COSEWIC
Assessment and Status Report

on the

Anticosti Aster
Symphyotrichum anticostense

in Canada

SPECIAL CONCERN
2017

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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Anticosti Aster — Photo provided by author.

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COSEWIC
Assessment Summary

Assessment Summary – April 2017

Common name
Anticosti Aster

Scientific name
Symphyotrichum anticostense

Status
Special Concern

Reason for designation
This clonal plant is restricted to calcareous shores of larger rivers (and occasionally lakes) in Eastern Québec and New Brunswick. At least 95% of its small global range occurs in Canada. Invasive species threaten habitat quality and there is some evidence that localized hybridization and deer browsing may minimally affect population persistence at local scales. Since the species' last assessment of Threatened in 2000, extensive searching resulted in the documentation of several new subpopulations. The subpopulations appear to be stable.

Occurrence
Quebec, New Brunswick

Status history
Designated Threatened in April 1990. Status re-examined and confirmed in May 2000. Status re-examined and designated Special Concern in April 2017.

COSEWIC
Executive Summary

Anticosti Aster
Symphyotrichum anticostense

Wildlife Species Description and Significance

Anticosti Aster is a 10 to 75 cm tall, herbaceous species that spreads by long rhizomes to form loose clonal colonies. The stiff, narrowly linear leaves are somewhat leathery in texture, often arched, and have smooth or minutely toothed margins. Flowers are in long-stalked flower heads composed of purple ray (petal-like) florets and yellow disk florets. Anticosti Aster is a Holocene (<11,700 year old) species that originated by hybridization of New York Aster and Rush Aster. Identification based solely on morphology is not entirely reliable, particularly in New Brunswick due primarily to similarity with narrow-leaved forms of New York Aster. It is of interest as a rare regional endemic species of post-glacial origin that grows in association with many other plant species of conservation concern within regionally significant calcareous river shore communities.

Distribution

Anticosti Aster is a rare northeastern North American endemic species occurring in three distinct regions: 1) Anticosti Island, QC, 2) Lac Saint-Jean, QC and 3) the southern and eastern portions of the Gaspé Peninsula, QC, northwestern New Brunswick (Restigouche and Saint John river systems), and northeastern Maine (Aroostook River, a Saint John River tributary). Each of these distinct regions could represent an independent hybrid origin for the species, but there is currently insufficient evidence of genetic distinctiveness to warrant considering them as separate designatable units.

Habitat

Anticosti Aster is found on the open shores of larger rivers within the zone of annual flooding, and sometimes on similar lakeshores. It is strongly associated with underlying calcareous sedimentary bedrock and surface materials (mainly limestone). Plants are most often found on wide, low gradient rock, cobble, gravel and sand shores in unvegetated or sparsely vegetated areas between the highest and lowest water marks. At one site, Anticosti Aster has extensively colonized the gravelly roadside and railroad bed adjacent to a river, indicating potential to take advantage of disturbed habitats.

Biology

Anticosti Aster is a colonial perennial species, spreading vegetatively via rhizomes, with genetic individuals likely capable of persisting for many years. Lifespan of individual shoots or rhizome segments is unknown. It is likely dependent on insect pollination. It flowers from late July to late September and disperses seed from mid-August to late fall. Transport by water flow is likely the most significant mode of dispersal. Plants can probably produce flowers within the first year, but in the field, time to sexual maturity is likely greater.

Population Sizes and Trends

The total population of Anticosti Aster in Canada is roughly estimated at 410,000 to 1,063,000 stems, distributed at 18 subpopulations for which identification is considered reliable (1 at Lac Saint-Jean, 7 on Anticosti Island and 10 in the Gaspé Peninsula / western New Brunswick region). Collectively, subpopulations in the Gaspé / western New Brunswick region of occurrence contain at least 95% of the total known global population. The Restigouche River (NB and QC) supports the largest known occurrence (hundreds of thousands of stems), extending over roughly 80 km of river. Gaspé Peninsula's Grande Rivière, Bonaventure and Petit Pabos rivers are the next largest subpopulations (>68,000, >20,000 and >5000, respectively). All other known subpopulations are estimated at a few thousand stems or fewer. Subpopulations are not believed to have changed significantly since the last status assessment in 2000.

Threats and Limiting Factors

Historically, a substantial amount of potential habitat has been lost through construction of large dams in the Saint John River system, NB, and at Lac Saint-Jean, QC. Competition from exotic invasive plant species, particularly Reed Canary Grass (*Phalaris arundinacea*), represents a significant threat to subpopulations on New Brunswick's Saint John River. Invasive exotic plants may be impacting other subpopulations to a lesser degree, and this threat is likely to increase in severity and extent in the future. On Anticosti Island, browsing by over-abundant introduced White-tailed Deer appears to be having a considerable negative impact. Continued hybridization with New York Aster may be causing localized loss of genetic integrity in New Brunswick and Gaspé Peninsula subpopulations. Beach activity from nearby housing and cottage development is a moderate threat at the isolated Lac Saint-Jean population. Other postulated threats appear very minor. Habitat specificity is an important limiting factor for Anticosti Aster, as suitable habitat represents a very small portion of the landscape within the species' range.

Protection, Status, and Ranks

Anticosti Aster is a Schedule 1 species listed as Threatened under the federal *Species at Risk Act*. It is provincially Endangered and legally protected in New Brunswick under the New Brunswick *Species at Risk Act* and provincially Threatened and protected in Quebec under the *Loi sur les Espèces Menacées ou Vulnérables*. The species is ranked as globally Vulnerable (G3) with national status ranks of Vulnerable (N3) in Canada and Critically Imperiled (N1) in the United States, and subnational status ranks of Vulnerable (S3) in Quebec, Imperilled to Vulnerable (S2S3) in New Brunswick and Critically Imperiled (S1) in Maine.

TECHNICAL SUMMARY

Symphyotrichum anticostense

Anticosti Aster

Aster d'Anticosti

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

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)	Perhaps 10 – 15 years Shoots are annual, yet it could take 2 to 3 years for a plant to progress from seed to flower. Rhizome segments are the most relevant unit and their longevity is poorly understood. Time to sexual reproduction in the field is likely several years. Clonal patches likely long-lived.
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Yes. Some local declines observed but not necessarily large or continuing. Small inferred continuing declines in some subpopulations from the encroachment of invasive species.
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	n/a
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Unknown. Likely not substantial. Estimated population size is significantly larger than in the previous update status report, but this is due to a greatly increased search effort.
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Unknown. Potential for only minor reductions suspected.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Unknown. Likely to be small overall, although hydroelectric development projects in the Saint John river system (NB) and at Lac Saint-Jean (QC) certainly eliminated a significant area of potential habitat and may have destroyed subpopulations (see **Habitat Trends, Threats**)
Are the causes of the decline a.clearly reversible and b.understood and c. ceased?	n/a
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence	129,000 km^2 Based on extant sites for which identification is confirmed or considered reliable (130,500 km^2 including high potential unconfirmed occurrences)

