

Recovery Strategy for the Victorin's Gentian (*Gentianopsis virgata* ssp. *victorinii*) in Canada

Victorin's Gentian



2012

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PREFACE

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

The Minister of the Environment and the Minister responsible for the Parks Canada Agency are the competent ministers for the recovery of Victorin's Gentian, a species listed as Threatened on Schedule 1 of SARA, and have prepared this recovery strategy as per section 37 of SARA. It has been prepared in cooperation with the Government of Quebec (Ministère du Développement durable, de l'Environnement et des Parcs).

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Environment Canada, Parks Canada or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of Victorin's Gentian and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by Environment Canada, Parks Canada Agency and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

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This recovery strategy was elaborated by Vincent Carignan and Benoît Jobin (Environment Canada, Canadian Wildlife Service, Quebec Region) based on a draft by Frédéric Coursol (botanist, consultant). The document also benefited from comments by members of the St. Lawrence Freshwater Estuary Threatened Flora Recovery Team: Pierre Morisset (Chair, consultant), Frédéric Coursol, Patricia Désilets (Ministère du Développement durable, de l'Environnement et des Parcs), Hélène Gilbert (Bureau d'écologie appliquée), Vincent Carignan, Nicole Lavoie (Fondation québécoise pour la protection du patrimoine naturel), Hubert Pelletier and Patrice Laliberté (Nature Conservancy of Canada, Quebec Region) as well as Sylvain Paradis (Parks Canada Agency). Many collaborators and former members of the recovery team also contributed to the document and were involved in Victorin's Gentian recovery measures: Alain Branchaud, Matthew Wild and Karine Picard (Environment Canada, Canadian Wildlife Service, Quebec Region), Marie-José Ribeyron and Manon Dubé (Environment Canada, Canadian Wildlife Service, National Capital Region), Benoît Roberge (formerly with the Parks Canada Agency), Vanessa Dufresne (formerly with Association des amis du Cap Tourmente), Isabelle Parent (formerly with Ducks Unlimited Canada), Michèle Dupont-Hébert (Fondation québécoise pour la protection du patrimoine naturel), Guy Jolicoeur, Line Couillard, Jacques Labrecque and Vincent Piché (Ministère du Développement durable, de l'Environnement et des Parcs), and Martin Lapointe (Université Laval/FloraQuebeca).

EXECUTIVE SUMMARY

The Victorin's Gentian (*Gentianopsis virgata* ssp. *victorinii*) is an endemic herbaceous annual or biennial plant, 10 to 50 cm tall that grows mainly along the upper shoreline of the freshwater or slightly brackish marshes of the St. Lawrence River estuary area in Quebec. The species was assessed as threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in May 2004 and was listed according to the same status on Schedule 1 of the *Species at Risk Act* in July 2005.

The Victorin's Gentian population is estimated at 1700 to 6000 individuals. To date, 45 occurrences¹ of the species have been documented along the St. Lawrence River between Deschambault and Lotbinière to the west and Saint-Roch-des-Aulnaies and Île aux Oies to the east. Ten of these occurrences have not been seen in the last 25 years or have been extirpated.

Habitat loss, through shoreline infilling and infrastructure development for example, is the greatest threat facing Victorin's Gentian. Anthropogenic trampling, invasive plants, mowing of vegetation and flower picking as well as overabundant animal populations also threaten its occurrences.

The recovery of Victorin's Gentian is considered technically and biologically feasible. The population and distribution objectives are two-fold. The short-term objectives are to maintain and, if possible, increase the population size and area of occupancy of Victorin's Gentian within each of the 14 occurrences identified as priority targets. The long-term objectives are to maintain and, if possible, increase the population size and area of occupancy of Victorin's Gentian throughout its range in Canada. The general strategies and approaches for achieving these objectives are defined in the section on Strategic direction for recovery.

Critical habitat is identified in the present strategy as the suitable habitat in the intertidal zones within the boundaries of each of the 14 priority occurrences. A schedule of studies is proposed to determine to what extent the current critical habitat may be able to meet the long term population and distribution objectives.

One or more action plans for Victorin's Gentian will be developed within five years following the publication of the recovery strategy in the Species at Risk Public Registry.

¹ Area of land and/or water where a species or natural community is, or was, present and has practical conservation value (NatureServe, 2010).

SUMMARY OF RECOVERY FEASIBILITY

Under section 41 (1) of the *Species at Risk Act*, the competent minister must determine whether the recovery of the listed wildlife species is technically and biologically feasible. Based on the criteria established by Environment Canada (2009), recovery of Victorin's Gentian is considered technically and biologically feasible since the answers to the following questions are "yes" or "unknown".

- 1. *Individuals of the wild species that can reproduce are currently present or will be in the near future to maintain the population or increase its abundance.***

Yes, reproductive individuals sufficient to at least maintain the population size are present within all extant occurrences.

- 2. *Enough suitable habitat is available to support the species or could be made available through habitat management or restoration activities.***

Yes, many of the occurrences where the species is currently found provide high-quality habitat. There are also several areas of suitable habitat for Victorin's Gentian along the St. Lawrence River, but it is not known why the species is not present in these locations. The same applies to some historical occurrences that could be restored through recovery measures.

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

Yes, apart from the potential impacts of climate change for which the amplitude is difficult to predict, none of the threats to the species and its habitat are unavoidable or prevent recovery.

- 4. *Recovery techniques for achieving the population and distribution objectives exist or can be developed within a reasonable time.***

Yes, the implementation of measures to eliminate certain threats (e.g., infilling or trampling) would improve habitat quality and maintain the species. The *ex situ* cultivation of Victorin's Gentian at the Montréal Botanical Garden suggests that the species can be effectively introduced *in situ* if necessary, providing suitable habitat is available.

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1. COSEWIC SPECIES ASSESSMENT INFORMATION*

Date of Assessment: May 2004

Common Name (population): Victorin's Gentian

Scientific Name: *Gentianopsis virgata* ssp. *victorinii*

COSEWIC Status: Threatened

Reason for Designation: A geographically highly restricted and short-lived annual or biennial that is endemic to the freshwater or slightly brackish shoreline areas of the St. Lawrence River estuary in Quebec. It is present at 28 extant sites but in very small localized habitats where it is at risk from a wide range of impacts. These include habitat disruption by ATVs, shoreline in-filling, mowing of vegetation, picking of flowers and potentially from oil spills.

