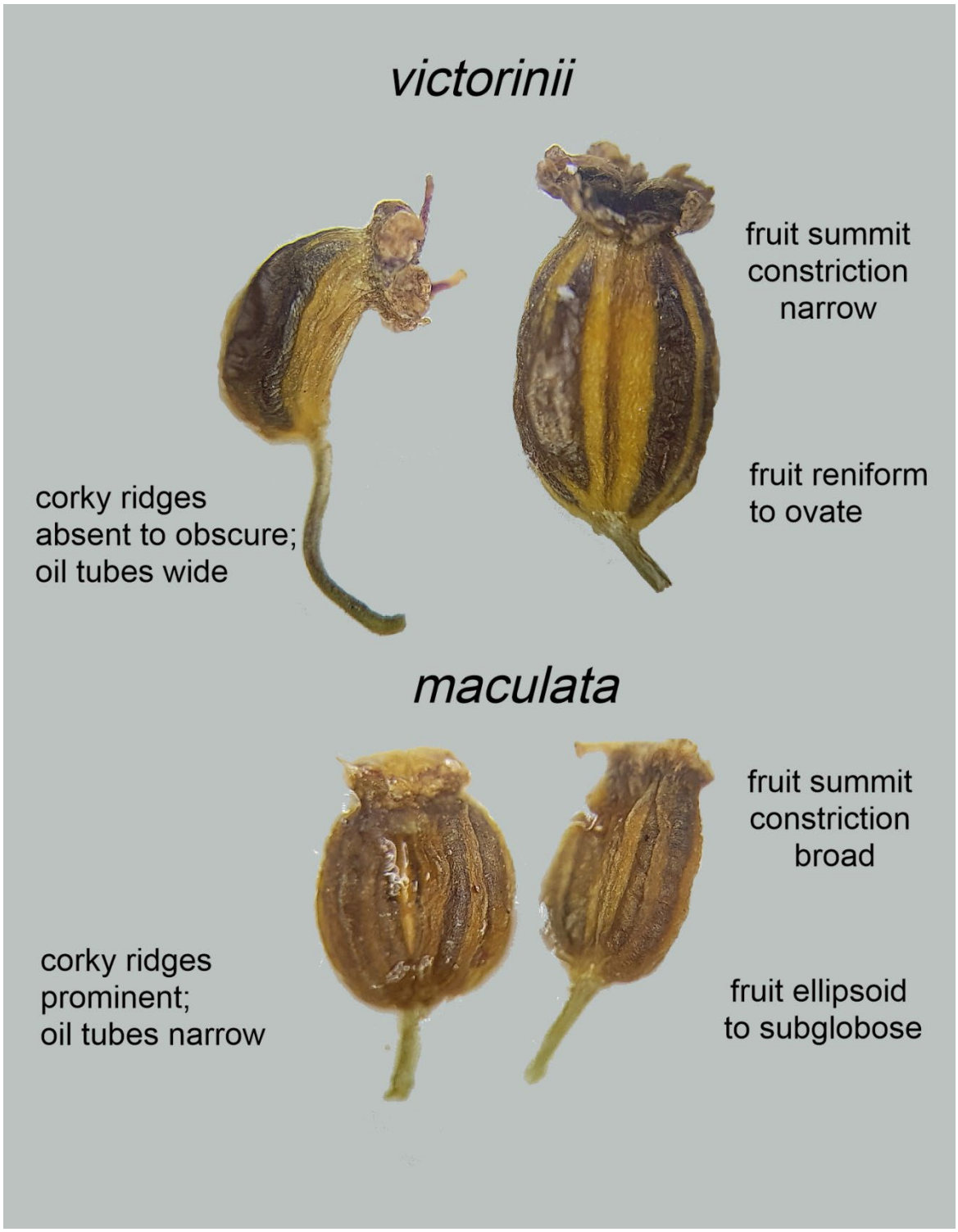

Figure 2. Characters to distinguish the typical variety from variety *victorinii* (Dan Brunton, DFB).

Designatable Units

The population of Victorin's Water-hemlock represents a single designatable unit (DU) within the Great Lakes Plain Ecological Area and the Lower St. Lawrence National Freshwater Biogeographic Zone (COSEWIC 2018). Because the ecology and habitat of all the subpopulations are similar, and there is no evidence of discreteness or evolutionary significance between one or more subpopulations, it is appropriate to consider the population as a single designatable unit.

Discreteness

The variety *victorinii* has evidence of heritable traits as it is the only variety that occurs in portions of intertidal marshes where plants are able to withstand regular tidal inundation and slightly brackish conditions (FQPPN 2017). The variety *maculata* occurs in several habitats, including wetlands, but is not subject to complete immersion for hours daily. The variety *victorinii* has phenotypical characters that separate it from other varieties (see **Morphological Description**).

Evolutionary Significance

The subpopulations are located in unique physical (waterbody type and size) habitats, resulting in local adaptation and representing evolutionary significance. The population is believed to have been on an independent evolutionary trajectory since Pleistocene glaciation or perhaps even longer, due to differing glacial refugia (Belland 1987; Bernatchez 1997).

It is inferred that variety *victorinii* has the adaptive trait of being able to withstand tidal inundation. Plants from the variety *maculata* do not tolerate these conditions. The most problematic specimens [i.e., prospective hybrids] are those at the edge of the habitat (outside of freshwater tidal areas) (Coursol pers. comm. 2022).

Given the taxon's endemism within the St. Lawrence River estuary, only one designatable unit is recognized.

Victorin's Water-hemlock is considered discrete under D1 as there are morphological characters which are evidence of heritable traits that clearly distinguish the putative DU from other DUs.

Victorin's Water-hemlock grows only in highly dynamic, tidal-dependent habitats and shares its specialized habitat with a number of other endemics. Significance of the DU reflects the fact that if it were lost, it could not be practically reconstituted as its entire range is in Canada, and it would be deemed extinct.

Special Significance

Victorin's Water-hemlock is endemic to the estuary of the St. Lawrence River in eastern Canada, restricted to ecologically significant freshwater tidal marsh habitat. It shares its specialized habitat with a number of other endemic or at-risk taxa, including Victorin's Gentian (*Gentianopsis virgata* subsp. *victorinii*), Estuarine Wildrice (*Zizania aquatica* subsp. *brevis*), and St. Lawrence Quillwort (*Isoetes laurentiana*; Brunton *et al*. 2019). It is considered a flagship species (Ducarme *et al*. 2013).

ABORIGINAL (INDIGENOUS) KNOWLEDGE

Aboriginal Traditional Knowledge (ATK) is relationship-based. It involves information on ecological relationships between humans and their environment, including characteristics of species, habitats, and locations. Laws and protocols for human relationships with the environment are passed on through teachings and stories, and Indigenous languages, and can be based on long-term observations. Place names provide information about harvesting areas, ecological processes, spiritual significance or the products of harvest. ATK can identify life history characteristics of a species or distinct differences between similar species.