Index of area of occupancy (IAO) (Always report 2x2 grid value).	488 km^2 Based on extant sites for which identification is confirmed or considered reliable (552 km^2 including high potential unconfirmed occurrences)
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 The majority of the population (likely >95%) is in large, apparently stable and viable occurrences.
Number of "locations"* (use plausible range to reflect uncertainty if appropriate)	8-18 Majority of the population is on the Restigouche River, where no major, immediate threats are present. Other subpopulations are under common threats from invasive species, yet the number of locations is likely closer to 18 (equal to the number of subpopulations).
Is there an [observed, inferred, or projected] decline in extent of occurrence?	No
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	No
Is there an [observed, inferred, or projected] decline in number of subpopulations?	No. No evidence of decline, although hydroelectric development projects in the Saint John river system (NB) and at Lac Saint-Jean (QC) certainly eliminated a significant area of potential habitat and may have destroyed undetected subpopulations (see **Habitat Trends, Threats**)
Is there an [observed, inferred, or projected] decline in number of "locations"*?	No
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat?	Yes. Observed local declines due to anthropogenic disturbance, White-tailed Deer herbivory and encroachment from exotic invasive plants. Limited population effects to date but future declines in habitat are projected.
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

* See Definitions and Abbreviations on COSEWIC website and IUCN (Feb 2014) for more information on this term

Number of Mature Individuals (in each subpopulation)
[only occurrences for which morphological identification has been genetically confirmed or is considered reliable are included]

Subpopulations	**N Mature Individuals [estimates and counts refer to numbers of stems; numbers of genetic individuals would be much lower]**
Lac Saint-Jean – Mashteuiatsh	~2,000 to 14,826 (latter count includes an unknown but probably small proportion of immature plants)
Anticosti Island – Jupiter River	30
Anticosti Island – Brick River	~700
Anticosti Island – Galiote River	>2,000
Anticosti Island – Aux Rats River	6
Anticosti Island – Chicotte River	~300
Anticosti Island – Aux Plats River	>1,100
Anticosti Island – Martin Brook	>500
Gaspé/NB – Grande Rivière	>68,000
Gaspé/NB – Petit Pabos River	>5,000
Gaspé/NB – Bonaventure River	>20,000
Gaspé/NB – Saint-Jean River	~200
Gaspé/NB – Restigouche River	310,000 to 950,000
Gaspé/NB – Aroostook, Saint John R.	No reliable count available
Gaspé/NB – Bristol and Bath, Saint John R.	No reliable count available
Gaspé/NB – Stickney, Saint John R.	No reliable count available
Gaspé/NB – Wakefield, Saint John R.	No reliable count available
Gaspé/NB – McKeens Corner, Saint John R.	No reliable count available
	[Saint John R. NB, including probable occurrences not confirmed genetically, likely in the tens of thousands of stems; see *Abundance*]
Total population estimate = 410,000-1,063,000 **(excl. Saint John R., with population less than Restigouche R. but potentially quite large)**	

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	No quantitative analysis done

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

Was a threats calculator completed for this species? Yes, a threats calculator was conducted on September 30th, 2016 by Sean Blaney, Dwayne Lepitzki, Bruce Bennett, Del Meidinger, David Mazerolle, Jacques Labreque, Mary Sabine, Jeannette Whitton, Stephanie Pellerin, Luc Brouillet, Jana Vamosi, Emmanuelle Fay, Joanna James

i. Invasive Non-native Species (Medium to Low - IUCN #8.1)
ii. Recreational Activities (Low - IUCN #6.1)
iii. Tourism & recreation areas (Negligible - IUCN #1.3)
iv. Roads and Railroads (Negligible - IUCN #4.1)
v. Work & other activities (Negligible - IUCN #6.3)
vi. Dams and Water Management / Use (Not calculated - IUCN #7.2)
vii. Problematic Native Species (Negligible - IUCN #8.2)
viii. Storms and Flooding (Unknown - IUCN #11.4)

What additional limiting factors are relevant?
i. Habitat Specificity

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	There is a single small occurrence of 12 stems 18 km upstream from the Canadian border on the Aroostook River in Maine (state rank S1). The identification of this record has not been confirmed by flow cytometry (see **Search Effort**).
Is immigration known or possible?	Possible – but unlikely due to very small population size (see note above).
Would immigrants be adapted to survive in Canada?	Yes, but see note above on identification of Maine occurrence.
Is there sufficient habitat for immigrants in Canada?	Yes, but see note above on identification of Maine occurrence.
Are conditions deteriorating in Canada?[+]	Some deterioration due to invasive plants on Saint John River, the only occurrence likely to receive immigrants from United States
Are conditions for the source population deteriorating?[+]	Possibly – the single extant occurrence reported in Maine was found in habitat invaded by several ruderal exotic species.
Is the Canadian population considered to be a sink?[+]	No
Is rescue from outside populations likely?	No. The outside source population in Maine (if confirmed as Anticosti Aster – see above) is much smaller than downstream Canadian subpopulations. Rescue potential is limited to the Aroostook and Saint John rivers, NB.

[+] See Table 3 (Guidelines for modifying status assessment based on rescue effect)

Data Sensitive Species

Is this a data sensitive species? No

Status History

COSEWIC: Designated Threatened in April 1990. Status re-examined and confirmed in May 2000. Status re-examined and designated Special Concern in April 2017.

Status and Reasons for Designation:

Status:	**Alpha-numeric codes:**
Special Concern	not applicable
Reasons for designation: This clonal plant is restricted to calcareous shores of larger rivers (and occasionally lakes) in eastern Quebec and New Brunswick. At least 95% of its small global range occurs in Canada. Invasive species threaten habitat quality and there is some evidence that localized hybridization and deer browsing may minimally affect population persistence at local scales. Since the species' last assessment of Threatened in 2000, extensive searching resulted in the documentation of several new subpopulations. The subpopulations appear to be stable.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not met. Trends not known or not met.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not met. Does not meet B1 with EOO exceeding thresholds. Meets B2 Endangered for known IAO, but likely extends just above threshold with expected but unconfirmed occurrences. Declines are projected for habitat quality (B2b(iii)), but does not undergo extreme fluctuations, is not severely fragmented, and number of locations exceeds thresholds.
Criterion C (Small and Declining Number of Mature Individuals): Not met, as number of mature individuals exceeds thresholds.
Criterion D (Very Small or Restricted Population): Not met. Population exceeds thresholds.
Criterion E (Quantitative Analysis): Not done.

PREFACE

The status of Anticosti Aster was initially assessed as Threatened by COSEWIC in 1990 (Labrecque and Brouillet 1990a) and that status was reassessed and upheld in 2000 (COSEWIC 2000). Since the last status review, extensive fieldwork has been conducted in Quebec and New Brunswick, both at known subpopulation sites and in potential habitat. All known Quebec sites have been surveyed over the last 15 years and exploration of potential habitat in southern and central Anticosti Island has led to the discovery of four previously unknown subpopulations and three unconfirmed potential occurrences.