Canadian Occurrence: QC

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

* Committee on the Status of Endangered Wildlife in Canada

2. SPECIES STATUS INFORMATION

Victorin's Gentian is endemic to Quebec. The entire population is therefore in Canada (Labrecque and Lavoie, 2002). The species was listed as threatened on Schedule 1 of the *Species at Risk Act* (SARA) (S.C. 2002, c. 29) in July 2005. It is also listed as threatened in Quebec under the *Act respecting threatened or vulnerable species* (R.S.Q. c. E-12.01) since 2001.

Victorin's Gentian was assigned the NatureServe (2010) global conservation rank of G2Q (imperiled – questionable taxonomy that may reduce conservation priority), the Canadian rank of N2 (imperilled) and the subnational rank of S2 (imperilled) in Quebec.

3. SPECIES INFORMATION

3.1 Species Description

Victorin's Gentian is an herbaceous annual or biennial plant 10 to 50 cm tall (COSEWIC, 2004). Its stem is glabrous, cylindrical at the base and hexagonal in the centre. Its fleshy leaves are linear-lanceolate,² asymmetric, acute apex, sessile,

² Lanceolate: lance-shaped (adapted from Marie-Victorin, 1964).

opposite and 1 to 6 cm long. The basal leaves are spatulate and arranged in a rosette. There are usually 1 to 30 flowers per individual. The calyx consists of four sepals cleft slightly beyond the middle, and the corolla (3.5 to 4.5 cm in length) consists of four purplish petals cleft nearly to the middle. The fruit of Victorin's Gentian is a capsule 3 to 3.8 cm in length, which opens at maturity and releases up to 400 brown seeds (Coursol, 2001).

3.2 Populations and Distribution

Victorin's Gentian occupies the freshwater or slightly brackish intertidal areas of the St. Lawrence River estuary in Quebec. It is at the southwestern limit of its distribution near Deschambault and Lotbinière and at the northeastern limit near Saint-Roch-des-Aulnaies and Île aux Oies (Brouillet *et al.*, 1996) (Figure 1).

Between the initial COSEWIC status report in 1986 and the one published in 2004, 25 new occurrences of Victorin's Gentian were documented; this increased the number of occurrences from 18 to 43 (COSEWIC, 2004). Since 2004, seven new occurrences of the species have been discovered, bringing the total to 50 occurrences. According to the latest official estimates, the Victorin's Gentian population in Quebec is between 1700 and 6000 individuals (Jolicoeur and Couillard, 2007).

In 2009, Quebec's conservation data centre, the Centre de données sur le patrimoine naturel du Québec (CDPNQ), had maps and demographic data for 37 of the 50 occurrences and ranked them as follows (see Appendix A for the definition of the quality ranks):

- 8 occurrences with an A quality rank (excellent)
- 2 occurrences with a B quality rank (good)
- 7 occurrences with a C quality rank (fair)
- 13 occurrences with a D quality rank (poor)
- 7 occurrences with an X quality rank (extirpated)

Of the 13 occurrences for which the CDPNQ had no demographic data, 10 had not been observed for at least 25 years (H quality rank) and three were recent occurrences (E quality rank) for which no demographic information was available. The habitat of half of the historical occurrences is still suitable for Victorin's Gentian (COSEWIC, 2004).

In 2011, after the CDPNQ data were updated, certain occurrences were merged because of their proximity (less than 1 km apart), bringing the total to 45 occurrences (Appendix B).

The COSEWIC report (2004) mentions that the population trend is unknown; however, based on the surveys conducted since 2008 (Gilbert 2009, 2010 a, b; Coursol 2011), the population appears to be stable. The increase in the number of occurrences since the species assessment does not necessarily indicate an increase in population size or

distribution. Rather, it reflects the fact that more comprehensive surveys have been conducted since the species has been listed at the federal and provincial levels.