Cultural Significance to Indigenous Peoples

There is no species-specific ATK in the report. However, Victorin's Water-hemlock is important to Indigenous peoples who recognize the interrelationships of all species within the ecosystem.

DISTRIBUTION

Global Range

The global and Canadian range of Victorin's Water-hemlock occurs only in the estuary of the St. Lawrence River in Canada (Figure 3) (Labrecque and Lavoie 2002; Brouillet *et al*. 2004) where it is found only in freshwater tidal marsh (MDELCC 2014). The southwestern limit of its range is at Sainte-Anne-de-la-Pérade and the northeastern limit, at Saint-Roch-des-Aulnaies (Figure 3).

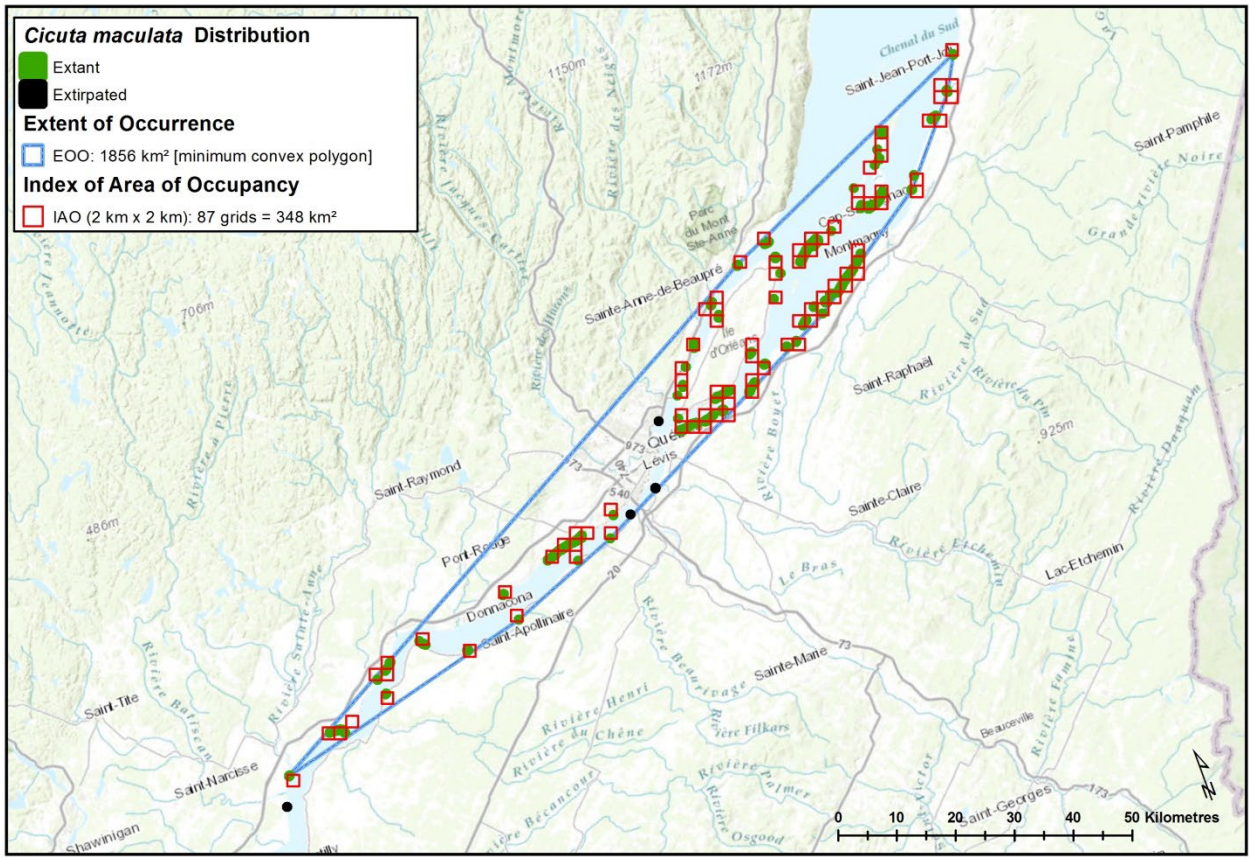

Figure 3. Current distribution of Victorin's Water-hemlock in Canada showing extant and extirpated occurrences, extent of occurrence and index of area of occupancy (COSEWIC Secretariat).

Population Spatial Structure and Variability

In this document, population refers to the sum total of all Victorin's Water-hemlock in Canada. Subpopulations are defined as geographically or otherwise distinct groups in the population between which there is likely to be little demographic or genetic exchange (typically one successful migrant individual or gamete per year or less). Subpopulation size is measured as numbers of mature individuals only (COSEWIC 2018). Subpopulation corresponds reasonably well to the habitat-based plant element occurrence delimitation standards (NatureServe 2002) where a subpopulation is defined as a group of occurrences that are separated by less than 1 km; or if separated by 1 to 3 km, with no break in suitable habitat between them exceeding 1 km; or if separated by 3 to 10 km but connected by linear water flow and having no break in suitable habitat between them exceeding 3 km. An occurrence refers to a physical place where Victorin's Water-hemlock occurs or has occurred. Location refers to a geographically or ecologically distinct area in which a single threatening event can rapidly affect all plants (COSEWIC 2021).

Introgression between the two Spotted Water-hemlock varieties is suspected to be common in some subpopulations (Lachance pers. obs.). The two varieties often grow adjacent to each other, with individuals at the upper limit of tidal influence tending to exhibit

characters of *maculata* and individuals submerged for longer periods to exhibit characters of *victorinii* (COSEWIC 2004; Gilbert 2010). No specific studies have been conducted on genetic variability in the population or on the current extent of introgression within *Cicuta maculata*.

Extent of Occurrence and Area of Occupancy

The extent of occurrence (EOO) for Victorin's Water-hemlock was estimated to be 1856 km², calculated by measuring the area of a minimum convex polygon drawn around all known extant occurrences, while the index of area of occupancy (IAO) for all extant occurrences is estimated to be 348 km², calculated by laying a grid of 2 x 2 km squares over the 35 known extant occurrences (Figure 3). These indices were not included in the last status report. There is a slight increase in the EOO and a larger increase in IAO due to increased search effort and not an actual increase of the species' abundance.

