

**COSEWIC**  
**Assessment and Status Report**

on the

**Victorin's Gentian**  
*Gentianopsis virgata* ssp. *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 gentian *Gentianopsis procera macounii* var. *victorinii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 24 pp. (<https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html>).

Legault, A. 1987. COSEWIC status report on the Victorin's gentian *Gentiana victorinii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 22 pp.

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## COSEWIC Assessment Summary

### Assessment Summary – May 2022

**Common name**

Victorin's Gentian

**Scientific name**

*Gentianopsis virgata* ssp. *victorinii*

**Status**

Special Concern

**Reason for designation**

This short-lived annual or biennial plant is endemic to Canada, and occurs in highly-restricted tidal freshwater or brackish shoreline habitats of the St. Lawrence River estuary in Quebec. About 30,000 mature plants are presently known from 35 small localized coastal sites. It is at risk from a wide range of threats, including habitat damage and loss through competition with invasive plant species, erosion and inundation from the effects of climate change, disruption by all-terrain vehicles, and potentially from oil spills. Change of status from Threatened in the previous assessment largely reflects a change in the definition of some assessment criteria. This subspecies is near to qualifying for Threatened status, and failure to effectively mitigate these threats could result in the species becoming Threatened.

**Occurrence**

Quebec

**Status history**

Designated Special Concern in April 1987. Status re-examined and designated Threatened in May 2004. Status re-examined and designated as Special Concern in May 2022.



## COSEWIC Executive Summary

### Victorin's Gentian *Gentianopsis virgata* ssp. *victorinii*

#### Wildlife Species Description and Significance

Victorin's Gentian (*Gentianopsis virgata* ssp. *victorinii*) is an annual or biennial plant about 15-50 cm in height. It is the only species of gentian that occurs in freshwater tidal marsh habitat in 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 Gentian is endemic to the St. Lawrence estuary of southern Quebec, where it grows exclusively in freshwater tidal marsh habitat along both shores of the lower St. Lawrence River in Quebec.

#### Habitat

Victorin's Gentian typically occurs in tall, dense Prairie Cordgrass beds and sometimes on raised rock outcrops. It prefers thick surface deposits (over 15 cm) of fine or mixed texture (seldom coarse), with no, or very few, stones (very stony on rare occasions). This zone is covered by water for two to three hours a day during high tides but is seldom reached by low tides or lower high tides.

#### Biology

Victorin's Gentian flowers from mid-July to mid-September and is an annual, winter annual or biennial plant. The flowers exhibit nyctinasty, remaining closed on overcast days and when submerged by the tide. Pollination is by insects. Fruiting begins in August and continues until October. The seeds are dispersed by water. It is assumed that seed banks are produced with a viability of at least a few years.

## **Population Sizes and Trends**

The subspecies is known from 48 subpopulations: 35 extant, one historical, seven extirpated, and five not relocated. The total Canadian population numbers at least 30,432 individuals, concentrated mainly in six subpopulations (which represent 70% of the population).

Subpopulation size fluctuates from year to year. Since the last status report update, five new subpopulations have been discovered and seven are considered to have been extirpated. There is no overall trend identified at the scale of the area of occupancy.

## **Threats and Limiting Factors**

The most serious threats to the subspecies are the encroachment on its habitat by invasive non-native plants, the effects of climate change, and recreational activities and other human disturbances. The subspecies is considered highly vulnerable to climate change impacts.

## **Protection, Status and Ranks**

Victorin's Gentian was assessed as Threatened in Canada by COSEWIC in 2004 and added to Schedule 1 of the *Species at Risk Act*. The Centre de Données sur le Patrimoine Naturel du Québec has assigned it the NatureServe global rank of Imperilled (G2), a Canadian rank of Imperilled (N2), and a provincial rank of Imperilled (S2).

Victorin's Gentian was designated as Threatened in Quebec in February 2001 and is currently protected under the *Act Respecting Threatened or Vulnerable Species*. Twenty-five extant subpopulations occur partially or completely within protected areas.

## TECHNICAL SUMMARY

*Gentianopsis virgata* subsp. *victorinii*

Victorin's Gentian

Gentiane de Victorin

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

### Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines (2011) is being used)	1-3 years
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Unknown. Some declines in some subpopulations, but this is not an overall trend. The threat calculation of overall High impact, projects a decline of 10-70 percent.
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]	Unknown.
[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].	Unknown. Apparent increases are likely due to more survey effort.
[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].	Unknown. No trend data are available. The threat calculation of overall High impact, projects a decline of 10-70 percent.
[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.	Unknown. No trend data are available. The threat calculation of overall High impact, projects a decline of 10-70 percent.
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	a. No b. Yes, marsh recession owing to erosion and human disturbances c. No
Are there extreme fluctuations in number of mature individuals?	No

### Extent and Occupancy Information

Estimated extent of occurrence (EOO)	1855 km <sup>2</sup>
Index of area of occupancy (IAO)	328 km <sup>2</sup>

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)	35 locations
Is there an [observed, inferred, or projected] decline in extent of occurrence?	Yes. Projected based on threats.
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	Yes. Projected based on threats.
Is there an [observed, inferred, or projected] decline in number of subpopulations?	Yes. Projected based on threats.
Is there an [observed, inferred, or projected] decline in number of “locations”**?	Yes. Projected based on threats.
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.
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
Saint-Laurent, Île d’Orléans	2,842
Grosse-Île	639
Berthier-sur-Mer–Montmagny	31+
Beaumont–Lévis	3,400
Saint-Augustin-de-Desmaures–Neuville	4,011
Deschambault-Grondines	505
Saint-Jean-Port-Joli	8,870
Neuville	19
Île aux Oies	649
Sainte-Croix, Barbin Brook	24+
Lotbinière	0

\* See Definitions and Abbreviations on [COSEWIC website](#) and [IUCN](#) for more information on this term.

Saint-François-de-l'Île-d'Orléans, Pointe d'Argenteu	4
Saint-Antoine-de-Tilly	9
Île à Deux Têtes	Unknown
Sainte-Croix, Platon Point	460
Lévis, Ross Cove	0
Saint-Michel-de-Bellechasse	2,097
Saint-Jean-Port-Joli–Saint-Roch-des-Aulnaies	1,906
Boischatel	14
Île aux Grues: wharf and Pointe-aux-Pins	881
Le Haut Marais, Île aux Grues	611
Sainte-Pétronille	470
L'Ange-Gardien	40
Pointe de Saint-Vallier	4
Beaumont, Anse du Moulin	519
Château-Richer	384
Île au Ruau	1,350
Château-Richer, Cazeau River	207
Deschambault-Grondines	0
Île au Canot	1
Île de la Corneille	17
Longue Island	Unknown
Saint-Laurent, Maheu River	50
Caye de la Prairie	317
Saint-Jean, Île d'Orléans	92
Total	At least 30,432

### 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]?	No quantitative analysis has been done.
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### Threats

<p>Was a threats calculator completed for this species? Yes with an overall assigned threat impact of High.</p> <ul style="list-style-type: none"> <li>i. Invasive alien species (Medium Impact)</li> <li>ii. Climate change and temperature extremes (Medium Impact)</li> <li>iii. Recreational activities (Medium Impact)</li> </ul> <p>What additional limiting factors are relevant? Habitat dynamics, species' ecological requirements</p>
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### Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	N/A
Is immigration known or possible?	Not possible
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?	Not applicable – Canadian endemic does not occur outside Canada

### Data Sensitive Species

Is this a data sensitive species?	No
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### Status History

**COSEWIC Status:** Designated Special Concern in April 1987. Status re-examined and designated Threatened in May 2004. Status re-examined and designated as Special Concern in May 2022.