In New Brunswick, extensive fieldwork by the Atlantic Canada Conservation Data Centre (AC CDC) along the Saint John, Restigouche, southwest Miramichi, and Nepisiguit rivers, and numerous other central New Brunswick rivers, found many occurrences of plants bearing a strong resemblance to Anticosti Aster. These occurrences, many of which are very extensive, were initially thought to represent a major extension of the species' distribution in the province. Subsequent genetic analysis, including chromosome counting and flow cytometry analysis, refuted many morphologically-based identifications, underlining the fact that the species cannot always be identified based on morphological characters alone. This raised questions about identification of Anticosti Aster throughout its range, but particularly in New Brunswick where morphologically similar forms of New York Aster (*Symphyotrichum novi-belgii*) are prevalent on river shores. The updated status report commissioned in 2009 was postponed pending the acquisition of further genetic identification of occurrences. Although the New Brunswick distribution remains incompletely understood because of extreme similarity to forms of the common New York Aster, flow cytometry analysis conducted from 2012 to 2016 seems to indicate that the species is locally common but restricted in New Brunswick to the Restigouche River and a section of the Saint John River. A subpopulation at Baker Brook in Madawaska County, which was reported in the previous status report (COSEWIC 2000), has been excluded due to uncertain identification and failure to rediscover the plants in multiple visits (see **Distribution: Canadian Range**).

A recent PhD thesis (Vaezi 2008) studying the hybrid origin of Anticosti Aster provides some, albeit weak, evidence supporting the hypothesis that it evolved from independent hybridization events in three areas: 1) Anticosti Island, QC, 2) Lac Saint-Jean, QC, and 3) the Gaspé Peninsula / New Brunswick / northeastern Maine area. These data, in combination with the natural disjunction of the three subpopulation groupings, could serve as partial justification for the separation of the Canadian population into three designatable units.

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
(2017)

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

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

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

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

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

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

COSEWIC Status Report

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Anticosti Aster

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2017

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific Name: *Symphyotrichum anticostense* (Fernald) Nesom

Original Description: Fernald, M.L., 1915. Some new or unrecorded *Compositae* chiefly of Northeastern America, Rhodora 17: 16-17

Type Specimen: Quebec, Anticosti; riverbanks and grassy slopes; Jupiter River, 22/07/1880 (erroneous date, should be 18 August 1883); J. Macoun N° 6. (as *Aster paniculatus*) (Holotype, Gray Herbarium).

Synonyms: *Aster anticostensis* Fernald
Aster gaspensis Marie-Victorin
Aster gaspensis f. *albiflora* Marie-Victorin
Aster hesperius A. Gray var. *gaspensis* (Marie-Victorin) Boivin
Aster hesperius var. *gaspensis* f. *albiflora* (Marie-Victorin) Boivin

English vernacular name: Anticosti Aster

French vernacular name: Aster d'Anticosti

Genus: *Symphyotrichum* Nees

Tribe: Astereae

Family: Asteraceae, aster family

Major plant group: Angiosperms, Eudicotyledons

Taxonomic Discussion

Anticosti Aster was first described by Fernald as *Aster anticostensis* in 1915 based on an early 1880s John Macoun collection from the Jupiter River on Anticosti Island. Prior to Brouillet and Labrecque (1987), the species was an obscure taxon only known from the type specimen and ignored by most botanists.

Marie-Victorin (1932) described specimens he collected from the Bonaventure River, Petit Pabos River, and Grande Rivière on the Gaspé Peninsula as *Aster gaspensis* (Marie-Victorin 1932). This taxon was reduced to synonymy by many subsequent authors. Fernald included it in *A. johannensis* Fern. (Fernald 1949, 1950). Cronquist recognized *A. gaspensis* (Cronquist 1947) and published a description in Gleason (1952), but when that work was revised in 1958, the same description was assigned to *A. johannensis* with no mention of *A. gaspensis* (Gleason 1958). Boivin (1966) placed it under *A. novi-belgii* L. var. *villicaulis* (Gray) Boivin, then under *A. hesperius* Gray var. *gaspensis* (Marie-Victorin) Boivin (Boivin 1972).

Brouillet and Labrecque (1987) investigated the morphological and cytological characteristics of plants in the type locality of *Aster gaspensis* and concluded that the taxon constituted a species and that *A. anticostensis* and *A. gaspensis* were identical (Labrecque and Brouillet 1988). Because *A. anticostensis* was described first, its name was given priority for the taxon. Their work also identified historical collections from Fort Fairfield, Maine, and the Lac Saint-Jean and Matapédia regions of Quebec as Anticosti Aster.

The genus *Aster* was revised by Nesom in 1994. In his now widely accepted treatment, all taxa having a base chromosome number of x=8 were transferred to the genus *Symphyotrichum*. Following this taxonomy, the proper scientific name of Anticosti Aster is now *Symphyotrichum anticostense* (Fernald) Nesom.

Morphological Description

The following description is largely based on Labrecque and Brouillet (1990a,b) and Brouillet *et al*. (2006), and includes some technical elements because of the similarity of Anticosti Aster to its closest relatives.

Anticosti Aster is a perennial species propagating by long rhizomes (2-3 mm in diameter) to form loose clonal colonies. It has a stiff, grooved, erect stem, 10 to 75 cm tall and 3 to 4 mm wide, that is often reddish and can be glabrous or minutely pubescent in lines from the point of attachment of the leaves. Larger plants are branched in their upper parts with branches tending to be strongly ascending. The leaves, 9 to 16 cm long by 6 to 18 mm wide, have a narrowly linear or linear-lanceolate outline, are stalkless and slightly clasp the stem at their base. They are stiff and often leathery in texture, spreading and often arched, with margins that can be smooth or minutely toothed and commonly bear short curved hairs. Branch leaves are reduced in length (8 to 50 mm) and width (1.5 to 5 mm). Flowers are arranged in a loose elongate panicle of 11 to 51 large, single heads at the ends of peduncles that are 8 to 50 mm long. Flower heads have appressed, leaf-like involucral bracts arranged in 2 or 3 unequal series and are composed of both ray and disc florets. Ray florets are pale purple, lilac or sometimes white and disc florets are yellow becoming reddish with age (Figures 1 and 2).

Figure 1. Above: Flowering Anticosti Aster (*Symphyotrichum anticostense*), showing typical lilac coloured ray florets and very elongate slightly arched leaves. Below: Stand of non-flowering and pre-flowering Anticosti Aster. Both photos are from the Restigouche River, New Brunswick. Photo credits: David Mazerolle and Sean Blaney.

Figure 2. Photo of flowering Anticosti Aster (*Symphyotrichum anticostense*) on the Restigouche River at Flatlands, NB, showing typical stiff narrow leaves and long flower peduncles. Photo credit: Sean Blaney.

Anticosti Aster is morphologically intermediate between its putative parent species New York Aster (*S. novi-belgii*) and Rush Aster (*S. boreale*) and can be difficult to distinguish from them and from some forms of White Panicled Aster (*S. lanceolatus*). Labrecque and Brouillet (1996) suggest that the features most useful in distinguishing Anticosti Aster are the shape of stem leaves (particularly length to width ratio), as well as their arched-erect appearance and firm texture.