Search Effort

Extensive survey efforts in the middle St. Lawrence estuary since the 1990s helped to establish the distribution of Victorin's Water-hemlock (Legault 1986; Brouillet *et al*. 2004). Considerable search effort has been expended for the taxon since the last update status report (COSEWIC 2004). Between 2004 and 2017, as part of stewardship efforts targeting private landowners, particularly in the Isle-aux-Grues archipelago, the Nature Conservancy of Canada conducted inventories of estuarine species on many otherwise inaccessible properties. Between 2008 and 2012, surveys were done as part of the work of the Endangered Flora of the St. Lawrence Freshwater Estuary Recovery Team (Gilbert 2009, 2010, 2011a,b, 2012, 2013). From 2013 to 2016, counts were performed at the same time as those for Victorin's Gentian (Lachance 2017). Since 2016, volunteers from the Fondation québécoise pour la protection du patrimoine naturel (FQPPN) have conducted exhaustive counts in some occurrences. However, data on the presence and total numbers of Victorin's Water-hemlock are scarce. In 2013, a few exhaustive counts of Water-hemlock plants were performed as part of an effort to update the occurrences of Victorin's Gentian (Lachance and Gilbert 2013). In 2019, 34 of the known occurrences were revisited. The islands in the Isle-aux-Grues archipelago contain a number of relatively undisturbed areas with potential habitat (Lachance pers. obs.).

The per-person effort in many of these inventories cannot be calculated. Those conducted in 2019 required roughly 400 total hours of work by 15 people. These various inventories, which did not always specifically target Victorin's Water-hemlock, did allow potential habitats to be covered and in some cases enabled individuals of the taxon to be discovered. Consequently, it is reasonable to believe that new occurrences could still be found in the next few years, although undetected sites are likely small (fewer than 1000 mature individuals) (Labrecque pers. comm. 2021).

HABITAT

Habitat Requirements

Victorin's Water-hemlock grows on thick (>15 cm) alluvial substrate of fine or mixed texture (never coarse) and variable stoniness (non-stony to very stony). Plant density is significantly lower in areas covered with gravel or pebbles, or in rocky areas (Robert 1993; Gilbert 2010, 2011a,b, 2012). The taxon does not colonize lower marshes where the superficial deposits consist primarily of fine clay (Lamarre 2012). The water pH measured in certain localities ranges from neutral to alkaline (Rousseau 1930, 1932).

Victorin's Water-hemlock occurs primarily in tall, dense Prairie Cordgrass (*Sporobolus michauxianus*) beds in the mid- and upper intertidal zones (Robert 1993; Brouillet *et al*. 2004; Gilbert 2009, 2010, 2011a,b, 2012, 2013; Lamarre 2012) (Figure 4). The vegetation in these areas generally ranges from very dense to dense with high species diversity (Gilbert 2009, 2010, 2011a, b, 2012; Normandeau 2013). Elsewhere it can be found in more open Common Three-square Bulrush (*Schoenoplectus pungens*) marsh vegetation or on a thin or rocky substrate (Figure 5).

Figure 4. Typical Victorin's Water-hemlock habitat (Audrey Lachance).

Figure 5. Less common Victorin's Water-hemlock habitat (Audrey Lachance).

The habitat of Victorin's Water-hemlock is highly dynamic, disturbance-tolerant and subject to extensive erosion, transport, and sedimentation processes (FQPPN 2017). Its habitat is covered with water for two to three hours a day during high tides. Individuals experiencing longer periods of inundation are smaller than those at higher (more landward) elevations (Robert 1993).

Habitat Trends

In the past, significant losses of potential Victorin's Water-hemlock habitat have occurred, particularly in the Quebec City metropolitan area. Road and railroad construction on the tidal flats of the St. Lawrence River has almost completely destroyed the mid- and upper intertidal zones of potential habitats between Boischâtel and Cap-Rouge. Habitat quality has also been severely affected by the in-filling of the upper littoral zone and the construction of retaining walls for many homes in Lévis, Saint-Romuald and several other residential neighbourhoods along the St. Lawrence River. The introduction of stricter environmental legislation seems to have halted or slowed this trend. The taxon's habitat appears to have remained in stable condition for at least the last 15 years (Brouillet *et al*. 2004); however, the habitat is expected to decline due to increased erosion and through the loss of habitat caused by the spread of invasive plants (see **Threats**).

BIOLOGY

Victorin's Water-hemlock is an herbaceous perennial, growing to 0.5–2 m in height. It flowers from June to September, and fruiting extends from August to September (October according to Legault 1986). The seeds of water-hemlocks are surrounded by a spongy fruit coat that keeps the fruits buoyant until they are completely saturated with water, which aids in their dissemination by water (Figure 2; Mulligan and Munro 1981).

Life Cycle and Reproduction

This herbaceous perennial herb has a short rootstock, with a bundle of 5 to 10 tubers growing from its base. Despite the production of such a large number of tubers, no signs of vegetative reproduction have been observed. Reproduction appears to occur solely through seed production. It forms a rosette after germination that lasts for at least the first year (Gilbert 2012). The plant requires vernalization (induction of a plant's flowering process by exposure to the prolonged cold of winter) to induce flowering. It takes at least two years to flower. The water-hemlocks are classified as perennials. The current year's plant normally dies each year, but water-hemlocks persist by producing several new rootstocks from buds around the perimeter of the old rootstock. In this way a clone will be built up and can survive for at least several decades (Mulligan and Munro 1981). Generation time is unknown, but is greater than two years and may be several decades. For this assessment it is estimated to be seven years, but may be longer.

In cultivation, seeds require scarification and cold stratification to germinate and those over two years old are not successful (Mulligan 1980). The stylopodium of *Cicuta* flowers has nectar-secreting glands and is brightly coloured (Heywood 1971), likely attracting feeding insects. Pollen is spread by a variety of insects crawling over the inflorescences, as they do with many Apiaceae species. A succession of inflorescences is formed over the growing season, with the last ones producing the least fruit (Mulligan and Munro 1981). Seed set in the fruit is low (<10%) (Gilbert 2009, 2010, 2011a,b, 2012).

Physiology and Adaptability

Caldwell and Crow (1992) studied the dynamics of estuarine environments and found three factors that contribute significantly to plant community structure: the duration of tidal inundation, the plant growth forms present, and physical disturbances caused by ice floes. The plants that are the most successful in these environments are annuals and highly rhizomatous perennials such as Victorin's Water-hemlock. A large number of rootstocks allow these plants to maintain an equilibrium between constant erosion and sedimentation, and to store nutrient reserves in order to emerge and grow quickly.

Dispersal and Migration

Abundant seed production in late summer or early fall is the principal means of reproduction (Lynn *et al*. 1988). The seeds generally fall near the parents and are protected

by the microrelief of the marsh surface although ice floes can disturb and even transport portions of the vegetation mat over large distances.

Interspecific Interactions

Browsing by White-tailed Deer (*Odocoileus virginianus*) or possibly by Muskrat (*Ondatra zibethicus*) has been observed on fruiting stems (Gilbert 2009, 2010, 2011a,b, 2012; Lachance pers. obs.). A Short-tailed Swallowtail (*Papilio brevicauda*) caterpillar was observed browsing on one individual in 2019. Observations of insect herbivory are infrequent and it does not appear to pose a significant threat to the species' survival.