### Status and Reasons for Designation

<b>Status:</b> Special Concern	<b>Alpha-numeric codes:</b> Not Applicable
<b>Reasons for Designation:</b> This short-lived annual or biennial plant is endemic to Canada, and occurs in highly-restricted tidal freshwater or brackish shoreline habitats of the St. Lawrence River estuary in Quebec. About 30,000 mature plants are presently known from 35 small localized coastal sites. It is at risk from a wide range of threats, including habitat damage and loss through competition with invasive plant species, erosion and inundation from the effects of climate change, disruption by all-terrain vehicles, and potentially from oil spills. Change of status from Threatened in the previous assessment largely reflects a change in the definition of some assessment criteria. This subspecies is near to qualifying for Threatened status, and failure to effectively mitigate these threats could result in the species becoming Threatened.	

### Applicability of Criteria

Criterion A: Not applicable. Declines have occurred or are inferred to have occurred at a few sites but there are insufficient data to estimate population trends.
Criterion B: Not applicable. Although the EOO of 1855 km <sup>2</sup> and IAO of 328 km <sup>2</sup> are both below threshold for Endangered, the habitat quality is in decline, and the population is projected to continue to decline. However, the subspecies is found at more than ten locations (35), and the population is not severely fragmented, and does not undergo extreme fluctuations.
Criterion C: Not applicable. Population estimate of over 30,000 mature individuals exceeds the threshold for Threatened.

Criterion D: Not applicable. Population estimate of over 30,000 mature individuals and thresholds for IAO and number of locations are exceeded. The population is not known to be vulnerable to rapid and substantial decline.

Criterion E: Not applicable. Analysis not conducted.

## PREFACE

Since Victorin's Gentian was last assessed (COSEWIC 2004), search effort has increased the number of subpopulations from 28 to 35 extant subpopulations in 2019. Although subpopulations fluctuate, the population estimate has increased considerably from 1,576-5,781 to more than 30,432. Various studies have led to a substantial increase in our knowledge of its ecology and threats. The scientific name *Gentianopsis procera* ssp. *macounii* var. *victorinii* was used in the previous status report, but has been revised to the currently accepted name *Gentianopsis virgata* ssp. *victorinii* following Pringle (2012). A Recovery Strategy has been completed led by Environment Canada (2012) and an action plan has also been developed (Environment Canada 2014).



### 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.

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

# **COSEWIC Status Report**

on the

## **Victorin's Gentian**

*Gentianopsis virgata* ssp. *victorinii*

**in Canada**

2022

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## WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

### Name and Classification

Scientific name: *Gentianopsis virgata* (Rafinesque) Holub ssp. *victorinii* (Fernald) Lammers

Pertinent synonyms: *Gentiana victorinii* Fern; *Gentianella crinita* (Froel.) G. Don ssp. *victorinii* (Fern.) J.M. Gillett; *Gentianopsis procera* (Th. Holm) Ma ssp. *macounii* (Th. Holm) Iltis var. *victorinii* (Fern.) Iltis; *Gentianopsis victorinii* (Fernald) Iltis

English common names: Victorin's Gentian, Victorin's Fringed Gentian

French common names: Gentiane de Victorin, gentianopsis de Victorin, gentianopsis élançé variété de Victorin

Family: Gentianaceae (gentian family)

Victorin's Gentian has undergone a number of taxonomic changes since it was described as a species within *Gentiana* by Fernald (1923). Gillett (1957, 1963) assigned it to the genus *Gentianella* and placed it as a subspecies of the *G. crinata* complex, which was followed by Scoggan (1979). Iltis (1965) believed that fringed gentians belong to the genus *Gentianopsis*, which is supported by the molecular phylogenetic studies of Yuan and Kupfer (1995). Iltis subsequently created the combination *Gentianopsis victorinii* (Fernald) Iltis, as was followed by Kartesz (1994). Iltis believed that the differences between the populations of the taxa that he associated with *Gentianopsis procera* were minor. In his opinion, *Gentianopsis victorinii* did not differ significantly from *Gentianopsis procera*. As such Mason and Iltis (1965) created a combination that better reflects his taxonomic opinion: *Gentianopsis procera* (Th. Holm) Ma ssp. *macounii* (Th. Holm) Iltis var. *victorinii* (Fern.) Iltis. This is the name used in the previous assessment (COSEWIC 2004). Lammers (2003) treated it as a subspecies, which is supported by Bouillé and Bousquet (1999; Bousquet pers. comm. 2021) within *Gentianopsis virgata*. This remains the current taxonomic update and is currently accepted in the latest *Flora of North America* treatment (Pringle 2012), VASCAN (Brouillet *et al.* 2010+), and The Biota of North America Program (Kartesz 2015), but it is still recognized as *Gentianopsis victorinii* by NatureServe (2022).

*Gentianopsis virgata* only occurs in North America and contains three subspecies. The nominate subspecies *virgata* occurs primarily in the Great Lakes region and the midwestern United States, from New York south to Illinois and west to the Dakotas. In Canada, it is found in Ontario to Saskatchewan. Subspecies *macounii* is found from the Northwest Territories and British Columbia east to Quebec and in the United States from Montana to Minnesota (Pringle 2012; Kartesz 2015). The subspecies *victorinii* is a distinctive entity that is widely recognized as endemic to the intertidal habitats of the St. Lawrence River estuary (Gillett 1963; Scoggan 1979; Labrecque and Lavoie 2002; Lammers 2003; Brouillet *et al.* 2010+; Pringle 2012; Kartesz 2015).

## Morphological Description

The subspecies is an herbaceous annual, winter annual or biennial, 10–50 cm tall, growing from a small taproot, relatively unbranched (Figure 1); stem glabrous, simple or branched 1–2 times. The stem leaves are opposite, fleshy, and linear-lanceolate. The flowers are deep blue or rarely white, 1–30; four sepals cleft for nearly half their length, two lanceolate, the other two ovate and shorter; corolla 3.5–4.5 cm long at maturity, four lobed, the lobes, finely dentate on the apex and very slightly lacerate at the margin; fruit a 3–3.8 cm long capsule with approximately 400 papillate brown seeds per fruit (Coursol 2001).



Figure 1. Victorin's Gentian in flower, with floral buds (Photo: Audrey Lachance).

Subspecies *victorinii* differs from the other subspecies of the species in its widely elliptic to orbiculate corolla lobes, which are rounded at the apex, less than twice as long and often about as long as wide, with the teeth at and near the apex mostly more than 1 mm long. The corolla lobes of the other subspecies are more nearly oblong, more or less truncate, and usually proportionately narrower, with teeth less than 1 mm long. Subspecies *victorinii* also differs in its distinct, slender style 1–2 mm long and in its relatively slender gynophore about 5 mm or longer at flowering, that is, 0.5–1 times as long as the body of the ovary (Pringle 2012).

## **Population Spatial Structure and Variability**

In this document, population refers to the sum total of all Victorin's Gentian 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 2020) where an element occurrence 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 Gentian occurs or has occurred. Location refers to a geographically or ecologically distinct area in which a single threatening event can rapidly affect all plants.

There have been no studies on variability within the subspecies.

## **Designatable Units**

The population of Victorin's Gentian 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 subspecies *victorinii* has evidence of heritable traits as it is the only subspecies that occurs in intertidal marshes where plants are able to withstand regular tidal inundation and slightly brackish conditions (Gillett, 1963; Pringle 2012). The other subspecies occur in a variety of habitats, including some wetlands, but are not subject to complete immersion for hours daily. The subspecies has phenotypical characters that separate it from other subspecies (see **Morphological Description**).