Rush Aster, New York Aster and White Panicled Aster are all sympatric with Anticosti Aster, although the latter species is absent from Anticosti Island and very rare in the Gaspé Peninsula. Within the range of Anticosti Aster, Rush Aster is mostly a plant of calcareous fens, while New York and White Panicled asters often occupy river shore habitats similar to those of Anticosti Aster. Narrow-leaved forms of New York Aster (Figure 3) are the most likely to be confused with Anticosti Aster. The narrow-leaved New York Aster variety (*S. novi-belgii* var. *elodes*) is distinguished from other varieties by linear-lanceolate leaves more than ten times longer than wide and by leaf bases that are little or non-clasping, characters which are also associated with Anticosti Aster (Brouillet *et al.* 2006). This variety of New York Aster occurs from Georgia to New Brunswick but has yet to be described in detail and it is not clear if all narrow-leaved forms in Canada are this taxon. Narrow-leaved forms of New York Aster are apparently very rare or absent from Quebec, but are widespread and locally common along river shores in New Brunswick and lakeshores in southern Nova Scotia (Labrecque pers. obs. 1987-2010; Blaney and Mazerolle pers. obs. 2007-2015).

Identification of Anticosti Aster based on morphological characters is further complicated by the fact that *Symphyotrichum* species (especially New York Aster, Brouillet and Labrecque 1987) can exhibit significant variability (which can be mistaken for hybridization, Brouillet *et al*. 2006) in size, shape and inflorescence development in response to different environmental conditions. Hybridization with *S. novi-belgii*, and possibly other *Symphyotrichum* species, is a further complication. Where hybridization occurs, a wide variety of plants showing intermediate characters can be present. Given the variability of Anticosti Aster and its morphological resemblance to several other taxa, genetic analysis is sometimes required for definite identification.

Figure 3. Photo of a narrow-leaved form of New York Aster (*Symphyotrichum novi-belgii*, possibly var. *elodes*), bearing strong similarities to Anticosti Aster, on the shore of Grand Lake, NB. The common occurrence of these plants on several New Brunswick rivers has caused confusion as to the distribution of Anticosti Aster in the province. Photo credit: David Mazerolle.

Population Spatial Structure and Variability

Hybridization within the genus *Symphyotrichum* is well documented and, along with polyploidy (genome doubling events) has played a major role in the evolution of species within the genus (Jones 1980; Semple and Brammal 1982; Nesom 1994). Interspecific barriers seem particularly poorly developed within the subgenus *Symphyotrichum* (Allen *et al.* 1983; Semple *et al.* 2002; Brouillet *et al.* 2006), which includes Anticosti Aster.

Anticosti Aster is a decaploid with a chromosome number of 2n=10x=80 (Brouillet and Labrecque 1987). Morphological, cytological and phytogeographic data indicates that it is an allopolyploid likely to have originated from hybridization and subsequent genome doubling involving New York Aster (2n=6x=48) and tetraploid individuals of Rush Aster (2n=4x=32) (Brouillet and Labrecque 1987; Labrecque and Brouillet 1988; Vaezi 2008). Vaezi (2008) investigated populations of all three species from within the range of Anticosti Aster, attempting to confirm this hybrid origin using data from DNA sequencing of nuclear ribosomal (ITS) markers. Consistent with the hybrid parents proposed above, he found seven ribotypes shared exclusively by Anticosti and New York asters, one shared exclusively by Anticosti and Rush asters, one shared exclusively by Rush and New York asters, and four shared by all three species, but he concluded that a more rapidly evolving marker was needed to conclusively determine the hybrid parents of Anticosti Aster.

Genetic and morphological similarities between the species and its presumed parents suggest it has had little time to differentiate (Vaezi 2008). The phytogeography of the putative parent species, particularly the limited distribution of New York Aster along the Atlantic Coast, suggests that Anticosti Aster is a taxon of Holocene origin (within the past 11,700 years) (Brouillet and Labrecque 1987).

Vaezi (2008) examined DNA sequences from 16 apparent Anticosti Aster specimens collected in Quebec (five from Lac Saint-Jean, seven from Anticosti Island and four from the Gaspé Peninsula) and seven specimens from the Saint John River system in New Brunswick and the Aroostook River in Maine, collected in at least six separate sites. Specimens were only identified morphologically prior to molecular study, and among the New Brunswick collections, the two sites furthest downstream on the Saint John River system (Grand Lake and Oak Point) are now believed to have been New York Aster, based on recent chromosome counts and flow cytometry analysis. This complicates Vaezi's results, but he found that some ribotypes were regionally isolated, leading him to propose that Anticosti Aster may have evolved independently by allopolyploidy (genome doubling in a hybrid) events in at least three regions: 1) Lac Saint-Jean, Quebec, 2) Anticosti Island, Quebec and 3) the Gaspé Peninsula, Quebec - New Brunswick - Maine region. Many polyploid plant species are known to have originated from multiple independent hybridization events and the multiple origin hypothesis is very plausible for Anticosti Aster, but the Vaezi (2008) results are inconclusive because none of the subpopulations from the three putative independent origins exhibit sufficiently unique loci to warrant this conclusion (Anticosti Aster and both putative parent species share a pool of alleles at the loci examined in the study). Lack of resolution and relatively low sample size, given the variability detected within regions, also limit conclusions (Whitton pers. comm. 2011).

Designatable Units

Because there are no subspecies or varieties recognized for Anticosti Aster, the identification of DUs within the Canadian population depends upon evidence that occurrences or groupings of occurrences are discrete and evolutionarily significant. To be considered sufficiently discrete, populations must meet criteria pertaining to genetic distinctiveness, natural disjunction or occurrence in different eco-geographic areas (COSEWIC 2014).

The Canadian population is separated into three geographically isolated groupings of occurrences; 1) Lac Saint-Jean, 2) Anticosti Island and 3) Gaspé Peninsula / western New Brunswick (see **Canadian Range** and Figure 4). The Lac Saint-Jean subpopulation is separated by over 350 km from the nearest confirmed subpopulation, located on the Restigouche River near Murray Gulch, NB. Anticosti Island occurrences on the Gaspé Peninsula (Saint-Jean River) are separated by over 100 km from the nearest subpopulation, over 70 km of which is across open sea. The considerable distances separating these groups and the scarcity or absence of suitable habitat (shores of large rivers and lakes on calcareous bedrock) between them likely precludes regular allele exchange. Disjunctions between the regions of occurrence are therefore such that they could favour the evolution of local adaptations, but there is no evidence that habitats differ in such a way that local adaptation would be promoted. In all three regions the habitat is sparsely vegetated, seasonally flooded and/or ice scoured shorelines on calcareous substrate (see **Habitat Requirements**).

The regions of occurrence are located in two different biogeographic areas; Lac Saint-Jean and Anticosti Island are situated in the Boreal Shield ecozone, while the Gaspé Peninsula / western New Brunswick region is situated in the Atlantic Maritime ecozone. Across its range, however, Anticosti Aster is found in similar ecological settings, both in terms of habitat and vegetation community types.