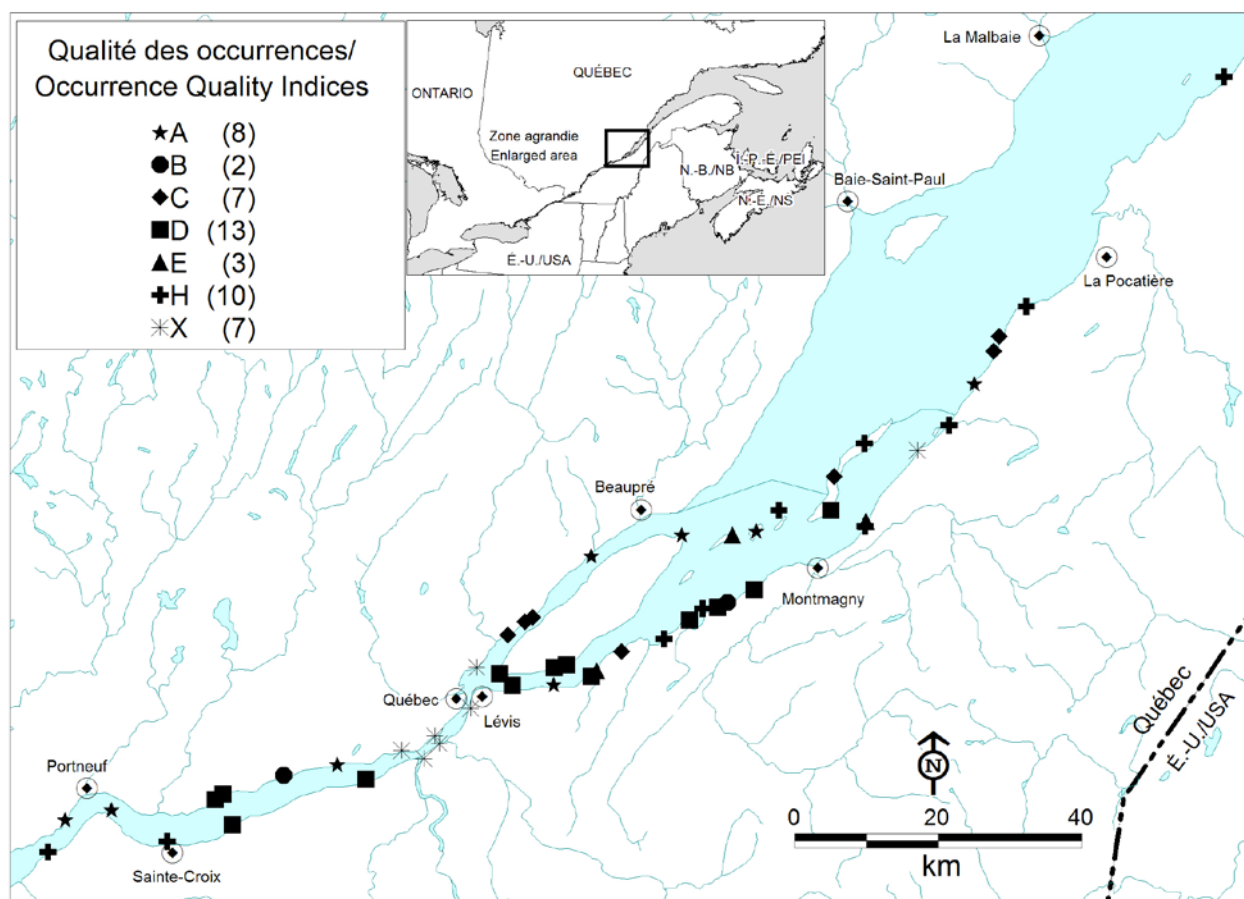


Figure 1. Distribution and quality ranks for Victorin's Gentian occurrences in Canada (CDPNQ, 2009).

3.3 Requirements of Victorin's Gentian

The very specific ecological requirements of Victorin's Gentian restrict its growth to the freshwater or slightly brackish intertidal zone (Rousseau, 1932, 1974; Fernald, 1950; Robert, 1993; Marie-Victorin, 1995; Brouillet et al., 1996). Its distribution in Quebec is limited by the low tidal range upstream of Deschambault and the higher water salinity downstream around Saint-Roch-des-Aulnaies and Île-aux-Oies. The species is located at the interface of the upper and mid-littoral zone, i.e., the portion that is covered by water for two to three hours a day during equinoctial high tides, but seldom reached by low tides (COSEWIC, 2004). Victorin's Gentian generally grows in beds of tall dense Prairie Cord Grass (*Spartina pectinata*) and sometimes on more or less densely vegetated raised outcrops (Robert, 1993). It prefers thick surface deposits (> 15 cm) of fine or mixed texture (seldom coarse) with few if any stones (rarely very stony).

Victorin's Gentian reproduces by seed production (COSEWIC, 2004). Therefore, its survival at a given site depends exclusively on the success of sexual reproduction

(Jolicoeur and Couillard, 2007). It flowers from late July to mid-September (Pierre Morisset, personal communication). Fruit production begins in August and continues until September (Fernald, 1950; Legault, 1986). Generally, populations downstream from Quebec City begin flowering and producing fruits earlier than those upstream (Rousseau, 1930). The ability of seeds to float on water probably helps the subspecies to disperse locally. It is plausible that seeds are also dispersed over long distances by birds that have a mixture of mud and seed stuck to their feet (Brouillet et al., 1996). The seeds may also be dispersed by bird feces. Finally, rafts of vegetation lifted by ice also travel long distances and disperse seeds.

4. THREATS

4.1 Threat Assessment

Table 1. Threat Assessment Table

Threat	Level of Concern ¹	Extent	Occurrence	Frequency	Severity ²	Causal Certainty ³
Habitat loss or degradation						
Shorline infilling and infrastructure development	High	Generalized	Historical/ Anticipated ⁴	Single	High	High
Anthropogenic trampling	High	Localized	Current/ Anticipated	Continuous	High	High
Erosion	Low	Generalized	Current	Recurrent	Moderate	High
Ice scouring	Low	Generalized	Current	Seasonal	Low	Low
Dumping of debris on the shore	Low	Localized	Current	Seasonal	Low	Low
Alien, invasive or introduced species or genome						
Invasive plants	High/ Medium	Localized	Current	Continuous	High/ Low	Low
Changes in ecological dynamics or natural processes						
Mowing and flower picking	Medium	Localized	Current	Continuous	High	High
Overabundant animal populations	Medium	Localized	Current	Seasonal	Medium	Medium

Climate and natural disasters						
Changing water salinity brought on by climate change	Low	Localized	Anticipated	Continuous	High/Unknown	Medium/Low
Pollution						
Pollution	Low	Generalized	Current	Unknown	Low/Unknown	Low
Oil Spills	Low	Localized	Anticipated	Single	Unknown	Low

¹ *Level of concern: indicates that threat management is a concern (high, medium or low) for recovery of the species, taking into account the population and distribution objectives. This criterion takes into account the assessment of all the information contained in the table.*

² *Severity: indicates the effect on the entire population (High: very significant effect on the entire population, moderate, low or unknown).*

³ *Causal certainty: indicates the scope of the information available on the threat (High: the available evidence establishes a strong link between the threat and pressure on population viability; Medium: there is a correlation between the threat and population viability, e.g., expert opinion; Low: the threat is assumed or likely).*

⁴ *Each threat assessment criterion is evaluated in terms of each occurrence and for the entire range. Two qualifiers in a box indicate that the identified threat does not have the same impact for each qualifier (Single occurrence / Entire range).*

4.2 Description of Threats

The threats are presented in order of decreasing level of concern.

Shoreline infilling and infrastructure development

Shoreline infilling and the development of infrastructures such as houses, roads, piers, railway lines or marinas has caused significant loss of Victorin's Gentian suitable habitat in the Quebec City region and has resulted in local extinctions (COSEWIC, 2004). For example, railway construction at Cap-Rouge has destroyed virtually all the natural shoreline between Saint-Augustin-de-Desmaures and Cap-Rouge, which has prevented Victorin's Gentian from recolonizing the area. Shoreline infilling is prohibited since 1987 under the *Environment Quality Act* of Quebec (R.S.Q., c. Q-2, s. 2.1). However, the number of projects requiring shoreline access continues to grow. Expansion of harbour facilities and marina construction projects like those in Saint-Jean-Port-Joli destroy the upper littoral zone where Victorin's Gentian is found. Restoration of retaining walls and shoreline excavation also cause habitat loss and degradation. This threat seems to be occurring throughout the species' range, except for occurrences in the Isle-aux-Grues archipelago.