There is a natural geographic disjunction between subspecies *victorinii* and the other two subspecies (Gillett 1963; Pringle 2012), and along with other endemic species in the region, it evolved in the glacial refugia of Gaspé and the Gulf of St. Lawrence (see **Special Significance**).

### **Evolutionary Significance**

The subpopulations are located in unique physical (waterbody type and size) habitats, resulting in local adaptation and representing evolutionary significance. The population has been separated from the next closest region by over 600 km (Iltis 1965), which precludes genetic exchange between the populations, which have likely been separated for ~10,000 years (~10,000 generations). The DUs 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 subspecies *victorinii* has the adaptive trait of being able to withstand tidal inundation. It is highly unlikely that plants from the other subspecies could tolerate these conditions.

### **Special Significance**

Victorin's Gentian is endemic to southern Quebec and shares its specialized habitat with other endemic taxa including Victorin's Water-hemlock (*Cicuta maculata* ssp. *victorinii*; Special Concern; COSEWIC 2004), Estuarine Wildrice (*Zizania aquatica* ssp. *brevis*), and St. Lawrence Quillwort (*Isoetes laurentiana*; Brunton *et al.* 2019) and 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 Gentian is important to Indigenous peoples who recognize the interrelationships of all species within the ecosystem.

## DISTRIBUTION

### Global Range

Victorin's Gentian is endemic to the estuary of the St. Lawrence River of southern Quebec where it is known from 48 subpopulations (Table 1), 35 of which are considered extant, seven extirpated, five have not been relocated, and one occurrence is historical. The southwestern limit of its range occurs in Lotbinière and Deschambault-Grondines and the northeastern limit in Saint Roch-des-Aulnaies (Figure 2).

**Table 1. Summary of quantitative and qualitative data on Victorin's Gentian subpopulations in Canada.**

Subpopulation	Name of site	Quality ranking	Number of mature individuals (most recent visit)	Previous observations	Area of occupancy (most recent visit)	Most recent visit	Most recent observation	Observer	Trend	Official status
	Saint-Nicolas, Anse Ross	D (poor, non-viable)	2-10				1996-09-03			Not found
	Pointe-aux-Trembles-Ouest	D (poor, non-viable)	3-11				1995-09-19			Not found
4996	Saint-Laurent, Île d'Orléans	A (excellent)	2,842	2014: Over 700 individuals 2013: 764 individuals 2004 Status Report (Saint-Laurent-d'Orléans : 32; Saint-Laurent-d'Orléans, Village-des-Anglais: 25-100)		2015	2015	Bureau d'écologie appliquée, Fondation québécoise pour la protection du patrimoine naturel	Stable	Extant
4998	Grosse-Île	B (good)	639	2015: Over 1,500 individuals. 2014: 1,123 individuals. 2013 (partial inventory): 27 individuals. 2012: Over 300 individuals. 2010: Over 220 individuals. (2): 2015: Over 200 individuals. 2010: Over 60 individuals. (3): 2015: Roughly 50 individuals. 2010: 4 individuals. (4): 2010: 1 individual. (5): 2010: 1 individual. 2004 Status Report (200-400)		2015	2015	Parks Canada, Bureau d'écologie appliquée, Quebec Department of Environment and the Fight Against Climate Change	Stable	Extant

Subpopulation	Name of site	Quality ranking	Number of mature individuals (most recent visit)	Previous observations	Area of occupancy (most recent visit)	Most recent visit	Most recent observation	Observer	Trend	Official status
5002	Berthier-sur-Mer–Montmagny	B (good)	363 (2015) +31 (2019)	2015: 62 individuals. 2014: Over 250 individuals. 2006: 9 plants. 1959: presence of individuals. 2014: Over 1,600 individuals. 2010: Over 280 individuals. 1995: 55–110 individuals. 2014: Roughly 900 individuals. 2006 (partial inventory): 6 plants. 2004: Record of species being observed in two locations, but no details on number of individuals. 2000 (partial inventory): 1. 2004 Status Report (Berthier-sur-Mer, Anse de Berthier: 55-110; Berthier-sur-Mer, Road 561: 1; Montmagny: 1)	1,000 m <sup>2</sup>	2019	2015 and 2019	Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée, Sud-de-l'Estuaire ZIP Committee	Stable	Extant
5003	Beaumont–Lévis	A (excellent)	3400	2016: Over 3,400 individuals. 2015: Slightly under 7,000 individuals. 2014: Slightly less than 15,000 individuals. 2013: Over 4,000 individuals. 2010 (partial inventory): Over 200 individuals. 2004 (partial inventory): Over 300 plants. 2004 Status report 11-50 (Beaumont, Anse de Vincennes)		2016	2016	Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée, Quebec Department of Environment and the Fight Against Climate Change	Stable	Extant
5004	Saint-Augustin-de-Desmaures–Neuville	A (excellent)	4011	2015: Slightly over 4,000 individuals. 2014: Slightly over 10,000 individuals. 2013: Slightly less than 3,000 individuals. 2012: 2,611 plants. 2010: Over 2,500 individuals. 2004 Status Report (Neuville, Provancher marsh: 10-30; Saint-Augustin-de-Desmaures: 300-500)		2015	2015	Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée, Société Provancher	Stable	Extant
5005	Deschambault-Grondines	C (fair)	505	2014: No demographic information. 2013: 2 individuals. 2015: 504 individuals. 2014 (partial inventory): Around 30 individuals. 2013: 291 individuals. 2010: Slightly less than 150 individuals. 2004 Status Report (Deschambault 100-1000)		2015	2015	Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée	Stable	Extant

Subpopulation	Name of site	Quality ranking	Number of mature individuals (most recent visit)	Previous observations	Area of occupancy (most recent visit)	Most recent visit	Most recent observation	Observer	Trend	Official status
5007	Saint-Jean-Port-Joli	B (good)	8870	2015: 7,356 individuals. 2014: Slightly under 300 individuals. 2013: Roughly 40 individuals. 2015: Over 8,800 individuals. 2014: Over 4,300 individuals. 2013 (partial inventory): Over 600 individuals. 2010: Over 120 individuals. 2007: Between 1,000 and 5,000 individuals. 1997 (partial inventory): 30–120 individuals. 2015: No demographic information. (4) Occurrence 21938: 2,049 individuals (increased numbers because two occurrences merged). (5) Occurrence explored: 10 individuals (occurrence 5007 expanded). 2004 Status Report (Saint-Jean-Port-Joli, the two sides of the wharf: 30-120; Saint-Jean-Port-Joli, Pointe à Menin: 50-100)		2015	2015	Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée, Pierre Morrisset	Stable	Extant
5010	Neuville	D (poor, non-viable)	19	2015: Around 20 individuals. 2014: 13 individuals. 2013: 10 individuals. 1999: 2–10 individuals. 1995: 3–11 individuals. 2004 Status Report (Neuville, Provancher marsh 10-30)		2015	2015	Fondation québécoise pour la protection du patrimoine naturel	Stable	Extant
5011	Île aux Oies	C (fair)	649	2015: 649 individuals. 2014 (partial inventory): Over 20 individuals. 2013 (partial inventory): Over 40 individuals. 2015: Roughly 640 individuals. 2014: Roughly 650 individuals. 2013 (partial inventory): 85 individuals. 2004 Status Report (no subpopulation information)		2019	2015 and 2019	Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée, Nature Conservancy of Canada	Stable	Extant
5012	Sainte-Croix, Barbin Brook	D (poor, non-viable)	partial: 24	2015 (partial inventory): 24 individuals. 2014: Over 350 individuals. 2013: No demographic information. 2004 Status Report (Sainte-Croix, Pointe Platon: 111-1050)		2015	2015	Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée	Declining	Extant
5016	Lotbinière	D (poor, non-viable)	0	2013: 0 2004 Status Report Historical (no subpopulation information)		2015	2013	Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée	Declining	Extant
5018	Îlet de Bellechase	F (not found)	0	Estuary shoreline. 1925: No details on number of individuals.		2013	2013	Bureau d'écologie appliquée	Declining	Not found