As discussed above, there may have been at least three hybrid origins for the species, stemming from independent allopolyploidization events in each of the three regions of occurrence (Vaezi 2008), but there is currently insufficient evidence of genetic distinctiveness (see **Population Spatial Structure and Variability**). Multiple or recurrent origins are known to be common in vascular plants and are believed to have played a role in the evolution of most polyploid species (Soltis and Soltis 1993, 1999; Otto and Whitton 2000) and given the extensive ranges of the putative parental species and the significant disjunctions of the three regions of occurrence, the theory of multiple origins remains plausible for this species.

Despite fairly significant geographic disjunctions and possible evidence of independent evolutionary origins and genetic distinctiveness, subpopulations of Anticosti Aster do not appear to meet the criteria for designation as separate DUs.

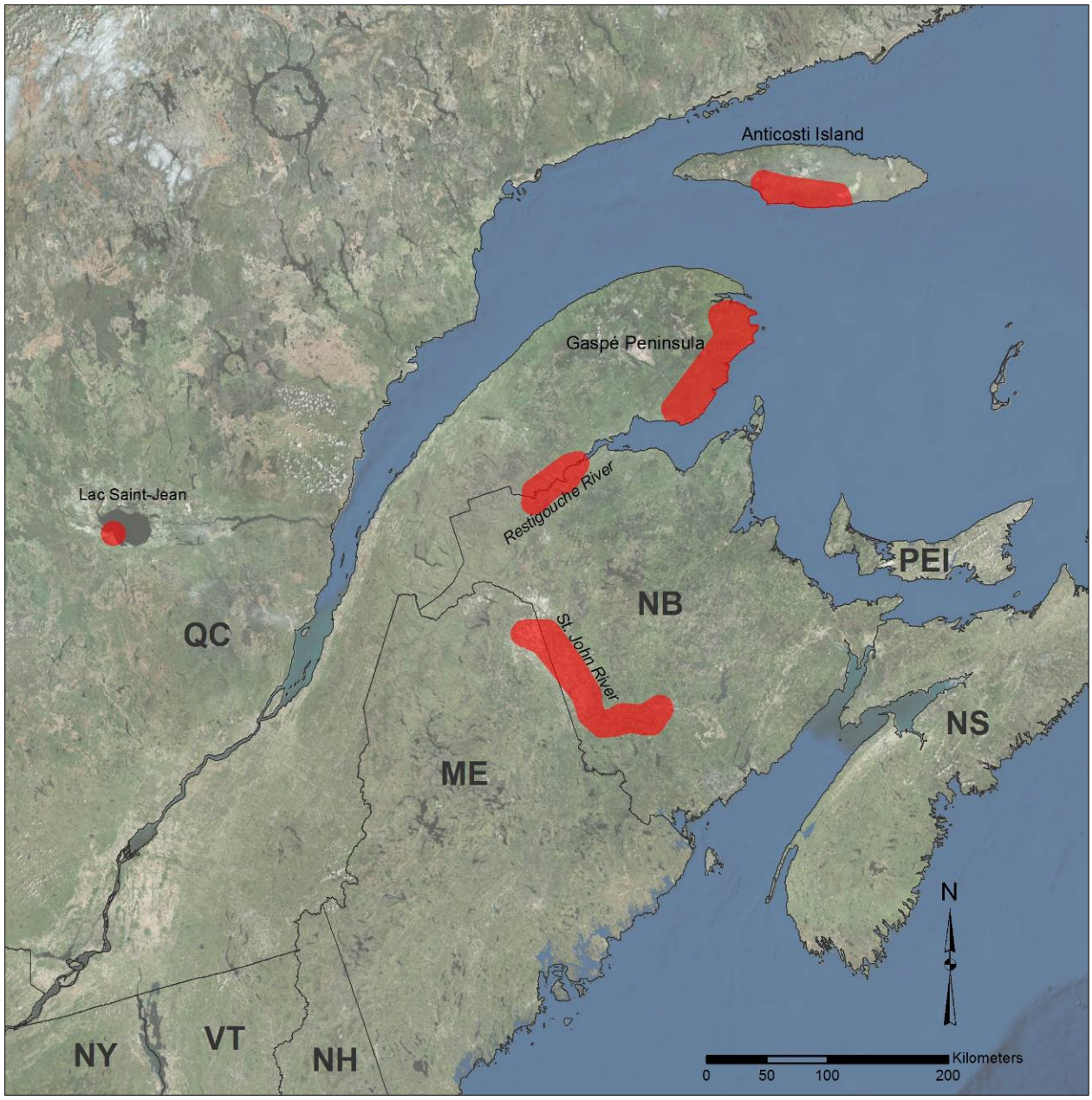

Figure 4. Global range of Anticosti Aster (*Symphyotrichum anticostense*). Note that occurrence in Maine has never been confirmed by chromosome counts or flow cytometry. [Aerial imagery source: Esri World Imagery Basemap.]

Special Significance

As a rare regional endemic species probably of post-glacial (Holocene) origin, Anticosti Aster is of considerable biological interest. The species is almost exclusively found in Canada, and is only known from a small number of sites in Quebec and New Brunswick. A putative single site also occurs in Maine only a few kilometres from the Canadian border.

Anticosti Aster is considered vulnerable to critically imperilled in all jurisdictions where it occurs, including Maine. In its typical calcareous river shore habitats, it grows in association with many other plant species of conservation concern as a component of regionally significant community types.

The species has no known commercial or medicinal uses and no evidence of Aboriginal uses was found in the preparation of this report.

DISTRIBUTION

Global Range

Anticosti Aster is a rare, northeastern North American endemic species (Figure 4), occurring in three distinct regions of occurrence: 1) Lac Saint-Jean, Quebec, 2), Anticosti Island, Quebec and 3) the Gaspé Peninsula, Quebec, western New Brunswick, and northeastern Maine (Figures 5-8). In Maine, the species has only been reported near the Canadian border along the Aroostook River, a tributary of the Saint John River, where one extant and one historical site (1923; extirpated by a hydroelectric dam) are known (Haines 2000). Identification of the Maine population, however, is solely based on morphological characters and has not been confirmed via genetic or flow cytometric analysis (see **Extent of Occurrence** and **Area of Occupancy, Genetic Analysis of Specimens**).

Figure 5. Known distribution of Anticosti Aster (*Symphyotrichum anticostense*) at Lac Saint-Jean. [Aerial imagery source: Esri World Imagery Basemap.]