Anthropogenic trampling

Victorin's Gentian occurrences are very vulnerable to trampling (e.g., hikers, water sports enthusiasts, kiteboarders) and all-terrain vehicle (ATV) traffic in the intertidal zone (COSEWIC, 2004). These activities not only cause individual plants to die, they alter the species' habitat by compacting the soil and creating openings that increase erosion of the substrate by waves. The population of Victorin's Gentian in Lotbinière was probably extirpated as a result of ATV traffic in the upper littoral zone, where ATVs disturb an area ranging from two to ten metres in width.

Invasive plants

Invasive plants such as the Common Reed (*Phragmites australis*) pose significant threats (Desilets *et al.*, 2009) because they can replace certain species in the upper littoral zone when they become established. There are also few known effective strategies for fighting these species or controlling their spread (Gilbert, 2009, 2010 a, b). Very dense Common Reed populations have now established themselves in the upper littoral zone in the Cap-Saint-Ignace occurrence and also cover part of the occurrence in Saint-Jean-Port-Joli. They could spread very quickly. There are dispersal foci both up- and downstream from several occurrences that were recently visited (Gilbert 2009, 2010 a, b). Japanese Knotweed (*Polygonum cuspidatum*) has become established in some occurrences (Saint-Augustin-de-Desmaures). Although it cannot survive in the same micro-habitat as Victorin's Gentian because it is unable to resist the tidal cycles, it poses a threat to the integrity of the habitat. Finally, habitat disturbance caused by various human activities (hunting, ATV traffic, kayaking, etc.) facilitates the establishment of invasive species. This threat is not identified in the COSEWIC report (2004).

Mowing and flower picking

Landowners along the St. Lawrence River estuary have been observed mowing the shoreline in some locations, which prevents flower stalks from developing (COSEWIC, 2004). Picking flowers to make bouquets is equally harmful, and this behaviour was observed at occurrences in Deschambault, Saint-Vallier and Saint-Jean-Port-Joli. Mowing and flower picking deprive Victorin's Gentian of its sole means of reproduction and could contribute to the extirpation of some occurrences. These types of activities may be more common in occurrences where there are homes and cottages along the shore and in occurrences frequented by hunters and residents (Saint-Augustin-de-Desmaures, Sainte-Pétronille, Beaumont and Anse Ross in Saint-Nicolas).

Overabundant animal populations

The increase in some animal populations caused by human activity may represent a significant threat to Victorin's Gentian. For example, the introduction of White-tailed Deer (*Odocoileus virginianus*) in the Isle-aux-Grues archipelago, followed by its spread onto Grosse Île, resulted in an increase in grazing and trampling, which altered

Victorin's Gentian habitat. Signs of White-tailed Deer grazing on Victorin's Gentian were observed on Grosse Île in 2008 (26% of the plants were grazed) and 2009 (43% of the plants were grazed) (Gilbert, 2009, 2010 a, b).³ The overabundance of Greater Snow Geese (*Chen caerulescens*), which is associated with increased grain crop production in their staging and wintering areas, may also alter the integrity of coastal marshes and Victorin's Gentian habitat (Belanger and Lefebvre, 2006; Gilbert, 2010 a). This threat is not identified in COSEWIC (2004).

Changing water salinity brought on by climate change

Climate change could affect the dynamics of the St. Lawrence River in several ways. First, reduced flow caused by increased retention of water in the Great Lakes or a decrease in rainfall in the watershed may change the level of salinity in the estuary (Ouranos, 2004). Victorin's Gentian tolerates low levels of salinity, and increased salinity upstream would likely lead to the extirpation of the occurrences located further downstream, especially those in Saint-Roch-des-Aulnaies and on the islands of the Isle-aux-Grues archipelago. Alternatively, rising sea levels caused by melting glaciers could cause the river to rise and the water to become brackish further upstream, which could produce the same potential results (Gilbert, 2010 a).

Ice scouring

Ice scouring (abrasion) of the rocks and shoreline during daily tides and the spring ice break-up could cause the tearing of vegetation rafts containing seeds of Victorin's Gentian (COSEWIC, 2004). On the other hand, these actions may also be beneficial in that they provide areas in which seeds can grow. However, it is not known whether these natural events have become more frequent, widespread and severe than they were before the St. Lawrence River shoreline was developed and climate change began to affect the river. Pierre Morisset (personal communication) mentioned that part of the population in the Saint-Jean-Port-Joli occurrence he had been observing over the last few years was literally removed by the movement of loose ice in winter, which resulted in a loss of individuals. Previously, a stable patch of ice covered the intertidal zone throughout the winter, limiting ice scour to a shorter period in the spring.

Pollution

Even though water quality is improving in the St. Lawrence River, the river is still being polluted by numerous discharges such as agricultural and residential phosphates (COSEWIC, 2004). The presence of fertilizers in the St. Lawrence River causes blooms of algae and other aquatic plant species (*Vallisneria americana*, *Potamogeton* sp., etc.). These plants can then cover the occurrences of Victorin's Gentian and prevent pollination by isolating the flowers from insects. Subsequent tides stir up the water and uncover the plants, but the range of the tides varies.

³ Frédéric Coursol (personal communication) indicated that tidal action can sometimes tear off a piece of stem, which may look like grazing activity. These percentages were therefore probably overestimated.

Erosion

Changes in St. Lawrence River water levels can delay freeze-up, which enables fall storms to cause extensive damage through accelerated erosion of shorelines and structures that protect infills (Ouranos, 2004). The increased erosion leads to net losses of habitat, a phenomenon which is exacerbated by the wave action from boats travelling on the St. Lawrence River (Gilbert, 2010 a). Conservation of the riparian strip is therefore of paramount importance. Experts predict that water levels in the freshwater estuary will rise by 10 cm and that winter ice cover will gradually disappear, which should accelerate the rate of erosion of high-marsh areas. The species that occur in this habitat (including Victorin's Gentian) will be able to move to higher elevations only if there are natural areas left to support them (Line Couillard, personal communication). This threat is not identified in the COSEWIC report (2004).