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

Brouillet *et al*. (2004) surveyed transects at sites chosen beforehand for their potential to contain species of interest. When a rare plant was observed (including Victorin's Water-hemlock), a count was conducted, and the area covered was assessed. Between 2004 and 2017, the Nature Conservancy of Canada performed counts of fruiting stems; depending on the time available for the locality (often limited on islands), vegetative plants were sometimes included in the inventories. Between 2008 and 2012, seven localities were surveyed over five years by counting individuals in 1-m^2 quadrats (20 quadrats) and then extrapolating the density to the area of the occurrence (Gilbert 2009, 2010, 2011a, b, 2012, 2013). Between 2013 and 2016, FQPPN performed exhaustive inventories of fruiting plants; depending on time limitations, sometimes vegetative plants were also included where the species was not previously known. In 2013, the consulting firm Bureau d'écologie appliquée and Environment Canada conducted exhaustive counts for some occurrences (Lachance and Gilbert 2013). In 2019, sampling focused on historical occurrences and the most accessible occurrences with significant subpopulations. Counts of fruiting and vegetative plants were carried out in known habitats and often in adjacent potential habitats. However, because the inventories were not exhaustive, the total number of individuals must be considered a minimum number.

Abundance

The total Canadian population of Victorin's Water-hemlock is estimated to be over 21,000 individuals (Table 1), with a minimum number of 16,637 mature individuals. The inventories conducted since the first status assessment (COSEWIC 2004) have substantially improved our knowledge of the species' distribution and the size of the population, which was previously estimated at 1,787-6,341 or fewer than 7,000 individuals (Jolicoeur and Couillard 2007). Most of the subpopulations remain small with only five having 1000 or more individuals, which combined make up more than 60 percent of the total population.

Table 1. Summary of quantitative and qualitative data on Victorin's Water-hemlock occurrences in Canada.

Locality	Name of site	Known in 2002	Quality ranking	Number of individuals (most recent visit)	Previous observations	Area of occupancy	Most recent visit	Observer	Trend	Official status
1	Portneuf RCM, Pointe-aux-Trembles-Ouest	Yes	D (poor, non-viable)	12	2013: A dozen individuals 1995: 2–10 evenly distributed individuals		2013	MELCC	Stable	Extant
2	Lotbinière, 200 m east of wharf	Yes	D (poor, non-viable)	40	2015: 2 individuals. 1985: No details on number of individuals. 1942: No details on number of individuals.		2019	Bureau d'écologie appliquée	Stable	Extant
3	Saint-Michel-de-Bellechasse and Saint-Vallier: Pointe à Labrecque and eastern shoreline of Saint-Vallier Cove	Yes	D (poor, non-viable)	0	1995: 55–120 evenly distributed individuals. 2013: Around 40 individuals.		2019	Bureau d'écologie appliquée	Possibly declining	Not re-found
	Beauport	Yes	X (extirpated)						Extirpated	Extirpated
	Saint-Nicolas, Pointe à Basile	Yes	X (extirpated)						Extirpated	Extirpated
4	Berthier-Montmagny	Yes	C (fair)	100	2015: Around 100 individuals. 2015: 29 individuals. 2006: 560 (partial inventory): A few continuously distributed plants. 1995 (partial inventory): 2–10 individuals. 1995: 115–1,060 individuals. 2004: Record of species being observed, but no details on number of individuals.		2015	Bureau d'écologie appliquée	Stable	Extant
	L'Ange-Gardien	Yes	X (extirpated)	0			2019	Bureau d'écologie appliquée	Extirpated	Extirpated
5	Beaupré–Ste-Anne-de-Beaupré	Yes	B (good)	827	2007: A few hundred individuals		2019	Bureau d'écologie appliquée	Stable or increasing	Extant
	Batiscan	No	X (extirpated)	0			2019	Denis Bastien, Botalys	Extirpated	Extirpated
6	Augustin-de-Desmaures-Neuville	Yes	A (excellent)	5,249	2010 (partial inventory): Over 30 individuals. 2008: Total of over		2019	Bureau d'écologie appliquée	Stable	Extant

Locality	Name of site	Known in 2002	Quality ranking	Number of individuals (most recent visit)	Previous observations	Area of occupancy	Most recent visit	Observer	Trend	Official status
					15,000.					
7	Cap-Rouge, Anse du Cap-Rouge	Yes	C (fair)	73	1995:100–1,000 scattered individuals		2019	Bureau d'écologie appliquée	Possibly declining	Extant
8	Saint-Nicolas, Ross Cove	Yes	D (poor, non-viable)	17	No details		2019	Bureau d'écologie appliquée	Stable	Extant
9	Saint-Laurent	Yes	B (good)	1,384	2015 (partial inventory): Around 100 individuals. 2013 (partial inventory): Over 900 individuals. 1995 (partial inventory): 2–10 individuals.		2019	Bureau d'écologie appliquée	Stable or increasing	Extant
10	Saint-Jean, Rivière-Lafleur	Yes	B (good)	1,028	1995: 2–10 isolated individuals		2019	Bureau d'écologie appliquée	Increasing	Extant
11	Grosse-Île	Yes	C (fair)	200	2012: 200 individuals		2012	Bureau d'écologie appliquée	Stable	Extant
12	Pointe-Platon, Sainte-Croix	Yes	C (fair)	177	1995: 3 isolated individuals		2019	Bureau d'écologie appliquée	Stable or increasing	Extant
13	Saint-Jean-Port-Joli, wharf	Yes	C (fair)	396	2012: Around 1,000 individuals. 1996: 30–120 individuals. 1995: 15–70 individuals.		2019	Bureau d'écologie appliquée	Stable	Extant
14	Saint-Jean, Dauphine Point	Yes	D (poor, non-viable)	16	1995: 155–310 scattered individuals		2019	Bureau d'écologie appliquée	Declining	Extant
15	Saint–Romuald		D (poor, non-viable)	1	1995: 11–50 scattered individuals; 1977: 1 individual.		2019	Bureau d'écologie appliquée	Declining	Extant
16	Beaumont-Lévis (previously Lévis, pointe Martinière)	Yes	A (excellent)	4,487	2004 (partial inventory): From 2 to 20 individuals observed at 2 sites. 1995 (partial inventory): 11–50 individuals. 2003: No details on number of individuals. 1996: 250 individuals. 2005: 1,010		2019	Bureau d'écologie appliquée	Stable or increasing	Extant