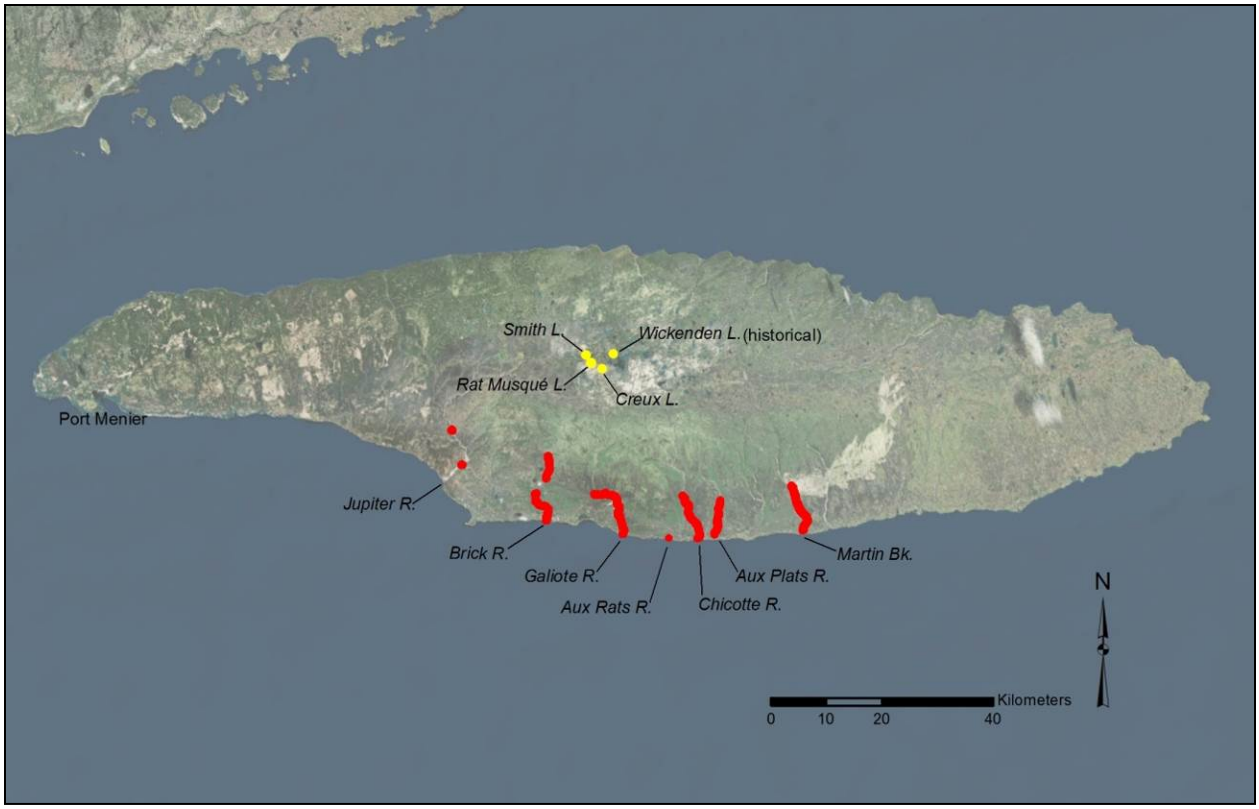

Figure 6. Known distribution of Anticosti Aster (*Symphyotrichum anticostense*) on Anticosti Island, QC. Yellow dots indicate lakeshore occurrences for which identification is considered questionable because of atypical morphology.

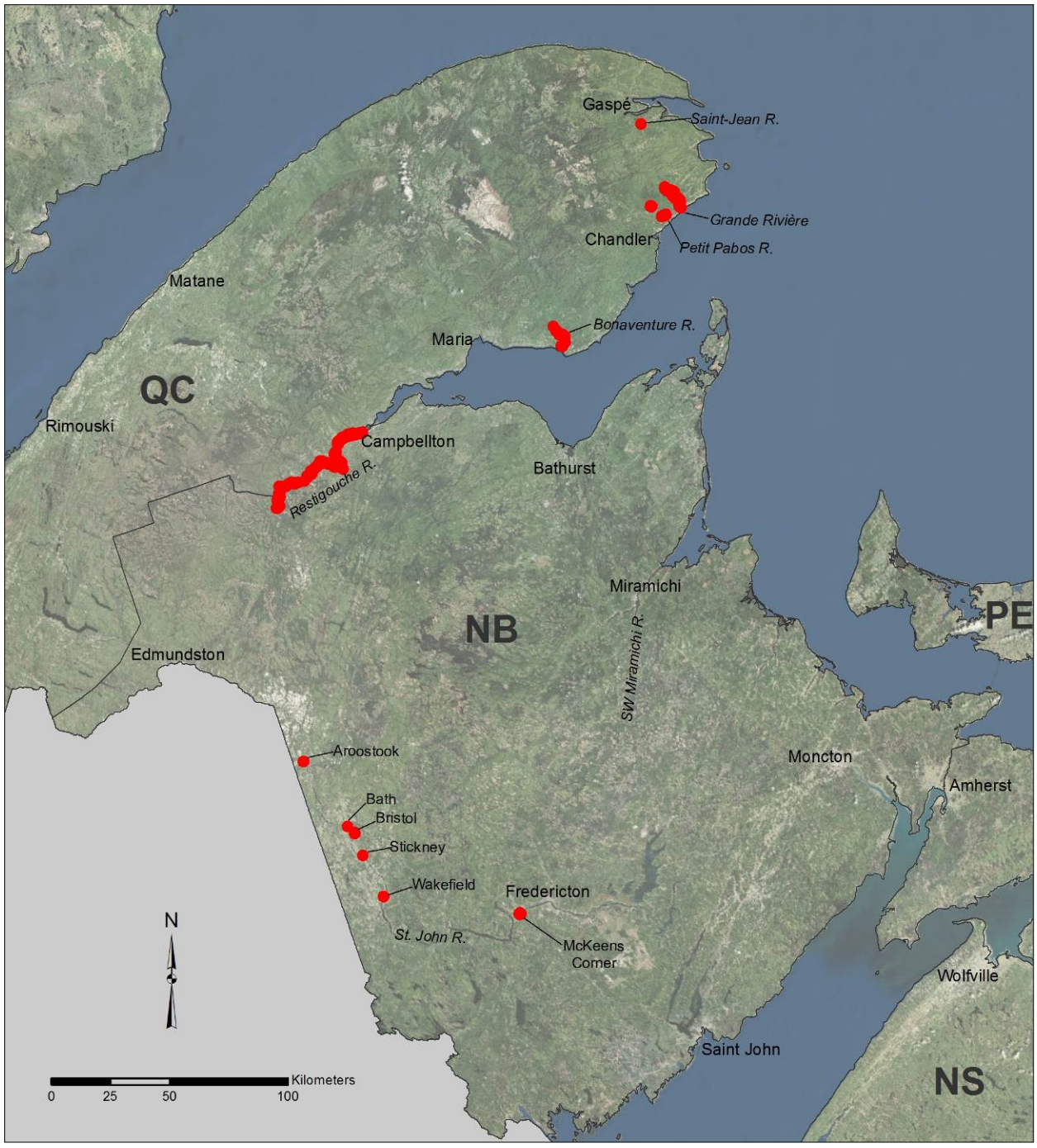

Figure 7. Known distribution of Anticosti Aster (*Symphyotrichum anticostense*) in the Gaspé / New Brunswick region, based on occurrences for which identification is considered valid. [Aerial imagery source: Esri World Imagery Basemap.]