Oil spills

An oil spill could destroy occurrences of Victorin's Gentian along the freshwater estuary of the St. Lawrence River by soiling the plants with toxic products and altering the abiotic conditions of the occurrences (Coursol, 1998; COSEWIC, 2004). The impact associated with cleaning up the shoreline after this type of spill would also be considerable. The narrowness of the St. Lawrence River at Quebec City increases this risk.

Disposal of debris on the shore

The presence of debris discarded by shoreline residents (e.g. dense mats of wood chips, plant debris from shoreline mowing, grass clippings and autumn leaves) has been observed in some occurrences. If individuals remain covered for too long, flowering and the survival of part of the population could be compromised in these occurrences. However, given the species' position in the upper littoral, it is naturally subjected to the deposition of plant debris (e.g., algae), which occurs twice a day with the tides. This threat is not identified in the COSEWIC report (2004).

5. POPULATION AND DISTRIBUTION OBJECTIVES

The population and distribution objectives are two-fold. The short-term objectives are to maintain and, if possible, increase the population size and area of occupancy of Victorin's Gentian within each of the 14 occurrences identified as priority targets. The long-term objectives are to maintain and, if possible, increase the population size and area of occupancy of Victorin's Gentian throughout its range in Canada.

The priority targets were identified in the "Plan de conservation du gentianopsis élané variété de Victorin (*Gentianopsis procera* subsp. *macounii* var. *victorinii*)" developed by the Government of Quebec (Jolicoeur and Couillard, 2007) [available in French only]. The plan identifies 18 occurrences as priority targets, 17 of which are considered viable because of the number of individuals they contain and the quality of the habitat they

occupy (quality ranks A, B and C; see Appendix). An occurrence with a quality rank of D (Anse Ross) was also selected because of its location in an area designated as plant habitat under the Act respecting threatened and vulnerable species. In the present recovery strategy, the Anse Ross occurrence of Victorin's Gentian was not retained since recent fieldwork⁴ as shown that the corresponding habitat is not very suitable for the species and that a very small number of individuals are present there. Of the 17 priority occurrences that remain, three were merged with adjacent occurrences in 2011, bringing to 14 the total number of priority occurrences retained (Appendix B). These occurrences alone account for nearly 80% of the Victorin's Gentian population (Jolicoeur and Couillard, 2007).

6. GENERAL STRATEGIES AND APPROACHES FOR ACHIEVING THE OBJECTIVES

6.1 Measures Already Completed or Underway

Conservation of the species, its suitable habitat and the adjacent riparian zone

Provincially, the Government of Quebec published the conservation plan for this species (Jolicoeur and Couillard, 2007) [available in French only], which lists the priority occurrences, conservation issues and various response strategies from 2007 to 2011. The plan is currently in review.

A number of private properties on which priority occurrences are located were acquired by various non-governmental agencies for conservation purposes. In addition, four of the priority occurrences are found on land managed for conservation, including three plant habitats and one ecological reserve. Several of the 45 occurrences also harbour other threatened or vulnerable plant species or species likely to be designated as such, which increases their conservation value.

Inventories and monitoring

As part of the initiatives of the St. Lawrence Freshwater Estuary Threatened Flora Recovery Team, a monitoring methodology was developed in 2008 to clarify certain demographic parameters of several occurrences of Victorin's Gentian, Victorin's Water-hemlock (*Cicuta maculata* var. *victorinii*) and Parker's Pipewort (*Eriocaulon parkeri*). Monitoring, which took place from 2008 to 2011, revealed significant variations in annual abundance at several occurrence sites (Gilbert, 2009, 2010 a,b, 2011; Coursol, 2011).

⁴ From 2008 to 2011, the St. Lawrence Freshwater Estuary Threatened Flora Recovery Team carried out monitoring by counting the number of individuals within 1-m x 1-m plots in eight occurrences, including the Anse Ross occurrence (Gilbert 2009, 2010 a, b, 2011).

Research

Seeds harvested in 2007 were used to grow Victorin's Gentian successfully at the Montréal Botanical Garden in 2008. Also, a literature review of the genetic and biological aspects of estuary species was conducted.

Communication and outreach

Various organizations developed a draft awareness plan in 2007 (Patricia Desilets, personal communication). Conservation organizations undertook various communication activities to raise public awareness of the precarious status of Victorin's Gentian and other species endemic to the St. Lawrence River. The occurrence located on the site of the proposed Rabaska liquified natural gas terminal was studied to mitigate the environmental impacts associated with this project. Finally, at the municipal level, Victorin's Gentian became the floral emblem of Saint-Michel-de-Bellechasse in 2007, which helped make people aware that the species grows in the area.

6.2 Strategic Direction for Recovery

Table 2. Recovery Planning Table

Threat or Limiting Factor	General Recovery Strategy	Priority	General Description of Research and Management Approaches
Shoreline infilling and infrastructure development; anthropogenic trampling; Invasive plants; Mowing and flower picking	Conservation of the species, it's suitable habitat as well as the adjacent riparian zone	High	<ul style="list-style-type: none"> Apply legal and stewardship measures within the occurrences as well as in the adjacent shoreline in order to reduce the effects of the main threats Maintain or implement management approaches aiming at increasing the abundance of the species and the area of occupancy of it's suitable habitat
Knowledge gaps	Surveys and monitoring	High	<ul style="list-style-type: none"> Establish a monitoring program for this species with highly fluctuating local populations
Knowledge gaps	Research	Medium	<ul style="list-style-type: none"> Clarify certain demographic parameters of Victorin's Gentian (vitality, viability of occurrences and threat responses).
All	Communication and Outreach	High	<ul style="list-style-type: none"> Develop and implement a communications strategy with partner organizations, special interest groups, landowners and the general public.

6.3 Comments on the Recovery Planning Table

Conservation of the species, its suitable habitat as well as the adjacent riparian zone

To maintain the population size and area of occupancy of priority occurrences of Victorin's Gentian, we need to specify the spatial boundaries of these occurrences. A clearer indication of the boundaries of the Government of Quebec's hydric domain (upper shoreline limit) should facilitate the conservation and management of priority occurrences found within this domain, since the Government of Quebec has control over these areas.⁵ Because many at-risk plant species share Victorin's Gentian habitat, a multi-species shoreline conservation approach will be promoted by supporting the work of the St. Lawrence Freshwater Estuary Threatened Flora Recovery Team. In addition, occurrences throughout the entire range will have to be monitored, and the conservation and management plans, as well as other current administrative documents targeting land management, will have to be amended to take into account the needs of Victorin's Gentian.