Locality	Name of site	Known in 2002	Quality ranking	Number of individuals (most recent visit)	Previous observations	Area of occupancy	Most recent visit	Observer	Trend	Official status
					individuals divided among 7 sites.					
17	Grondines, Chez Therrien Cove		C (fair)	100	11–50 scattered individuals		2019	Denis Bastien, Botalys	Stable or increasing	Extant
18	L'Islet-sur-Mer, cove east of wharf, shoreline of St. Lawrence River		D (poor, non-viable)	23	1995: 1 isolated individual		2019	Bureau d'écologie appliquée	Stable or increasing	Extant
19	Cap-Saint-Ignace, Vincelotte River		C (fair)	131	2015: Over 20 individuals. 1996: 100 to 1,000 individuals		2019	Bureau d'écologie appliquée	Stable or declining	Extant
20	Saint-Michel-de-Bellechasse		C (fair)	392 (partial inventory)	2012: Roughly 30 individuals, distributed over more than 1,000 m^2. 1995: 55–120 evenly distributed individuals.		2019	Bureau d'écologie appliquée	Stable	Extant
21	Saint-Nicolas, Saint-Nicolas Point		D (poor, non-viable)	3	1995: 2–10 scattered individuals		2019	Bureau d'écologie appliquée	Stable	Extant
22	Deschambault-Grondines		C (fair)	50	2011: Over 50 individuals	1,000 m^2	2011	Bureau d'écologie appliquée	Unknown	Extant
23	Sainte-Pétronille, Chez Royer Point	Yes	D (poor, non-viable)	33 (partial)	2015: 33 individuals. 2007: a few individuals. 1995: Between 200 and 500 individuals.		2015	Bureau d'écologie appliquée	Stable	Extant
24	Île aux Grues, wharf		B (good)	686	1996: Between 11 and 50 individuals.		2019	Bureau d'écologie appliquée	Stable or increasing	Extant
25	Saint-Antoine-de-l'Isle-aux-Grues, northeast of La Grande Rivière (previously Île aux Grues, La Grande Rivière)	Yes	C (fair)	193 (many hybrids or var. *maculata*)	2006: Over 500 individuals. 1996: Between 100 and 250 individuals.		2019	Bureau d'écologie appliquée	Stable	Extant
26	Saint-Jean-Port-Joli, Anse de Trois-Saumons		B (good)	641	2014: Between 100 and 1,000 individuals		2019	Bureau d'écologie appliquée	Stable	Extant
27	Saint-François, Île d'Orléans		D (poor, non-viable)	1	1997: 1 individual		?		Unknown	Extant
28	Cap Tourmente National Wildlife Area		D (poor, non-viable)	2	2012: Over 3,000 individuals	1 km	2019	Bureau d'écologie appliquée	Declining, almost extirpated	Extant

Locality	Name of site	Known in 2002	Quality ranking	Number of individuals (most recent visit)	Previous observations	Area of occupancy	Most recent visit	Observer	Trend	Official status
29	Pointe-de-Saint-Vallier		D (poor, non-viable)	10	2015: 10 individuals. 2013: Around 40 individuals. 2005: Roughly 160 individuals. 2004: Slightly over 200 individuals.		2015	Bureau d'écologie appliquée	Declining	Extant
30	Beaumont		B (good)	730	2013: Around 450 individuals. 2007 (partial inventory): 45 individuals.		2019	Bureau d'écologie appliquée	Stable or increasing	Extant
31	Cap-Saint-Ignace, Petit Cap trail		B (good)	1,000	2006: many individuals (continuously distributed in upper part)	10 individuals /10 m^2	2006	Bureau d'écologie appliquée	Unknown	Extant
32	Anse de Bellechasse, Berthier-sur-Mer (previously Berthier-sur-Mer, anse de Berthier)	Yes	D (poor, non-viable)	34	2004: Observation of two colonies, but no details on number of individuals.		2019	Bureau d'écologie appliquée	Stable	Extant
33	Château-Richer		C (fair)	301	2012: Over 1,000 individuals		2019	Bureau d'écologie appliquée	Declining	Extant
34	Portneuf RCM, Municipality of Deschambault-Grondines, west of Cap Lauzon and near Octave-Delisle Brook; West of Belle-Isle River		D (poor, non-viable)	2	2013: 2 isolated individuals. 2010: No details on number of individuals.		2013	MELCC	Unknown	Extant
35	Île aux Oies		To be determined	No details on number of individuals	1970: No details on number of individuals.		1970	Bureau d'écologie appliquée	Unknown	Extant
36	Sainte-Anne-de-la-Pérade		D (poor, non-viable)	5	2011: 5 individuals	500 to 1,000 m^2	2011	Bureau d'écologie appliquée	Unknown	Extant
37	Sainte-Croix, southeast of the mouth of Barbin Brook		D (poor, non-viable)	5	2011: 2 individuals		2019	Bureau d'écologie appliquée	Stable	Extant
38	Île de la Corneille		D (poor, non-viable)	4	2011: 4 individuals	101 to 500 m^2	2011	Bureau d'écologie appliquée and NCC	Unknown	Extant

Locality	Name of site	Known in 2002	Quality ranking	Number of individuals (most recent visit)	Previous observations	Area of occupancy	Most recent visit	Observer	Trend	Official status
39	Longue Island		To be determined	No details on number of individuals	2009: No details on number of individuals.		2009	Bureau d'écologie appliquée and NCC	Unknown	Extant
40	Le Haut Marais, Île aux Grues		D (poor, non-viable)	3	2012: 3 individuals	2 to 10 m^2	2012	Bureau d'écologie appliquée	Unknown	Extant
41	Île aux Grues, Pointe aux Pins		B (good)	683	2012: Over 1,200 individuals. 2010: 2,360 individuals. 2009: 1,960 individuals. 2008: 1,480 individuals.		2019	Bureau d'écologie appliquée and NCC	Stable or declining	Extant
42	Île au Ruau		D (poor, non-viable)	15	2014: Around 20 individuals		?	Bureau d'écologie appliquée and NCC	Unknown	Extant
43	Saint-François-de-l'Île-d'Orléans, Argentenay Point		C (fair)	200	2013: Around 20 individuals		2019	Bureau d'écologie appliquée	Stable or increasing	Extant
44	Château-Richer, Cazeau River		C (fair)	337	2013: 70 individuals		2019	Bureau d'écologie appliquée	Stable	Extant
45	L'Île d'Orléans, east of bridge to island		D (poor, non-viable)	3 (partial)	1995: Around 30 individuals		2015	Bureau d'écologie appliquée	Stable	Extant
46	St-Antoine-de-Tilly		D (poor, non-viable)	10	2013: No details		2019	Bureau d'écologie appliquée	Stable	Extant
47	Ste-Famille, Île d'Orléans		To be determined	No details on number of individuals	2014: Around 40 individuals		2015	Bureau d'écologie appliquée	Unknown	Extant
48	Île de Bellechasse		D (poor, non-viable)	10	2013: Roughly a dozen individuals		2013	Bureau d'écologie appliquée	Unknown	Extant
49	Île aux Grues, Boulanger property		C (fair)	230			2019	Bureau d'écologie appliquée and NCC	Maintaining	Extant
50	Saint-Jean-Port-Joli–Saint-Roch-des-Aulnaies		C (fair)	269			2019	Bureau d'écologie appliquée	Unknown	Extant, recently discovered