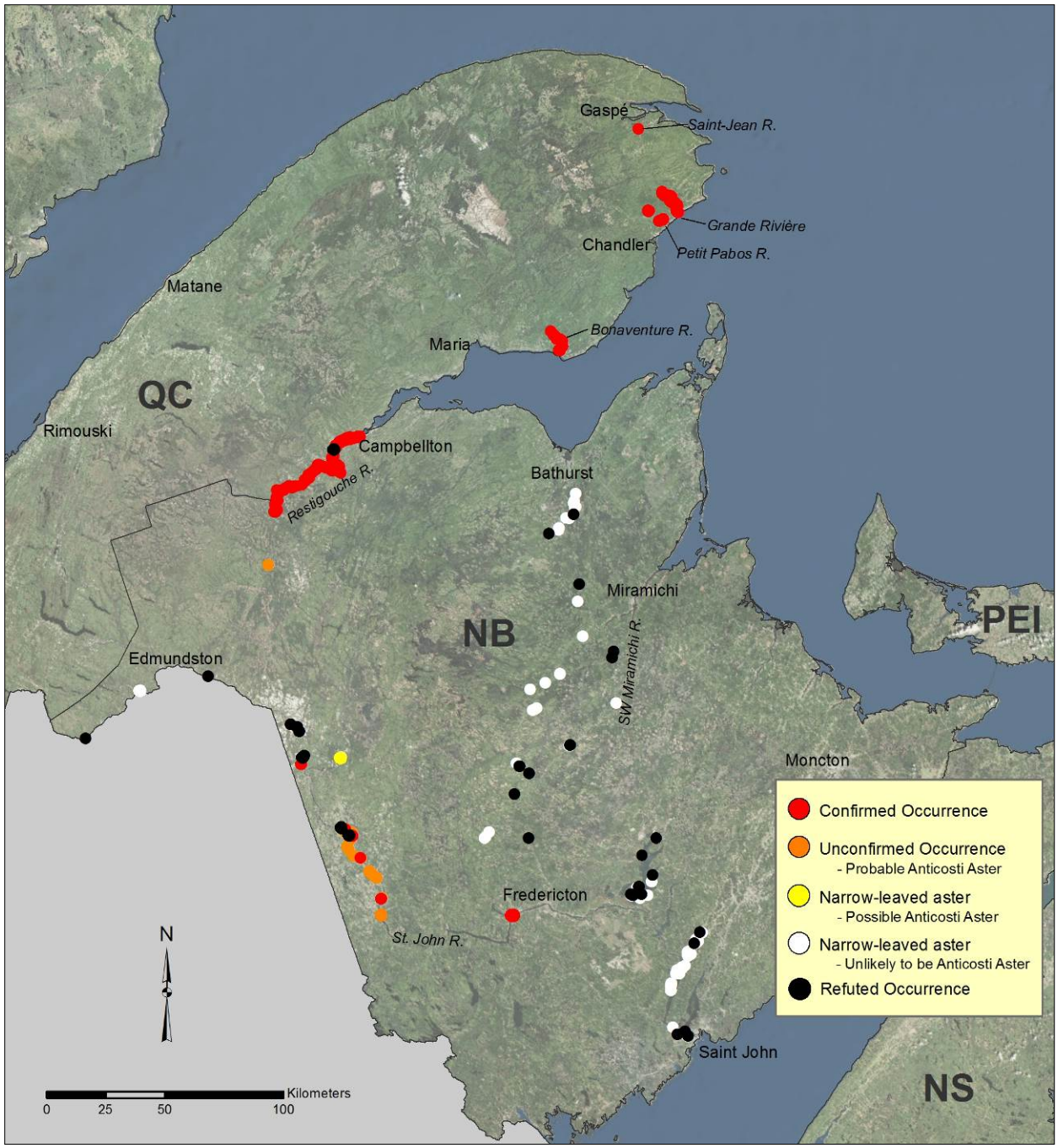

Figure 8. Distribution of confirmed, unconfirmed and potential Anticosti Aster occurrences[1], and refuted occurrences (sites with Anticosti-like narrow-leaved asters in which all sampled plants were subsequently found to be non-Anticosti asters through cytology or flow cytometry analyses. [Aerial image: Esri World Imagery Basemap.]

[1] The likelihood of potential records not evaluated by cytology or flow cytometry being Anticosti Aster is determined by location. "Probable" records are within or near known zones of occurrence on the Saint John and Restigouche Rivers, "possible" record is from the Tobique River near the known area of occurrence on the Saint John River, "unlikely" records are from regions in which all tested specimens are not Anticosti Aster.

Canadian Range

The Lac Saint-Jean area supports a single subpopulation, restricted to a small area of limestone west of the town of Roberval, in the Mashteuiatsh First Nation reserve. It is isolated by more than 350 km from the nearest Canadian subpopulation on the Restigouche River in New Brunswick, and by more than 600 km from Anticosti Island.

The Lac Saint-Jean area supports a single subpopulation in the Mashteuiatsh First Nation reserve. It is isolated by more than 350 km from the nearest Canadian subpopulation on the Restigouche River in New Brunswick, and by more than 600 km from Anticosti Island.

On Anticosti Island, subpopulations are concentrated along the island's southern shore, where the species is known from seven rivers: the Jupiter, Brick, Galiote, aux Rats, Chicotte, aux Plats, and Martin rivers. All of these watercourses are located in the island's central section and generally flow from north to south, with the exception of the Jupiter River, which flows northeast to southwest. Occurrences which are slightly atypical in morphology have also been reported from the shores of four headwater lakes of the Jupiter River, situated within an 8.5 km by 4 km area in the island's centre: Wickenden, Rat musqué, Creux, and Smith lakes. The Wickenden Lake occurrence, last observed in 1940, is presently considered historical.

In western New Brunswick, cytological data (measurements of genome size from flow cytometry, see **Genetic Analysis of Specimens**) confirm the species' occurrence on the Restigouche River (discussed in detail below) and at six sites on the Saint John River, scattered along a roughly 165 km section between McKeens Corner in York County and the mouth of the Aroostook River in Victoria County. There are 33 additional presumed Anticosti Aster records from 12 2 km x 2 km grid squares within this zone (AC CDC 2016; Figure 8) that were identified based only on morphology[2].

COSEWIC (2000) reported Anticosti Aster from Baker Brook, NB a further 113 km upstream from the Aroostook River. This record is rejected in this report because the specimen supporting this record is morphologically atypical, and 2004 annotation on the specimen by Jacques Labrecque identifies it only as "possible" Anticosti Aster. Extensive search effort by Fournier (pers. comm. 2009) and the AC CDC has found no morphologically typical Anticosti Aster along the Saint John River from the American border (37 km upstream from Baker Brook) to Grand Falls (83 km downstream from Baker Brook) and the two samples tested from this region were not Anticosti Aster based on flow cytometry.

[2] These records are likely mostly Anticosti Aster given the general accuracy of field identifications confirmed by flow cytometry, but in this report they are treated separately when counting area of occupancy and extent of occurrence because cytological data suggested some morphologically identified "Anticosti" asters from this portion of the Saint John River were actually other taxa (see "refuted records" mapped in Figure 8), presumably New York Aster (Whitton pers. comm. 2013, also see **Morphological Description**).