Surveys and monitoring

Recent field surveys have confirmed the highly dynamic nature of Victorin's Gentian populations. The species may be very abundant and occupy a large area one year and virtually disappear the following year. Given that the priority occurrences were selected based on data in the CDPNQ in 2009 at a time when the species' abundance was very low at several sites, it is essential to ensure that certain occurrences that did not meet the selection criterion used for priority occurrences (quality index A, B or C) were not simply excluded due to the small number of individuals present at that particular time. Interannual fluctuations in abundance, combined with the high dispersal of seeds of Victorin's Gentian, make it important to conduct monitoring in non-priority occurrences in order to update the data periodically. There is also a need for monitoring at sites containing suitable habitat that the species may have colonized in the interim. A protocol should be developed to enable monitoring teams to quickly estimate the number of individuals present in each occurrence location.

Research

Research work should also be carried out to more accurately assess certain demographic aspects of occurrences such as viability, determination of reproduction and mortality rates, and the vitality of the species (annual or biennial). This work, in conjunction with demographic information to be obtained during surveys and monitoring,

⁵ Section 919 of the *Quebec Civil Code* specifies that the beds of navigable and floatable lakes and watercourses are the property of the State to the high-water line (except in cases where there may have been bed or shoreline concessions based on historical privileges relating to the seigneurial system). The same applies to the beds of non-navigable and non-floatable lakes and watercourses bordering lands alienated by the State after February 9, 1918. Before that date, ownership of riparian land carried with it, upon alienation, ownership of the beds of non-navigable and non-floatable watercourses. In all cases, the law or act of concession may provide otherwise.

is essential for identifying the main causes of variations that can affect an occurrence over time and assessing whether recovery efforts are successful. Work is also needed to understand the impact of various threats (plant and algal deposits, predation and invasive plant species) on occurrences.

Communication and outreach

It is also essential to raise awareness among various users of the St. Lawrence River (fishers, kayakers, boaters) and shorelines (hunters, shoreline property owners) who are responsible for many of the threats to the occurrences of Victorin's Gentian. This requires informing the public and shoreline communities regarding the fragility of this environment and the importance of this unique ecosystem which is home to many plant species at risk.

7. CRITICAL HABITAT

7.1 Identification of the Species' Critical Habitat

Victorin's Gentian colonizes the mid-littoral zone and extends to the adjacent shore, including the upper littoral zone. The biophysical attributes of suitable habitat include:

- thick surface deposits (more than 15 cm) of fine or mixed texture (seldom coarse) with few if any stones (rarely very stony);
- located in the freshwater or slightly brackish intertidal areas of the estuary, which are covered by water for two to three hours a day during equinoctial high tides but seldom reached by low tides;
- presence of beds of tall, dense Prairie Cord Grass (*Spartina pectinata*) or presence of more or less densely vegetated raised outcrops.

Critical habitat corresponds to all suitable habitat with each of the 14 priority occurrences; it consists of all the suitable habitat within the boundaries of the occurrence delineated on one side by the shore (high-water mark) and on the other side by the upper limit of the lower littoral zone. Along the shoreline, the boundaries are defined by the outer edges of zones that are currently colonized (2011) or that were colonized in the past; therefore all the observations recorded in the CDPNQ are included. Within the boundaries of each occurrence, any anthropogenic structure (e.g. wharves, utility poles) and any zone (e.g. boulder) that do not possess the attributes of suitable habitat for the Victorin's Gentian are not identified as critical habitat.

The critical habitat boundaries were mapped based on a characterization using photo-interpretation of recent stereoscopic images of orthophotographs (scale 1:15 000 and 1:30 000; Desilets, 2010). This was done by using the boundaries of the occurrences identified as priority targets in the provincial conservation plan (Jolicoeur and Couillard 2007). These boundaries were subsequently modified based on the fieldwork done from 2008 to 2011 by the St. Lawrence Freshwater Estuary Threatened

Flora Recovery Team (Gilbert, 2009, 2010 a, b, 2011; Coursol, 2011) and the updating of data in the CDPNQ in 2011. Appendix C provides the geographic coordinates of the boundaries of each of the occurrences along the shoreline.

This recovery strategy identifies critical habitat for the Victorin's Gentian; however, it is unknown to what extent the current critical habitat may be able to meet the long term population and distribution objectives. This is because it may be difficult to increase the population and area of occupancy at the 14 priority occurrences to maintain the overall population and area of occupancy. The schedule of studies (section 7.2) outlines the activities required to fill this knowledge gap and, as such, identify any additional critical habitat required to meet the long term population and distribution objectives.

7.2 Schedule of studies

Table 3. Schedule of studies.

Description of activity	Outcome/rationale	Timeline
Conduct studies on occurrence viability and population dynamics	Determine to what extent the 14 priority occurrences meet the long term population and distribution objectives	2012-2017
Identify additional critical habitat if required	Identification of additional occurrences as critical habitat to meet the long term population and distribution objectives if required	2012-2017

7.3 Activities Likely to Result in the Destruction of Critical Habitat

Critical habitat destruction is determined on a case-by-case basis. Destruction occurs if part of the critical habitat is degraded, either permanently or temporarily, to the point where it can no longer meet the species' requirements. Destruction may be the result of one or more activities at a given point in time or the cumulative effects of one or more activities over a period of time.

Victorin's Gentian critical habitat can be destroyed through three main mechanisms resulting from human activity:

Habitat conversion or degradation. Road construction or construction of any other type of infrastructure as well as dredging and infilling operations result in the direct loss or degradation of suitable habitat.

Modification of the chemical conditions of the soil or water. Fertilizer and chemical inputs from the river, inland watercourses or upland areas along the upper littoral zone may foster the growth of plants that compete with Victorin's Gentian, causing changes in the composition of plant communities.

Soil compaction and vegetation loss. Trampling and ATV traffic lead to the loss of plant cover and to soil compaction, which can exacerbate the effects of erosion or cause changes in plant communities.

These examples do not represent a comprehensive list of activities likely to destroy critical habitat of Victorin's Gentian.