Subpopulation	Name of site	Quality ranking	Number of mature individuals (most recent visit)	Previous observations	Area of occupancy (most recent visit)	Most recent visit	Most recent observation	Observer	Trend	Official status
5020	Saint-François-de-l'Île-d'Orléans, Pointe d'Argenteuay	D (poor, non-viable)	4	2015: 4 individuals. 2014: around 20 individuals. 2013: 24 individuals. 2010: Over 40 individuals. 1995: 100–1000 individuals. 2004 Status Report (Saint-François, pointe d'Argenteuay: 100-1000)		2019	2019	Nature Conservancy of Canada, Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée	Declining	Extant
5021	Saint-Antoine-de-Tilly	D (poor, non-viable)	9	2014: Around 20 individuals. 2013: 9 individuals. 2015: No demographic information. 2014: Around 20 individuals. 2013: A dozen individuals. 1995: 11–50 individuals. 2004 Status Report (Saint-Antoine-de-Tilly, Les Fonds: 11-50).		2019	2019	Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée, Amis du Marais de Saint-Antoine-de-Tilly	Stable	Extant
5025	Île à Deux Têtes	AC (excellent to fair)	No details on numbers	Estuary shoreline; in flower in late August. 2004 Status Report Historical (no subpopulation information)		2010	2010	Nature Conservancy of Canada, Bureau d'écologie appliquée	Unknown	Extant
5026	Sainte-Croix, Platon Point	C (fair)	460	2015: 460 individuals. 2014: Over 1,000 individuals. 2013: Roughly 600 individuals. 2010: Roughly 600 individuals. 2004 Status Report Historical Sainte-Croix (no subpopulation information)		2015	2015	Quebec Department of Environment and the Fight Against Climate Change, Bureau d'écologie appliquée, Fondation québécoise pour la protection du patrimoine naturel	Stable	Extant
5027	Lévis, Ross Cove	D (poor, non-viable)	0	2013: 1 individual. 1996: 2–10 individuals. 1991: 20–40 individuals. 2004 report (Lévis, Pointe Martinière: 15)		2019	2019	Quebec Department of Environment and the Fight Against Climate Change, Nature Conservancy of Canada, Bureau d'écologie appliquée	Declining	Extant
5028	Saint-Michel-de-Bellechasse	A (excellent)	2097	2015: Over 2,600 individuals. 2014: Over 2,600 individuals. 2013 (partial inventory): Over 600 individuals. 2010: Over 4,350 individuals. 2006: 50–100 individuals. 2014: Roughly 370 individuals. 2013: Over 50 individuals. 2004 Status Report Historical (no subpopulation information)	Over 1,000 m <sup>2</sup>	2019	2019	Fondation québécoise pour la protection du patrimoine naturel, Quebec Department of Environment and the Fight Against Climate Change, Bureau d'écologie appliquée	Increasing because of expanded search effort	Extant

Subpopulation	Name of site	Quality ranking	Number of mature individuals (most recent visit)	Previous observations	Area of occupancy (most recent visit)	Most recent visit	Most recent observation	Observer	Trend	Official status
5031	Saint-Jean-Port-Joli–Saint-Roch-des-Aulnaies	AB (excellent to good)	1906	2015: No demographic information. 2014: Over 2,600 individuals. 2013 (partial inventory): 116 individuals. 2010: Over 260 individuals. 2007: Roughly 60 individuals. 2003: 50–100 plants. 2015: No demographic information. 2014: Around 30 individuals. 2010: Over 200 individuals. 2007: 100 individuals divided into two subpopulations of 50 individuals each. 2004 Status Report (Saint-Roch-des Aulnaies - historical, Saint-Jean-Port-Joli, Anse de Trois-Saumons historical; Pointe à Chouinard: 70-100).		2015	2015	Bureau d'écologie appliquée, Fondation québécoise pour la protection du patrimoine naturel	Increasing because of expanded search effort	Extant
5034	Boischatel	D (poor, non-viable)	14	2013: 14 individuals in flower. 2012: Occurrence not found again. 1995: 11–59 individuals. 2004 Status Report (Saint-Jean-de-Boischatel: 11-59)	5 m <sup>2</sup>	2013	2013	Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée	Declining	Extant
10697	Île aux Grues: wharf and Pointe-aux-Pins	C (fair)	881	2015: Over 600 individuals. 2014: Over 1,100 individuals. 2004 report (11-50)		2015	2015	Nature Conservancy of Canada, Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée	Stable	Extant
10698	Le Haut Marais, Île aux Grues	C (fair)	611	2012: Over 1,600 individuals. 2010 (partial inventory): Over 410 individuals. 2006: Over 200 individuals in flower. 1996: 13–60 individuals. 2004 report (Île aux Grues, Rivière à Anguilles: 13-60)		2015	2015	Quebec Department of Environment and the Fight Against Climate Change, Nature Conservancy of Canada, Bureau d'écologie appliquée	Increasing because of expanded search effort	Extant
10701	Sainte-Pétronille	CD (fair to poor)	470	2015: 140 individuals. 2015 roughly 200 individuals. 2014: Roughly 140 individuals. 2015: Over 270 individuals. 2004 Status Report (Sainte-Pétronille: 32; Sainte-Pétronille, Anse chez Porteous: 200-500)		2015	2015	Association forestière des deux rives, Bureau d'écologie appliquée	Stable	Extant
10740	L'Ange-Gardien	D (poor, non-viable)	40	2015: 40. 2014: 10. 2010: 98 individuals. 2002: 51–100 individuals. 1996: Between 51 and 100 individuals. 2004 Status Report (L'Ange-Gardien, Casgrain Street: 51-100 L'Ange-Gardien, du Fleuve Street: 51-100)		2015	2015	Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée	Stable	Extant