Locality	Name of site	Known in 2002	Quality ranking	Number of individuals (most recent visit)	Previous observations	Area of occupancy	Most recent visit	Observer	Trend	Official status
51	Cap-Santé		C (fair)	147			2019	FQPPN	Unknown	Extant, recently discovered
52	Montmagny RCM, St. Lawrence River shoreline, up to Montmagny Airport		D (poor, non-viable)	11			2019	Bureau d'écologie appliquée	Unknown	Extant, recently discovered
53	Lévis, Saint-Nicolas area Gingras Cove		D (poor, non-viable)	8			2019	Bureau d'écologie appliquée	Unknown	Extant, recently discovered
54	L'Islet, Panet Rock (previously L'Islet, Rocher Panet)	Yes	Historical	200	1996: 200 to 500 individuals		1996		Unknown	Historical

The discovery of a number of new subpopulations and the greater number of inventories conducted in potential habitats have led to a significant increase in the number of known occurrences and individuals since 1986. New occurrences could still be discovered along the shores of the St. Lawrence River, particularly on islands, although it is unlikely that any large subpopulations (i.e. greater than 1000 mature individuals) have been missed (Labrecque pers. comm. 2021)

Fluctuations and Trends

Search methods have not been standardized over the years and it is difficult to assess trends because search effort varies according to years and participants. The most reliable data for assessing population trends comes from a survey of three rare species in the fluvial and brackish-water estuary carried out from 2008 to 2012 (Gilbert 2009, 2010, 2011a,b, 2012, 2013) where seven localities were surveyed over five years (Gilbert 2013). Although variations in the total number of individuals occurred in some years, the difference was not statistically significant, indicating that subpopulations are generally stable (Gilbert 2013). There is no evidence of extreme fluctuations; however, declines in the number of mature individuals are projected due to threats.

The 2019 data appear to confirm this stable trend, except for three localities where a decline was noted (Saint-Romuald, Château-Richer, and Cap Tourmente) due to extensive storm erosion at these sites (Gilbert 2012; Gervais 2014). The Saint-Romuald locality has minimal remaining habitat and retaining walls are present.

Rescue Effect

Because Victorin's Water-hemlock is endemic to the St. Lawrence River estuary, there is no possibility of rescue from outside Canada.

THREATS AND LIMITING FACTORS

Threats

Threats to Victorin's Water-hemlock in Canada were assessed using the IUCN-CMP (International Union for Conservation of Nature–Conservation Measures Partnership) unified threats classification system (Salafsky *et al*. 2008; Master *et al*. 2012; Appendix 1). Threats are presented in the approximate order of highest to lowest impact. Due to the cumulative impacts of combined threats, the overall threat impact was rated as "high" (implying 10–70% decline from threats operating over the next ten years). Note the threat calculation used a generation time of two years, but it is now thought to be seven years or more.

The primary threats to the taxon are invasive alien species, recreational activities (including off-road vehicle traffic in intertidal zones), and the anticipated effects of climate change. The effect of pollution from various sources (urban, agricultural or industrial) has not been specifically assessed, despite its potential impact on the quality of the taxon's habitat.

The impacts of some threats are anticipated rather than documented. Work is currently underway to document the presence or absence of actual threats to plants at the various subpopulations (Dupont-Hébert pers. comm. 2020). The numbers associated with the threats correspond to the IUCN threat numbers and the threat calculator and are arranged in order of severity.

8.1 Invasive Non-native/Alien Species/Diseases (Medium Impact)

Taxa considered to be invasive alien plants are present in all habitats where Victorin's Water-hemlock is found (Lachance pers. obs.). There does not appear to be excessive competition with some species such as Purple Loosestrife (*Lythrum salicaria*). Japanese Knotweed (*Reynoutria japonica*), European Common Reed (*Phragmites australis* subsp. *australis*), and Jerusalem Artichoke (*Helianthus tuberosus*); however, all cover part of the upper intertidal zone at some localities. These three invasives appear be expanding their populations along the estuary shoreline (Lachance pers. obs.). The actual loss of Victorin's Water-hemlock plants due to the presence of invasive alien plants has not been documented.

11.4 Storms & Flooding (Medium Impact)

The species is considered to be highly vulnerable to climate change (Gendreau *et al*. 2016). Ice scouring of rocks and the shoreline during the daily tidal cycle, spring ice break-up, and winter storms can uproot plants. Studies have shown that significant recession of

the upper salt marsh has occurred as a result of storms in some localities (Île aux Grues and Château-Richer) (Gervais 2014). Current climate change projections include a shrinking ice cover, and therefore a potentially greater impact on habitat from winter storms, as well as more extreme temperatures and more intense storms (Bernatchez *et al*. 2008). Rising sea levels could also result in habitat loss (Sirois 2015).

6.1 Recreational Activities (Medium Impact)

Human intrusion is deemed to be a moderate threat to Victorin's Water-hemlock. Various subpopulations are exposed to trampling, damage from mountain bikes, pulling up of boats, and/or off-road vehicles (all-terrain vehicles and sport utility vehicles). These activities not only cause plant mortality, but also significantly alter the fragile balance of the taxon's habitat. Pronounced habitat fragmentation has been observed in the lower salt marsh in some localities, which appears to limit the inundation of the upper salt marsh and to favour plant species other than Victorin's Water-hemlock, including invasive alien plants (Lachance pers. obs.).

7.3 Other ecosystem modifications (Low Impact)

At some eastern sites, people are building small structures to stop erosion. The number of projects requiring access to the shoreline continues to grow. Harbour expansion and marina construction projects, such as those at Saint-Jean-Port-Joli, destroy the upper littoral where Victorin's Water-hemlock occurs. The restoration of deteriorating retaining walls and shoreline excavation activities also cause habitat loss and degradation. These problems appear to be widespread throughout the species' range, with the exception of the Isle-aux-Grues occurrences (Environment Canada 2011).

Other Threats

Under the *Loi sur les abus préjudiciables à l'agriculture* (*Agricultural Abuses Act* 1997) (CQLR c A-2), Spotted Water-hemlock (*Cicuta maculata*) is considered a weed when it grows along roads, highways and railways, under power lines, in agricultural ditches, and on vacant lots and other land. Landowners are required to destroy such weeds before the seeds mature. It is possible that Victorin's Water-hemlock plants may be pulled up accidentally. The lack of provisions in the Act regarding variety *victorinii* creates confusion for the public and land managers alike.

Limiting Factors

Victorin's Water-hemlock grows only in highly dynamic, tidal-dependent habitats (Gilbert 2012). Its limited habitat niche prevents it from colonizing other sites outside the freshwater and slightly brackish intertidal zone. In addition, it often does not produce many viable seeds (Gilbert 2012). Introgression (hybridization) could also be occurring with variety *maculata* in some subpopulations (Lachance pers. obs.; Gilbert 2009). Seed set is low (<10%) (Gilbert 2009, 2010, 2011a,b, 2012) which could limit recolonization.