8. MEASURING PROGRESS

The performance indicators presented below provide a way to define and measure progress in achieving the population and distribution objectives. Successful implementation of this recovery strategy will be assessed every five years based on the following performance indicators:

- In the short term, the population size and area of occupancy of Victorin's Gentian are maintained and, if possible, increased in each of the 14 occurrences identified as priority targets.
- In the long term, the population size and area of occupancy of Victorin's Gentian are maintained and, if possible, increased throughout its range in Canada;

9. ACTION PLAN STATEMENT

An action plan for Victorin's Gentian will be developed within five years after the recovery strategy is posted on the Species at Risk Public Registry.

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APPENDIX A: DESCRIPTION OF THE QUALITY RANKS FOR VICTORIN'S GENTIAN OCCURENCES (CDPNQ, 2011)

Quality ranks	Description (2009)	Description (2011)
A (Excellent)	Population of over 200 individuals in a habitat that is only slightly disturbed or not at all disturbed by human activity.	Size: population of over 2000 stems. Condition: habitat occupying an area of > 1000 m ² , with little or no disturbance from human activities. Surrounding context: buffer area surrounds the occurrence completely, structure, integrity and high quality of surrounding landscape.
B (Good)	Population of 101 to 200 individuals in a habitat that is only slightly disturbed or not at all disturbed by human activity, or a population of 200 individuals affected by infilling operations or pedestrian or vehicular traffic.	Size: population of 401 to 2000 stems. Condition: habitat occupying an area of 200 to 1000 m ² , with little or no disturbance from human activities. Surrounding context: buffer area surrounds the occurrence completely, structure, integrity and high quality of surrounding landscape OR a larger population in a habitat moderately disturbed by human activities but likely to persist over the long term.
C (Fair)	Population of 50 to 100 individuals in a habitat that is only slightly disturbed or not at all disturbed by human activity, or a population of 101 to 200 individuals affected by infilling operations or pedestrian or vehicular traffic.	Size: population of 51 to 400 stems. Condition: habitat occupying an area of 10 to 200 m ² , with little or no disturbance from human activities. Surrounding context: buffer area surrounds the occurrence completely, structure, integrity and high quality of surrounding landscape OR population of 401 to 2000 stems in a habitat moderately disturbed by human activities but likely to persist in the medium or long term.
D (Poor)	Population of fewer than 50 individuals in a habitat that is only slightly disturbed or not at all disturbed by human activity, or a population of 50 to 100 individuals affected by infilling operations, human trampling or vehicular traffic.	Population of less than 50 individuals in a habitat with little or no disturbance from human activities OR population of 50–100 individuals disturbed by infilling or by human or vehicle traffic.
E (Recent)	Recent population, observation dates back more than 25 years, but we have no information on the population's demographics.	Recent population, observation dates back less than 25 years, but we have no information on the population's demographics.
H (Historical)	Historical population, observation dates back more than 25 years.	Historical population, observation dates back more than 25 years.
X (Extirpated)	Extirpated population	Extirpated population

APPENDIX B: LIST OF OCCURRENCES OF VICTORIN'S GENTIAN

Table B-1. Quality ranks for Victorin's Gentian occurrences.

Occurrence ¹	Last Observation ²	Quality rank 2011 ³	Quality rank 2009
Saint-Augustin-de-Desmaures/Marais Provancher	2010	A	A/B ⁴
Château-Richer	2010	A	A
Saint-Michel-de-Bellechasse	2010	A	C
Lévis (Beaumont–Anse de Vincennes)	2010	B	A
Sainte-Croix (Pointe Platon)	2010	B	A
Saint-Antoine-de-l'Île-aux-Grues (Île aux Grues)	2010	B	C
Saint-Jean-Port-Joli (Pointe à Menin)/ Saint-Roch-des-Aulnaies	2010	B	C/C
Saint-Jean-Port-Joli (wharf)	2010	C	A
Berthier-sur-Mer (Anse de Berthier)	2010	C	B
Deschambault–Grondines	2010	C	A
L'Ange-Gardien (L'Ange-Gardien 1 /L'Ange-Gardien 2)	2010	C	C/C
Saint-Antoine-de-l'Île-aux-Grues (Grosse Île)	2010	C	A
Saint-François-de-l'Île-d'Orléans (Pointe d'Argentenay)	2010	D	A
Saint-Jean-de-Boischatel	1995	D	C
Saint-Pétronille	2007	D	D
Lévis (Baie de Beaumont – Entrée 27)	2007	D	D
Montmagny (Hwy 561)	2006	D	D
Montmagny (Trou de Berthier)/ Cap Saint-Ignace	2006	D	D/E
Saint-Vallier (Pointe de Saint-Vallier)	2005	D	D
Neuville (Pointe à Alain)	1999	D	D
Saint-Laurent-de-l'Île-d'Orléans	1997	D	D
Île-aux-Grues (west of wharf)	1996	D	D
Lévis (Pointe de la Martinière)	1996	D	D
Saint-Nicolas (Anse Ross)	1996	D	D
Saint-Antoine-de-Tilly (mouth of Ruisseau Bourret)	1995	D	D
Saint-Laurent-de-l'Île-d'Orléans (Trou Saint-Patrice)	1995	D	D
Lévis (Baie de Beaumont – Anse du Moulin)	2006	E	E
Saint-François-de-l'Île-d'Orléans (Île au Ruau)	2006	E	E
Anse de Saint-Vallier	1993	H	H/H
Lotbinière	1986	H	H
Saint-Jean-Port-Joli (mouth of Rivière Trois-Saumons)	1954	H	H
Saint-Germain	1952	H	H
Îles-aux-Oies (Montmagny)	1944	H	H
Sainte-Croix	1943	H	H
Saint-Roch-des-Aulnaies	1939	H	H
Île de Bellechasse	1925	H	H
Île-aux-Grues (Île à Deux Têtes)	1925	H	H
Ville de Québec (Sillery)	1971	X	X
Ville de Québec (Cap-Rouge)	1955	X	X

Occurrence¹	Last Observation²	Quality rank 2011³	Quality rank 2009
Pont-Garneau (mouth of the Chaudière River)	1954	X	X
L'Îlet-sur-Mer (Rocher Panet)	1947	X	X
Ville de Québec (Beauport)	1943	X	X
Lévis (Saint-Romuald)	1936	X	X
Ville de Lévis	1935	X	X

¹ Occurrences in bold represent the priority targets.