Subpopulation	Name of site	Quality ranking	Number of mature individuals (most recent visit)	Previous observations	Area of occupancy (most recent visit)	Most recent visit	Most recent observation	Observer	Trend	Official status
15259	Pointe de Saint-Vallier	CD (fair to poor)	4	2015: 4 plants. 2014: Fewer than 10 individuals. 2013: 36 individuals. 2012: Over 100 individuals. 2005 (partial inventory): 22 individuals. 2004: A few hundred individuals. 2004 Status Report (Saint-Vallier, Pointe de Saint-Vallier: 200-400).		2015	2015	Nature Conservancy of Canada	Declining	Extant
16029	Beaumont, Anse du Moulin	B (good)	519	2015: 745 individuals. 2014: Over 800 individuals. 2013: 472 individuals. 2006: Roughly 1,000 individuals.		2015	2015	Volunteers from Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée	Stable	Extant
16054	Château-Richer	AB (excellent to good)	384	2015: 384 individuals. 2014: 2,550 individuals. 2013: 73 individuals. 2012: Over 800 individuals. 2010: Over 2,240 individuals. 2006: Over 1,000 individuals evenly distributed over the site (according to Hélène Gilbert, between 200 and 600 individuals).		2015	2015	Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée	Declining	Extant
16122	Île au Ruau	B (good)	1350	2014: 1,350 individuals. 2006 (partial inventory): Over 200 individuals.	Spread along almost all of the island's shoreline	2014	2014	Nature Conservancy of Canada	Stable	Extant
19727	Château-Richer, Cazeau River	D (poor, non-viable)	207	2015: 207 individuals. Tidal flats. 2013 (partial inventory): (1): 22 individuals in flower the fourth week of August. 2012: (1) and (2): 200 individuals in total. 2007: (1): 5 individuals. (2): 1 individual.		2015	2015	Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée	Stable	Extant
20550	Deschambault-Grondines	C (fair)	0	2014: Roughly 130 individuals. 2013 (probably partial inventory): 2 individuals. 2014: Roughly 50 individuals. 2011: No demographic information. 2004 Status Report (Deschambault 100-1000)		2015	2015	Nature Conservancy of Canada, Fondation québécoise pour la protection du patrimoine naturel, Bureau d'écologie appliquée	Stable	Extant
20574	Île au Canot	D (poor, non-viable)	1	2010: 1 individual in flower, last week of August.		2010	2010	Nature Conservancy of Canada	Unknown	Extant
21368	Cap-Saint-Ignace	F (not found)	0	1959: No details on number of individuals. 2004 Status Report Historical (no subpopulation information)		2015	2015	Bureau d'écologie appliquée, Fondation québécoise pour la protection du patrimoine naturel, Sud-de-l'Estuaire ZIP Committee	Declining	Not found

Subpopulation	Name of site	Quality ranking	Number of mature individuals (most recent visit)	Previous observations	Area of occupancy (most recent visit)	Most recent visit	Most recent observation	Observer	Trend	Official status
21939	Île de la Corneille	D (poor, non-viable)	17	2011: 17 individuals.	101 to 500 m <sup>2</sup>	2011	2011	Nature Conservancy of Canada, Bureau d'écologie appliquée	Unknown	Extant
21940	Longue Island	CD (fair to poor)	No details on numbers	2009: No details on number of individuals.		2009	2009	Nature Conservancy of Canada, Bureau d'écologie appliquée	Unknown	Extant
21941	Saint-Jean, Île d'Orléans	F (not found)	0	2013: No demographic information.		2015	2015	Bureau d'écologie appliquée, Fondation québécoise pour la protection du patrimoine naturel	Declining	Not found
24932	Saint-Laurent, Rivière Maheu	D (poor, non-viable)	50	2015: Fewer than 50 individuals.		2015	2015	Fondation québécoise pour la protection du patrimoine naturel	Unknown	Extant
24933	Caye de la Prairie	C (fair)	317	2014: 317 individuals.		2014	2014	Bureau d'écologie appliquée	Stable	Extant
	Saint-Jean, Île d'Orléans	C (fair)	92	2019: 92 individuals.		2019	2019	Bureau d'écologie appliquée	Discovered in 2019	Extant
	Beauport			2004 Status Report			1943			Extirpated
	Cap Rouge			2004 Status Report			1942			Extirpated
	L'Islet-sur-Mer, Rocher Panet			2004 Status Report			1947			Extirpated
	Saint-Romuald, Garneau Bridge			2004 Status Report			1954			Extirpated
	Saint-Romuald			2004 Status Report			1936			Extirpated
	Sillery			2004 Status Report			1971			Extirpated
	Lévis			2004 Status Report			1935			Extirpated
	Ile aux Oies, Anse à la Beguine			2004 Status Report			1970			Historical

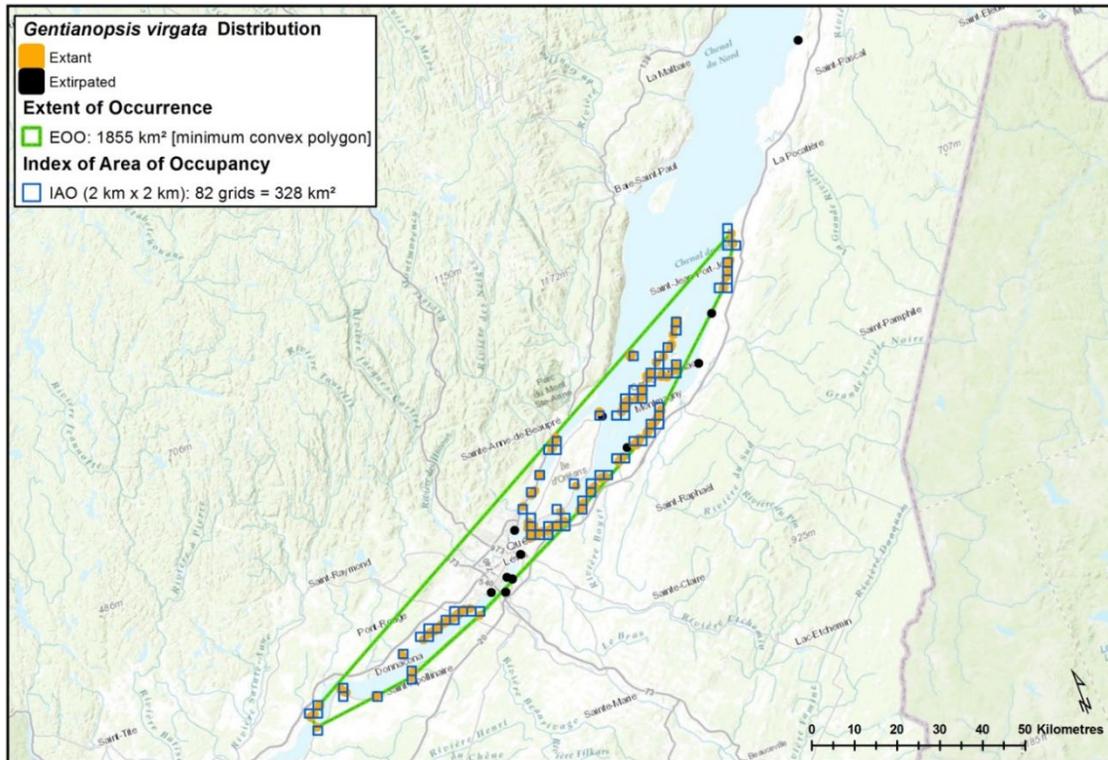


Figure 2. Current distribution of Victorin's Gentian in Canada showing extant and extirpated occurrences, extent of occurrence and index of area of occupancy (COSEWIC Secretariat).

## Extent of Occurrence and Area of Occupancy

The extent of occurrence (EOO) of Victorin's Gentian was estimated to be 1855 km<sup>2</sup>, calculated by measuring the area of a minimum convex polygon drawn around all known extant occurrences (Figure 2), which is a large increase from 171 km<sup>2</sup> reported in the 2004 report (COSEWIC 2004). The increase in EOO is believed to be mainly due to the differences in EOO calculations, and an increase in search effort (see Search Effort) and not due to an increase in the subspecies' range. The index of area of occupancy (IAO) is estimated to be 328 km<sup>2</sup>, calculated by laying a grid of 2 x 2 km squares over the known extant occurrences. The IAO was not calculated in the previous report.