Number of Locations

Because there are no natural or anthropogenic phenomena with the potential to destroy all the individuals in more than one subpopulation over a given period, the number of locations corresponds to the number of subpopulations, in accordance with IUCN recommendations (IUCN 2012). The estimated number of locations of Victorin's Water-hemlock is 54, which is the number of extant and historical subpopulations.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

In 2005, Victorin's Water-hemlock was listed on Schedule 1 of the *Species at Risk Act* as a species of Special Concern (Environment Canada 2011). In Quebec, it was designated as threatened under the *Loi sur les espèces menacées ou vulnérables* (Act respecting threatened or vulnerable species) in February 2001. In addition, its habitat is governed by an authorization process pursuant to Quebec's *Loi sur la qualité de l'environnement* (*Environment Quality Act 2020*) (CQLR c Q-2) and the regulations made thereunder.

The taxon's habitat is afforded protection against one of its main threats—off-road vehicles—by the *Règlement sur la circulation de véhicules motorisés dans certains milieux fragiles* (Regulations respecting motor vehicle traffic in certain fragile environments) (CQLR c Q-2 r.2.2). Furthermore, the Quebec Protection Policy for Lakeshores, Riverbanks, Littoral Zones and Floodplains seeks to maintain and improve water quality by ensuring an adequate level of protection for these environments, including shorelines. Regulations alone, however, are inadequate to protect the taxon in the absence of adequate enforcement measures.

A federal management plan for the habitat of this taxon aims to ensure the conservation and management of occurrences, reduce the main threats to the taxon and its habitat and increase knowledge of the taxon's demographics, biology and taxonomy (Environment Canada 2011). Many of the planned activities have been completed.

A provincial protection plan was written in 2007, specifying priority conservation targets and measures for the taxon (Jolicoeur and Couillard 2007). Many of these actions have been completed. A number of measures were only carried out in the past ten years by the organizations involved (Nature Conservancy of Canada and FQPPN), although under the plan they were scheduled for completion by 2011. As in the case of the federal management plan, certain actions have still not been undertaken, including outreach with waterfront residents and the legal protection of many priority targets.

Non-Legal Status and Ranks

The taxon has a global NatureServe rank of G5T3 (species Secure, variety Vulnerable), a national (Canada) rank of N3 (Vulnerable) and a subnational (Quebec) rank of S3 (Vulnerable) (NatureServe 2021).

Habitat Protection and Ownership

Thirty-nine of the 54 extant subpopulations are located in whole or in part in various types of protected areas.

The subpopulations of Saint-Michel-de-Bellechasse (Saint-Vallier Cove), L'Islet, and Saint-Jean-Port-Joli (Anse de Trois-Saumons) are afforded some level of habitat protection owing to their occurrence in the Saint-Vallier, L'Islet, and Trois-Saumons Migratory Bird Sanctuaries. The Grosse-Île subpopulation is also afforded some measure of protection because it lies within the Grosse Île and the Irish Memorial National Historic Site, which is managed by Parks Canada. In addition, the Nature Conservancy of Canada (NCC) and FQPPN owns or has conservation protection arrangements for all or part of some occurrences. Other occurrences are designated as "significant plant habitat" by the Quebec Ministère de l'environnement, or designated as ecological reserves.

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BIOGRAPHICAL SUMMARY OF REPORT WRITERS

Audrey Lachance has expertise in the characterization of natural habitats and exceptional forest ecosystems, wetland identification and delineation, and rare plant surveys and inventories. She received a diploma in natural environment technology and wildlife management in 2005. For many years, she has been involved in carrying out inventories and population monitoring and in drafting a variety of documents on various plant species at risk, including American Ginseng (*Panax quinquefolius*), Victorin's Gentian, Parker's Pipewort (*Eriocaulon parkeri*), Provancher's Fleabane (*Erigeron philadelphicus* var. *provancheri*), and Van Brunt's Jacob's-ladder (*Polemonium vanbruntiae*). Audrey Lachance is a member of two recovery teams (threatened plants of the fluvial St. Lawrence estuary and Van Brunt's Jacob's-ladder). She also carries out work on rare species in Quebec and assists with the assessment of threats and the vulnerability of rare plants to climate change. She recently drafted a case study on assisted migration involving Meadow Thistle (*Cirsium scariosum* var. *scariosum*).

Hélène Gilbert is a biologist and plant ecologist. From 1975 to 1978, she served as a research assistant in plant ecology in Nouveau-Québec (now Nunavik). Since 1979, she has been an independent researcher, teacher and, first and foremost, a consultant in botany and plant ecology. In the field of rare species, she managed a project to monitor three at-risk species in the fluvial St. Lawrence estuary from 2008 to 2012: Victorin's Gentian, Victorin's Water-hemlock, and Parker's Pipewort. In 2007, she drafted the Canadian recovery strategy for the American Water-willow (*Justicia americana*) and served on the recovery committee, after carrying out a review of the existing knowledge on the taxon in the previous year. In 2005, she conducted a rare plant inventory in La Mauricie National Park and updated the status report on the Gulf of St. Lawrence Aster (*Symphyotrichum laurentianum*) for COSEWIC. In 2002, she carried out a rare plant

inventory in Forillon National Park in the Gaspé region, to provide updated information on the park's flora. In 2001 and 2002, she worked on inventories to confirm occurrences of threatened and vulnerable plants and exceptional forest ecosystems on privately owned land in the Gaspé region. In 1999, she participated in a rare plant inventory and mapping project in the Montreal Urban Community's nature parks and updated the status reports for Ram's-head Lady's-slipper (*Cypripedium arietinum*), Pinedrops (*Pterospora andromedea*), and Gulf of St. Lawrence Aster for the Quebec Ministère de l'Environnement.

COLLECTIONS EXAMINED

No herbarium collections were consulted. However, specimens were collected during the 2019 inventory and deposited in the Louis-Marie herbarium.

Appendix 1. Threats calculator for Victorin's Water-hemlock.

Threats Assessment Worksheet						
Species or Ecosystem Scientific Name	*Cicuta maculata* var. *victorinii*					
Element ID		**Elcode**	2351			
Overall Threat Impact Calculation Help:		**Level 1 Threat Impact Counts**				
	Threat Impact	**high range**	**low range**			
	A Very High	0	0			
	B High	0	0			
	C Medium	3	3			
	D Low	1	1			
Calculated Overall Threat Impact:		High	High	B = High	B	
Assigned Overall Threat Impact:		**B = High**				
Overall Threat Impact Adjustment Reasons:		General notes - Participants of call: Audrey Lachance (report writer), Stephanie Pellerin (VP SSC), Danna Leaman (VP SSC), Dan Brunton (VP SSC), Jenny Heron (moderator), Marie-France Noel (COSEWIC Secretariat), Jacques Labrecque (QC), Gina Schalk (CWS), Jana Vamosi (VP Co-Chair), Generation time=2 years, so threats were examined over a 10 year timeframe.				