² The date indicates the last visit during which the number of individuals was assessed for the entire occurrence. Although some occurrences have been monitored since 2008, the methodology employed (counts in 10-m x 10-m plots) cannot be used to update the data on the number of individuals at the occurrences visited.

³ The quality ranks in 2011 differ in some cases from those reported for 2009, the year that was used in selecting the priority occurrences. These differences are due to two factors: 1) the definition of the quality ranks was revised in 2011; the number of individuals required to attain higher ranks is now higher (e.g., for index A, the presence of more than 2000 individuals is required in 2011, whereas more than 200 individuals were required in 2009); 2) the quality ranks for Victorin's Gentian occurrences vary greatly from year to year for a given site.

⁴ Shows the quality rank for each occurrence before they were merged.

APPENDIX C: CRITICAL HABITAT FOR VICTORIN'S GENTIAN

Table C-1: Geographic coordinates of critical habitat for Victorin's Gentian along the shoreline.

Name of occurrence	Geographic coordinates of the boundaries of the occurrence (latitude/longitude)	Land tenure
Deschambault–Grondines	46.6519541522/-71.92496338180 46.65488430520/-71.92217541340	Non federal
Sainte-Croix (Pointe Platon)	46.82841720170/-71.08209686580 46.83483903030/-71.05152995910	Non federal (provincial plant habitat)
Saint-Augustin-de-Desmaures/Provancher Marsh	46.71296053100/-71.53512054550 46.73359615170/-71.42809996540	Non federal (provincial natural reserve on private land)
Boischatel	46.89684285300/-71.12377695170 46.89801064570/-71.12127876930	Non federal
L'Ange-Gardien	sector 1 46.91077063630/-71.09405142090 46.91419092850/-71.08821313490 sector 2 46.91436540890/ -71.08695576980 46.91739377570/-71.08041620560 sector 3 46.91735715000/ -71.07859326950 46.92290702370/-71.06824450170	Non federal
Lévis (Beaumont – Anse de Vincennes) (patch 1)	sector 1 46.82841720170/-71.08209686580 46.83007873850/-71.07194294650 sector 2 46.83234832850/-71.04022993260 46.83321774730/-71.03738136260 sector 3 46.83020657970/-71.07156416790 46.83269026820/-71.06417097670 sector 4 46.83266484680/-71.05615853690 46.83296706630/-71.05610522420 sector 5 46.83440824280/-71.03267398580 46.83466748530/-71.03234261460 sector 6 46.83386836110/-71.04758733370 46.83483903030/-71.05152995910	Non federal
Château-Richer	46.98646171820/-70.98615891100 47.00704342770/-70.95987811890	Non federal (provincial natural reserve on private land)
Saint-Michel-de-Bellechasse	46.87477437600/-70.92269668980 46.87784483400/-70.91335673280	Non federal

Saint-François-de-l'Île-d'Orléans (Pointe Argentenay)	47.02237481550/ -70.80812669730 47.02520247270/-70.80547644530	Non federal
Berthier-sur-Mer (Anse de Berthier)	46.93273929900/-70.74080008930 46.94133366990/-70.72170038890	Non federal
Grosse Île	sector 1 47.01787728360/-70.68019718940 47.01851338720/-70.67956715020 sector 2 47.02019823500/-70.67210879190 47.02056100000/-70.67367200000 sector 3 47.02176900000/-70.67985000000 47.02316659140/-70.68335428450 sector 4 47.02663609590/-70.68156845210 47.02674870570/-70.68156772410 sector 5 47.02867368010/-70.66328566250 47.02995490780/-70.66290853260 sector 6 47.02820984660:-70.67982220960 47.03000653180/-70.67845524750 sector 7 47.03276475500/-70.65854555680 47.03897200000/-70.65851400000	Federal (national historic site)
Île aux Grues	47.09650522170/-70.53221291760 47.10351631790/-70.52242956110	Non federal
Saint-Jean-Port-Joli (wharf)	47.21277989080/-70.27335896680 47.22089463900/-70.26498992930	Non federal
Saint-Jean-Port-Joli (Pointe à Menin)/Saint-Roch-des-Aulnaies	sector 1 47.25164295140/-70.23374549250 47.25706009250/-70.23633584380 sector 2 47.27027677150/-70.22920247380 47.27169304830/-70.22978946080 sector 3 47.27520999680/-70.22673423700 47.27581544980:-70.22627228740	Non federal

* The eastern and western boundaries correspond to the boundaries of critical habitat located along the shoreline. Between these two boundaries, critical habitat stretches between the shoreline and the lower littoral (low-water line).

APPENDIX D: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

A Strategic Environmental Assessment (SEA) is conducted on all SARA recovery planning documents in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. The purpose of an SEA is to incorporate environmental considerations into the development of public policy, plan and program proposals to support environmentally sound decision-making.

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

The potential for the strategy to inadvertently lead to adverse effects on the environment and other species was considered. Recommended activities are limited to non-intrusive activities, such as monitoring occurrences and increasing public and stakeholder awareness. We concluded that this strategy will not entail any significant adverse effects.

Victorin's Gentian is dependent on the upper and middle littoral zones. Protection of Victorin's Gentian critical habitat will have beneficial effects on many wildlife species that occupy this habitat, including nesting waterfowl and other plant species endemic to the freshwater estuary of the St. Lawrence River that live in association with Victorin's Gentian, many of which are in precarious situations, such as Provancher's Fleabane (*Erigeron philadelphicus* ssp. *provancheri*) (a species of special concern listed in Schedule 3 of SARA and listed as a threatened species under the ARTVS), Victorin's Water-hemlock (a species of special concern listed in Schedule 1 of SARA and listed as a threatened species under the ARTVS) and Parker's Pipewort (listed as a threatened species under the ARTVS). In addition, about ten other species likely to be designated as threatened or vulnerable in Quebec live in association with Victorin's Gentian. Activities for the protection of priority Victorin's Gentian occurrences, as well as awareness initiatives targeting the public and shoreline communities, will directly contribute to the conservation of populations of other rare species that occupy the St. Lawrence River freshwater estuary.