## Search Effort

Since the last update status report, substantial search efforts have been devoted to finding this taxon. Between 2004 and 2017, the Nature Conservancy of Canada (NCC) conducted inventories of estuarine species on many otherwise inaccessible properties, as part of stewardship efforts targeting private landowners, particularly in the Isle-aux-Grues archipelago. Between 2008 and 2012, surveys of some localities were carried out by counting individual plants in 1-m<sup>2</sup> quadrats (20 quadrats), and then extrapolating the density to the entire area of the occurrence (Gilbert 2009, 2010, 2011a,b, 2012, 2013). In 2013, a number of exhaustive counts were performed to confirm historical occurrences and

update occurrences with small numbers (Lachance and Gilbert 2013). Additional comprehensive counts were carried out between 2013 and 2016 (Lachance 2017). Since 2016, volunteers from the Fondation québécoise pour la protection du patrimoine naturel (FQPPN) have conducted comprehensive counts in certain localities while other counts do not cover all the area known to host a given subpopulation. One new subpopulation (Saint-Jean) and additional individuals in an extant subpopulation (Île aux Grues, Le Haut Marais) were discovered in 2019.

Inventories conducted from 2013 to 2016 by the FQPPN entailed roughly 500 total hours of work involving 56 people annually (Lachance 2017). However, it is reasonable to believe that new occurrences of Victorin's Gentian could be found in the next few years within the subspecies' current range because apparently suitable unoccupied habitat is abundant (Lachance pers. obs.).

## HABITAT

### Habitat Requirements

Victorin's Gentian grows in thick (> 15 cm) marine or glaciomarine surface deposits of fine or mixed texture (never coarse) and variable stoniness (no stones to very stony) in freshwater tidal marsh habitat. These superficial deposits consist mainly of sand and silt and, to a lesser extent, gravel (Lamarre 2012; Normandeau 2013). Plant density is significantly lower in areas with gravel or pebbles, and in rockier areas (Robert 1993; Gilbert 2010, 2011a,b, 2012). The subspecies is found in both upper and lower marshes provided the surface deposits and the duration of inundation are suitable, as described above (Lamarre 2012; Normandeau 2013; Sirois 2015). The taxon does not colonize lower marshes where surface deposits consist primarily of fine clay (Lamarre 2012). The water pH measured in several occurrences ranges from neutral to alkaline (Rousseau 1930, 1932).

Victorin's Gentian is found primarily in tall, dense Prairie Cordgrass (*Sporobolus michauxianus*) in the mid- and upper intertidal zones (Robert 1993; Brouillet *et al.* 2004; Gilbert 2009, 2013; Lamarre 2012) (Figure 3). The vegetation at these sites ranges from sparse to dense, with a high species diversity (Gilbert 2009, 2012; Normandeau 2013). In addition, the taxon sometimes grows on sparsely vegetated, raised outcrops (Figure 4). Victorin's Gentian is generally found at the interface of the mid- and upper intertidal zones or near openings in the vegetation of the upper intertidal zone. Here the shorter vegetation allows it to get more sunlight than in the upper intertidal zone where the herbaceous layer is taller. This habitat corresponds to a freshwater estuary system in the NatureServe classification (CDPNQ 2018).



Figure 3. Typical habitat of Victorin's Gentian in an upper marsh (Photo: Audrey Lachance).



Figure 4. Rocky habitat of Victorin's Gentian (Photo: Audrey Lachance).

The habitat of Victorin's Gentian is highly dynamic and subject to extensive erosion, transport and accumulation processes (FQPPN 2017). A geomorphological characterization of the coastal habitats supporting Victorin's Gentian was conducted in ten of its localities (FQPPN 2017). It was found in a wide variety of shoreline types, but very low-lying coastline (<1.5 m in elevation) consisting of intertidal marshes, beach terraces and rocky shoreline without cliffs appeared to be the most preferred. This was followed by low-lying coastline (1.5 to 5 m) with low unconsolidated cliffs, and lastly, higher-elevation coastline (>5 m) with rocky cliffs (FQPPN 2017). The duration of tidal inundation and dynamic coastal processes determine the plant communities that are present in the intertidal zone (Normandeau 2013; Sirois 2015; Badeau-Trépanier 2017; FQPPN 2017). Victorin's Gentian appears to be well adapted to these dynamic environments. Its habitat is covered with water for two to three hours a day during high tides, but is seldom flooded during low high tides. According to tide gauge data, the habitat occurs at elevations between the higher high water large tide (HHWLT) and the higher high water mean tide (HHWMT) (Dionne 2001; CHS 2017). An analysis based on Victorin's Gentian observations and LiDAR (Light Detection and Ranging is a remote sensing method that uses light in the form of a pulsed laser to measure elevation) showed that the taxon is found at elevations above the zero-tide level between 2 m and 3.99 m in 91% of cases (CDPNQ 2018).

## Habitat Trends

Significant losses of potential habitat have occurred in the past, particularly in the Quebec City metropolitan area. Road and railroad construction on the tidal flats of the St. Lawrence River destroyed almost all of the mid- and upper littoral zone in 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 other residential areas along the St. Lawrence River where Victorin's Gentian subpopulations have been documented. The introduction of tighter environmental legislation seems to have halted or slowed this trend, and the taxon has managed to persist even in areas with human disturbances.

Major sampling efforts in the fluvial and middle estuary beginning in the 1990s have led to the discovery of several new occurrences and potential habitats (Legault 1986; Brouillet *et al.* 2004; Lachance 2017). The islands in the Isle-aux-Grues archipelago contain potential habitats that are relatively undisturbed and suitable for the subspecies (Lachance pers. obs.). Since the publication of the report by Brouillet *et al.* (2004) and subsequent studies (Gilbert 2013; Lachance 2017), the taxon's habitat appears to be stable overall, although a number of threats could alter this trend.

## BIOLOGY

Victorin's Gentian is an annual, winter annual, or biennial plant (Gillett 1963; Pringle 2012; Gilbert 2013). Plants flower from mid-July to mid-September. The flowers exhibit nyctinasty (periodic opening and closing in response to external stimuli), remaining closed

on overcast days and when submerged by tides (Rousseau 1932) and opening under more favourable conditions. Pollination is by various species of insects. Fruiting begins in August and continues until October and the seeds are dispersed by water (CDPNQ 2015).

## **Life Cycle and Reproduction**

No signs of clonal reproduction have been observed in the taxon, and reproduction is only known from seed. The observation of various species of insects on the flowers confirms the subspecies to be insect-pollinated. The nectar secreted at the base of the stamens primarily attracts bumble bees, which sometimes become trapped overnight (Rousseau 1932; Marie-Victorin 1995). Bouillé (1996) reported that the nyctinasty found in the taxon could hinder pollination by insects by limiting their access to the flowers.

The optimal germination conditions and germination rate are not known, nor are the seedling survival rate and seed viability. It is assumed that seed banks are produced with a viability of at least a few years, given the subspecies' reappearance after years of virtual absence (Gilbert 2013). For plants with seed banks, the generation time is increased to the half-life of seeds in the seed bank. Seed bank half-lives commonly range between <1 and 10 years (IUCN 2019). As a consequence, the generation time is estimated to be between one and three years.

## **Physiology and Adaptability**

In subpopulations downstream of Quebec City, flowering and fruiting occur earlier than in those upstream of the city. This phenomenon is curious because the climate is generally harsher and colder downstream of the city. Furthermore, individuals in these subpopulations are often more exposed to winds and storms and plants are often smaller or have fewer flowers (Lachance pers. obs.).

Victorin's Gentian has been successfully cultivated for at least two years at the Montreal Botanical Garden. A series of attempts to germinate seeds, however, have been unsuccessful (Coursol pers. comm. 2020). A research project led by the Bureau d'écologie appliquée is currently underway attempting to cultivate Victorin's Gentian, or at least to find out more about seed viability and ex situ germination conditions (Lachance pers. obs.). Previous research indicates some success with germination with cold stratification for at least three months (Teusher 1941).

## **Dispersal and Migration**

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 disturbance caused by ice floes. The plants that are the most successful in these environments are annuals or strongly rhizomatous perennials. In addition, ice scouring stirs up sediments and physically dislodges portions of the vegetation mat, which then can potentially be redeposited elsewhere along rivers.