Threat		**Impact (calculated)**		**Scope**	**Severity**	**Timing**	**Comments**
1	**Residential & commercial development**		Negligible (<1%)	Negligible (<1%)	Extreme or 71-100% pop. decline	High (continuing)	
1.1	Housing & urban areas		Negligible	Negligible (<1%)	Extreme or 71-100% pop. decline	High (continuing)	The law in QC prevents most new development near shorelines.
1.2	Commercial & industrial areas						
1.3	Tourism & recreation areas						
2	**Agriculture & aquaculture**						
2.1	Annual & perennial non-timber crops						
2.2	Wood & pulp plantations						
2.3	Livestock farming & ranching						
2.4	Marine & freshwater aquaculture						
3	**Energy production & mining**						
3.1	Oil & gas drilling						
3.2	Mining & quarrying						
3.3	Renewable energy						
4	**Transportation & service corridors**		Unknown	Pervasive (71-100%)	Unknown	High (continuing)	
4.1	Roads & railroads						
4.2	Utility & service lines						

Threat		Impact (calculated)		Scope	Severity	Timing	Comments
4.3	Shipping lanes		Unknown	Pervasive (71-100%)	Unknown	High (continuing)	Shipping lanes in St. Lawrence runs through many of these subpopulations. Severity is very uncertain. It is assumed it could result in some erosion but there are currently no data on whether this causes mortality in these plants.
4.4	Flight paths						
5	**Biological resource use**		Negligible	Negligible (<1%)	Negligible or <1% pop. decline	High (continuing)	
5.1	Hunting & collecting terrestrial animals						
5.2	Gathering terrestrial plants		Negligible	Negligible (<1%)	Negligible or <1% pop. decline	High (continuing)	Scientific collection to study the species requires some collection of the seeds.
5.3	Logging & wood harvesting						
5.4	Fishing & harvesting aquatic resources						
6	**Human intrusions & disturbance**	C	Medium	Large (31-70%)	Moderate or 11-30% pop. decline	High (continuing)	
6.1	Recreational activities	C	Medium	Large (31-70%)	Moderate or 11-30% pop. decline	High (continuing)	Mountain biking, public access for ATV use, the installation of traffic lights, etc. do cause some disturbance in many of the sites. The continued use results in plant mortality and also disturbance of their habitat. Also, many owners make trails in the habitat and destroy some plants through trampling and/or pulling out boats with ATVs. Permanent trails have compacted the soil. Some disturbance from duck hunters as well, as they trample the habitat.
6.2	War, civil unrest & military exercises						
6.3	Work & other activities						Mowing/cutting grass nearby but no other controls are observed.
7	**Natural system modifications**	D	Low	Restricted (11-30%)	Moderate or 11-30% pop. decline	Moderate (short-term)	
7.1	Fire & fire suppression						
7.2	Dams & water management/use		Not a Threat	Pervasive (71-100%)	Neutral or Potential Benefit	High (continuing)	St. Lawrence River level is controlled but this is not thought to have a large effect on the habitat.
7.3	Other ecosystem modifications	D	Low	Restricted (11-30%)	Moderate or 11-30% pop. decline	Moderate (short-term)	At some eastern sites, people are building small structures to stop erosion.
8	**Invasive & other problematic species, genes & diseases**	C	Medium	Pervasive (71-100%)	Moderate or 11-30% pop. decline	High (continuing)	

Threat		Impact (calculated)		Scope	Severity	Timing	Comments
8.1	Invasive non-native/alien species/diseases	C	Medium	Pervasive (71-100%)	Moderate or 11-30% pop. decline	High (continuing)	*Phragmites australis* subsp. *australis* and *Reynoutria japonica* (Japanese Knotweed) are the main invasive species affecting this species. These invasive species are not stopped by tidal activity and are abundant in the two largest subpopulations. *Phragmites* is a particularly aggressive invasive species and the effect on this species in the near future is thought to be significant.
8.2	Problematic native species/diseases		Negligible	Negligible (<1%)	Negligible or <1% pop. decline	High (continuing)	Like most plant species, this species experiences some herbivory and is a host to pests (aphids) but none of these effects appear to be increasing to the point of being notable. Deer are present at most sites but do not seem to target this species.
8.3	Introduced genetic material						Some subpopulations seem to have many hybrids but there are no data to know if the rate of hybridization is increasing or connected to human activity.
8.4	Problematic species/diseases of unknown origin						
8.5	Viral/prion-induced diseases						
8.6	Diseases of unknown cause						
9	**Pollution**		Unknown	Large (31-70%)	Unknown	High (continuing)	
9.1	Domestic & urban waste water		Unknown	Large (31-70%)	Unknown	High (continuing)	Houses next to some sites have manicured lawns (= herbicide use). May be an issue but there are too little data to infer threat level at the moment. However, these residential areas have been there for a while and it has not been recorded to be having a large effect on this species. This requires some additional study.
9.2	Industrial & military effluents		Unknown	Small (1-10%)	Unknown	High (continuing)	No data yet to estimate the severity of this threat. Not many industrial roads near subpopulations.
9.3	Agricultural & forestry effluents		Unknown	Large (31-70%)	Unknown	High (continuing)	Almost all sites are near forest but the severity and data on effluents are not available.
9.4	Garbage & solid waste		Negligible	Large (31-70%)	Negligible or <1% pop. decline	High (continuing)	Green waste, compost dumping, as well as refuse washing up from the St. Lawrence River. Doesn't appear to have a large effect on this species.
9.5	Air-borne pollutants						

Threat		Impact (calculated)		Scope	Severity	Timing	Comments
9.6	Excess energy						
10	**Geological events**						
10.1	Volcanoes						
10.2	Earthquakes/tsunamis						
10.3	Avalanches/landslides						
11	**Climate change & severe weather**	C	Medium	Pervasive (71-100%)	Moderate or 11-30% pop. decline	High (continuing)	
11.1	Habitat shifting & alteration	D	Low	Pervasive (71-100%)	Slight or 1-10% pop. decline	High (continuing)	Coastal erosion is documented in the habitat, reducing the amount of space available for this species. This is occurring gradually, and as a result of storms.
11.2	Droughts						
11.3	Temperature extremes		Unknown	Pervasive (71-100%)	Unknown	High (continuing)	This species requires cold temperatures to induce flowering (and induce germination) and so warming may decrease the number of individuals. There are currently no data to infer whether the projected climate change will be outside the thermal tolerances of the species within 10 years.
11.4	Storms & flooding	C	Medium	Pervasive (71-100%)	Moderate or 11-30% pop. decline	High (continuing)	There is severe erosion of the habitat during storms, and submersion of the individuals under water also results in increased mortality of individuals.
11.5	Other impacts						This species attracts many generalist pollinators so the effect of climate change on pollinators will not likely influence this species.
12	**Other options**						
12.1	Other threat						

Classification of Threats follows IUCN - CMP Unified Classification of Direct Threats Version 3.2.