The seeds of Victorin's Gentian are denser than water, but are buoyant due to the papillae covering them, which act as floats. When the papillae have absorbed water, the seeds sink with the slightest movement of the water (Rousseau 1932; Marie Victorin 1995). Rousseau (1932) speculated, however, that this property likely contributes little to the spread of the taxon.

## **Interspecific Interactions**

Victorin's Gentian is dependent on insect pollination for its reproduction, and various insect species play a role in this regard (Rousseau 1932; Marie Victorin 1995). Browsing on some plants by White-tailed Deer (*Odocoileus virginianus*) and possibly by Muskrat (*Ondatra zibethicus*) has been observed (Gilbert 2009, 2012; Lachance pers. obs.).

## **POPULATION SIZES AND TRENDS**

### **Sampling Effort and Methods**

Brouillet *et al.* (2004) surveyed transects at freshwater tidal marsh sites believed to have potential to support populations of species of conservation interest, including Victorin's Gentian. When such a significant plant was observed, a subpopulation count was conducted. The Nature Conservancy of Canada conducted inventories between 2004 and 2017. Between 2008 and 2012, certain localities were surveyed by counting individual plants in 1-m<sup>2</sup> quadrats (20 quadrats) and extrapolating the density to the entire area of the occurrence (Gilbert 2009, 2013). Between 2013 and 2016, FQPPN performed exhaustive counts of plants for several subpopulations, with a focus on critical habitats (Environment Canada 2012; Lachance 2017). Volunteers from FQPPN continued these surveys in some subpopulations. In 2013, the consulting firm Bureau d'écologie appliquée and Environment Canada conducted detailed inventories of certain subpopulations (Lachance and Gilbert 2013).

### **Abundance**

The total Canadian population of Victorin's Gentian is estimated to be over 30,432 individuals, representing a considerable increase from 1,576 to 5,781 (COSEWIC 2004) or 6,000 (Jolicoeur and Couillard 2007). Victorin's Gentian is currently known from 48 occurrences of which 35 are extant. Six extant occurrences account for nearly 70% of the total global population.

### **Fluctuations and Trends**

There has been a significant increase in the number of known occurrences and individuals since 1986, owing to greater search efforts in potential habitats, and the consequent discovery of a number of new subpopulations. The most reliable data for assessing population trends in the subspecies 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) as well as the inventories conducted by the FQPPN (Lachance 2017). Significant fluctuations in abundance were found in some subpopulations, including Saint-Augustin-de-Desmaures, where the taxon was virtually absent in 2009 (0.1 plant/m<sup>2</sup>) but exhibited a substantial increase by 2010 (8.4 plants/m<sup>2</sup>) (Gilbert 2013). Interannual fluctuations were also observed in surveys of a number of subpopulations between 2013 and 2016 (Lachance 2017). These fluctuations are clearly dependent on local germination and climatic conditions, because no overall trend was identified at the scale of the area of occupancy (Gilbert 2013; Lachance 2017). Because the fluctuations in the number of mature individuals represent changes between life stages (i.e., there is a store of immature individuals (seeds) awaiting germination) this does not meet the COSEWIC definition of extreme fluctuations (IUCN 2019). Some subpopulations have experienced a decline, including Château-Richer, Pointe de Saint-Vallier, and Cap Tourmente (extirpated), owing to intense storm erosion at these sites (Gilbert 2012; Gervais 2014). Several subpopulations were not rediscovered (Table 1).

## **Rescue Effect**

Owing to its endemic nature, Victorin's Gentian has no possibility of rescue.

## **THREATS AND LIMITING FACTORS**

### **Threats**

The threats classification for Victorin's Gentian in Canada is based on the IUCN-CMP (International Union for Conservation of Nature–Conservation Measures Partnership) unified threats classification system (Salafsky *et al.* 2008; Master *et al.* 2012) and follows a threats calculator exercise involving members of COSEWIC's Vascular Plant Species Specialist Subcommittee and other people with expertise on this subspecies (Appendix 1). The following discussion is based on available literature, direct field observations, and an assessment in the federal recovery strategy (Environment Canada 2014). The assigned overall threat impact is High, owing mostly to threats from the categories Invasive Alien Species, Climate Change and Severe Weather, and Human Intrusions and Disturbance (Appendix 1). The numbers associated with the threats correspond to the IUCN threat numbers and the threat calculator and are arranged in order of severity.

Although habitat loss from shoreline in-filling has contributed to the extirpation of the taxon from some localities that does not currently represent the greatest threat to its survival. The primary threats are invasive alien plants (e.g., European Common Reed [*Phragmites australis* ssp. *australis*] and Japanese Knotweed [*Reynoutria japonica*]), recreational activities (including off-road vehicle traffic in the intertidal zone), and the anticipated effects of climate change. The taxon is considered to be highly vulnerable to climate change (Gendreau *et al.* 2016). The effects of pollution from various sources (urban, agricultural or industrial) have not been specifically studied.

The uncertainty associated with threats is significant because in many cases, there are too few data available to determine whether the threat will actually negatively affect subpopulations. Work is currently underway to document the presence or absence of threats to the taxon at the various localities (Dupont-Hébert pers. comm. 2020).

The assessment of the scope, severity and reversibility of threats is presented in table form in Appendix 1.

### 8.1 Invasive Alien Species (Medium Impact)

Taxa currently considered to be invasive non-native species are present in all habitats where Victorin's Gentian is found. European Common Reed and Japanese Knotweed are the main invasive species affecting Victorin's Gentian. The spread of these invasive species is not stopped by tidal activity and they are abundant in the two largest subpopulations. European Common Reed is a particularly aggressive invasive species and the predicted effect of this species in the near future is thought to be significant. Purple Loosestrife (*Lythrum salicaria*) and Jerusalem Artichoke (*Helianthus tuberosus*) are also present and increasing (Lachance pers. obs.). The actual loss of Victorin's Gentian plants due to these species has not been demonstrated or studied.

### 11. Climate Change and Severe Weather (Medium Impact)

It is expected that ice scouring of the shoreline resulting from the daily tidal cycle, spring ice break-up and winter storms can uproot individuals and remove the seedbank. Significant recession of upper marsh habitat has occurred at some sites (Île aux Grues and Château-Richer) as a result of storms (Gervais 2014). The Cap Tourmente subpopulation has been extirpated due to habitat loss from erosion.

Current climate change projections include a potentially greater impact on the freshwater tidal marsh habitat from winter storms and from the negative effects of more extreme temperatures (Bernatchez *et al.* 2008), which could reduce the quantity and quality of the available Victorin's Gentian habitat. Rising sea levels could also result in net habitat loss (Sirois 2015). Brunton *et al.* (2019) suggest that rising sea levels might enable an expansion of the freshwater marsh habitat further upstream or inland, with beneficial effects on distribution. Submersion due to rising sea levels or increased storm activity may also result in increased mortality of individuals.

## 6. Human Intrusions and Disturbance (Medium Impact)

Subpopulations of the taxon are exposed to human trampling and/or off-road vehicles (all-terrain vehicles, quads, sport utility vehicles). These vehicles not only cause plant mortality, but also significantly impact the fragile habitat. Pronounced habitat fragmentation has been observed in the lower portions of freshwater tidal marsh habitat in some localities, which appears to limit the inundation of the upper marsh and to favour plant species other than Victorin's Gentian, including invasive non-native plant species (Lachance, pers. obs.). Off-road vehicle activity is pervasive along the occupied portion of the St. Lawrence, with the impact particularly noticeable in some subpopulations.

### 4.3 Marine Transportation (Unknown Impact)

Shoreline erosion from waves generated by ships and recreational watercraft could adversely affect the taxon. In addition, colonies of Victorin's Gentian on the banks of the St. Lawrence River are potentially vulnerable to oil spills (Coursol 1998).

## **Limiting Factors**

Victorin's Gentian grows in highly dynamic, tidal-dependent habitats (Gilbert 2012), which limits its potential for expansion in Quebec and Canada. In particular, the small tidal range to the west of Batiscan and the increase in salinity towards the eastern part of the middle estuary restricts its distribution (Environment Canada 2012).

## **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 relatively short period, the number of locations corresponds to the number of subpopulations (IUCN 2019). The estimated number of locations of Victorin's Gentian is 35, which is the number of extant subpopulations. The single historical subpopulation is not included as it has not been seen in at least 20 years; the same holds true for the seven extirpated subpopulations and the five subpopulations that were not relocated during the most recent inventories.

## **PROTECTION, STATUS AND RANKS**

### **Legal Protection and Status**

In 2004, Victorin's Gentian was assessed as Threatened by COSEWIC and in 2005, was added to Schedule 1 of the *Species at Risk Act* (Environment Canada 2012). In Quebec, it is protected under the *Act Respecting Threatened or Vulnerable Species* and was designated as Threatened in February 2001. In addition, its habitat is governed by an authorization process pursuant to the Quebec *Environment Quality Act* (CQLR c. Q-2) and its regulations. The taxon's habitat is protected against one of its main threats—off-road vehicles—by the *Regulation Respecting Motor Vehicle Traffic in Certain Fragile*

*Environments* (CQLR c Q-2 r. 9). 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. However, these regulations alone are inadequate to protect the taxon in the absence of adequate enforcement measures.

A federal action plan was developed for the taxon in 2014 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 2014). Many of the planned measures have been completed, particularly conservation strategies; surveys and monitoring; and communication and outreach activities. The implementation schedule for the action plan has ended (2019) and certain measures have not been achieved, such as certain avenues of research and measures related to stewardship on adjacent land. The federal action plan complements the provincial protection plan that was drawn up 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 implemented by organizations (Nature Conservancy of Canada and FQPPN) have been achieved only in the past ten years, although this was expected by 2011 under the plan. As is the case for the federal action plan, certain actions have still not been undertaken, including the education of waterfront residents and the legal protection of many priority targets.

In order to optimally distribute the resources allocated to the protection of species of threatened or vulnerable flora, the Directorate of Ecological Heritage and Parks has developed (Jolicoeur, 2003) an intervention priority grid. According to this grid, the Victorin's Gentian is in the intervention priority class high. This classification can be explained in part by the endemism of the species in Quebec. For the species of this class, the conservation priorities are:

1. Ensure the protection and long-term maintenance of all current occurrences of the species;
2. Introduce or reintroduce the species, if feasible, in physiographic sets where it has disappeared (Jolicoeur and Couillard 2007).

## **Non-Legal Status and Ranks**

Centre de données sur le patrimoine naturel du Québec (CDPNQ) assigned the species a global rank of Imperilled (G2), a national (Canada) rank of Imperilled (N2), and a subnational (Quebec) rank of Imperilled (S2) (NatureServe 2022).

## Habitat Protection and Ownership

Among the 35 extant subpopulations, 25 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) received some protection by virtue of their locality in the Saint-Vallier, L'Islet, and Trois-Saumons migratory bird sanctuaries. The Grosse-Île subpopulation is also afforded some measures of protection because it is found within Grosse Île and the Irish Memorial National Historic Site, which is managed by Parks Canada. In addition, the NCC and the FQPPN own all or part of the land containing some subpopulations, in the form of nature reserves on private land or under other conservation arrangements. The Saint-Augustin-de-Desmaures subpopulation is protected by FQPPN, while the subpopulations on Île aux Grues, and in Saint-Vallier, Deschambault-Grondines, and Saint-Nicolas are afforded protection by NCC. Some occurrences (Cap-Saint-Ignace, Saint-Michel-de-Bellechasse and Saint-Nicolas) are afforded protection as plant habitats by the Quebec Department of Environment and the Fight Against Climate Change, and Platon Point (Sainte-Croix) is an ecological reserve.

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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 the American Ginseng (*Panax quinquefolius*), Victorin's Gentian (*Gentianopsis virgata* ssp. *victorinii*), Victorin's Water-hemlock (*Cicuta maculata* var. *victorinii*), 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 along the fluvial estuary of the St. Lawrence 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 terms 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 and served on the recovery committee, after carrying out a review of the existing knowledge on the species 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 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 private 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, Pinedrops, and Gulf of St. Lawrence Aster for the Quebec Department of Environment.

## **COLLECTIONS EXAMINED**

No previously existing herbarium collections were consulted. Specimens collected during the 2019 inventory are deposited in the Louis-Marie (QFA) Herbarium (Laval University).

## Appendix 1. Threat calculator for Victorin's Gentian.

<b>Species or Ecosystem Scientific Name</b>		<i>Gentianopsis virgata</i> subsp. <i>victorinii</i>		
<b>Element ID</b>		<b>Elcode</b> 3791		
<b>Overall Threat Impact Calculation Help:</b>		<b>Level 1 Threat Impact Counts</b>		
<b>Threat Impact</b>		<b>high range</b>	<b>low range</b>	
A	Very High	0	0	
B	High	0	0	
C	Medium	3	3	
D	Low	1	1	
<b>Calculated Overall Threat Impact:</b>		High	High	B = High
		B	B	
<b>Assigned Overall Threat Impact:</b>		<b>B = High</b>		
<b>Overall Threat Impact Adjustment Reasons:</b>		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=1 year, so threats were examined over a 10 year timeframe.		

Threat	Impact (calculated)	Scope	Severity	Timing	Comments
No known threats					
Unknown/undetermined					
1 Residential & commercial development	Negligible	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 further development near shorelines.
1.2 Commercial & industrial areas					
1.3 Tourism & recreation areas					Campsites represent the only source of potential upcoming recreation development. There is ongoing recreational activity in the areas occupied by this species (marinas), but there are not likely to be many major changes in next 10 years.
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					

Threat		Impact (calculated)		Scope	Severity	Timing	Comments
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						
4.3	Shipping lanes		Unknown	Pervasive (71-100%)	Unknown	High (continuing)	Shipping lanes in St. Lawrence run 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 ATV. Permanent trails were made and 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	D	Low	Small (1-10%)	Extreme or 71-100% pop. decline	High (continuing)	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

Threat		Impact (calculated)		Scope	Severity	Timing	Comments
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)	
8.1	Invasive non-native/alien species/diseases	C	Medium	Pervasive (71-100%)	Moderate or 11-30% pop. decline	High (continuing)	<i>Phragmites australis</i> subsp. <i>australis</i> and <i>Reynoutria japonica</i> (Japanese Knotweed) are the main invasive species affecting this species. These invasive species do not get stopped by tidal activity and are abundant in the two largest subpopulations. <i>Phragmites</i> is a particularly aggressive invasive species and the effect on this species in the near future is thought to be significant. Purple Loosestrife and Jerusalem Artichoke are also present and increasing in the habitat of this species.
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						
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 is 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						
9.6	Excess energy						
10	Geological events						

Threat		Impact (calculated)		Scope	Severity	Timing	Comments
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)	Germination requirements for this species are largely unknown.
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 bumblebees so the effect of climate change on pollinators may be a factor
12	Other options						
12.1	Other threat						

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