The Restigouche River, which forms the border between northern New Brunswick and Quebec's Gaspé Peninsula, is now known to support the world's largest Anticosti Aster subpopulation, with the species extending fairly continuously (427 sites databased by AC CDC [2016] and CDPNQ [2016], occupying 39 2 km x 2 km grid squares) over roughly 80 km of river length from Murray Gulch to Tidehead. Of the 39 specimens identified through flow cytometry from this section of river, 36 have been confirmed as Anticosti Aster (Whitton pers. comm. 2013, 2016; Hersh pers. comm. 2016), and three were identified as hybrids. One of the three non-Anticosti Aster specimens was identified *a priori* by Sean Blaney as a probable hybrid based on morphology. The other two non-Anticosti specimens were collected from a single site at Matapédia. The Restigouche River seems to support mainly the relatively distinct, hairy variety of New York Aster (*Symphyotrichum novi-belgii* var. *villicaule*) with smooth-stemmed New York Aster seemingly limited to the lowermost 5-10 km, where occurrence is sparse. This greatly facilitates *in situ* morphological identification of Anticosti Aster. Because of the 94.8% (37/39) accuracy rate of field identification confirmed by flow cytometry, all reported occurrences from the Restigouche River are considered reliable in this report. Systematic and intensive canoe and shoreline botanical surveys by AC CDC in 2007 and 2015 over the 72 km of the Restigouche River upstream of the continuous distribution of Anticosti Aster (including the Four Mile Brook area) have found no morphologically typical Anticosti Aster. Although COSEWIC (2000) only reported four Anticosti Aster sites on the Restigouche River, one of them (Four Mile Brook) was 38 km upstream from the currently known continuous distribution. The specimen supporting this record was garden-grown and atypical, but may represent a small isolated subpopulation of Anticosti Aster. It is considered an unconfirmed occurrence for this report.

Numerous additional occurrences of narrow-leaved asters bearing strong similarities to Anticosti Aster have been documented along western, central and northern New Brunswick rivers since the last update status report (COSEWIC 2000; see **Search Effort**). All specimens for which genome size estimates are available outside of the presently known distribution in New Brunswick have had flow cytometry values consistent with New York Aster, rather than Anticosti Aster (Whitton pers. comm. 2013). However, if small numbers of Anticosti Aster were present within large occurrences of similar New York Asters, they would be very hard to detect. It is therefore possible that Anticosti Aster occurrences exist on river systems beyond those presented in this report.

Along the south and east sides of the Gaspé Peninsula, the species is reported from the Grande Rivière, Petit Pabos, and Bonaventure rivers, which flow into Chaleur Bay, and the Saint-Jean River flowing into Gaspé Bay. While the former three subpopulations have been verified both by chromosome counts (Brouillet and Labrecque 1987) and flow cytometry (Whitton pers. comm. 2013), the identification of the Saint-Jean River occurrence is solely based on morphology. This identification is, however, considered reliable because morphologically confusing narrow-leaved New York Aster is rare along river shores in the Gaspé Peninsula and relevant specimens have been examined and confirmed by Jacques Labrecque.

Extent of Occurrence and Area of Occupancy

Over its entire Canadian range, Anticosti Aster has an extent of occurrence (EOO) of 129,000 km^2 based on extant sites for which identification is confirmed or considered reliable. Based on a 2 km x 2 km grid aligned with the Universal Transverse Mercator (UTM) 10 km x 10 km grid depicted on National Topographic System maps (Natural Resources Canada 2016), the index of area of occupancy (IAO) of these occurrences is 488 km^2. If unconfirmed occurrences (Figure 8) on Anticosti Island and the Restigouche and Saint John rivers are included, the total Canadian EOO increases by 1,500 km^2 to 130,500 km^2, and the IAO increases by 64 km^2 to 552 km^2. Because the species is restricted to shorelines and typically does not create dense colonies, its biological area of occupancy is exponentially smaller.

The Lac Saint-Jean subpopulation has an EOO of approximately 2.9 km^2, with an IAO of 4 km^2. By COSEWIC convention, when the EOO is less than the IAO, the value of the EOO is set to the larger of the two values (4 km^2). The biological area of occupancy within the region, however, is limited to approximately 4000 m^2 along a total shoreline length of 2.7 km.

Anticosti Island river subpopulations collectively have an EOO of approximately 780 km^2 and an IAO of 164 km^2. If extant occurrences situated along the shores of central island lakes (which have not been genetically confirmed and are questionable due to their atypical morphology) are included, these values are increased to 1,370 km^2 and 172 km^2 respectively.

Based solely on occurrences confirmed through chromosome counts, flow cytometry or otherwise considered reliable, the Gaspé Peninsula / western New Brunswick region of occurrence has an EOO of approximately 35,140 km^2 and IAO value of 320 km^2. These figures are increased to 35,550 km^2 and 372 km^2 respectively if probable but unconfirmed occurrences on the middle Saint John River and upper Restigouche River are included.

Search Effort

Targeted search effort for Anticosti Aster has included more than 129 person-days between 1988 and 2013 in Quebec, and more than 119 person-days between 1988 and 2015 in New Brunswick. Details of these extensive search efforts are given in Appendix 1. Additional untargeted botanical effort in potential habitat has also been considerable.

In Quebec, Anticosti Island has the highest likelihood of supporting unknown subpopulations. Other areas have been relatively well searched. In the Lac Saint-Jean area, the entire <1 km limestone portion of the lake's shoreline has been searched (last visited in August 2013 by J. Courtois, CDPNQ 2016). The calcareous shores of the nearby Ouiatchouan River have also been searched without success. Likewise, in the Gaspé Peninsula, the rivers with the best potential for supporting the species have been at least partially surveyed. On Anticosti Island, there is a strong possibility of additional occurrences in the difficult-to-access rivers, particularly Pavillon River on the south shore, and a high potential for finding additional subpopulations along the shorelines of many lakes at the centre of the island, particularly Lac Wickenden where the species was known historically (CDPNQ 2016). Anticosti Island lakeshore occurrences are, however, sometimes morphologically atypical and further research on their identity would be desirable. Additionally numbers of individuals and extent of occurrence at known Anticosti Island sites could also be larger than currently documented because accessibility and available time have limited survey effort and unsurveyed high potential habitat exists.

The existence of subpopulations along river systems east of Lac Saint-Jean is unlikely given that significant limestone deposits are absent in the Côte-Nord region between the Saguenay River and the Mingan Archipelago. A number of sites have been visited in this region, but no suitable Anticosti Aster habitat was found.

New Brunswick Search Effort

Although targeted survey coverage of potential habitat within the province is not comprehensive, the majority of sites having the highest likelihood of supporting Anticosti Aster (shores of major rivers in areas with high-pH substrates or underlain by high-pH bedrock) have been visited over the last fifteen years. If Anticosti Aster occurred at low density within rivers having high populations of narrow-leaved New York Aster, it would have been very difficult to detect, but flow cytometry analysis of numerous specimens suggests this is not occurring (see below).

Genetic Analysis of Specimens

Narrow-leaved forms of New York Aster (Figure 3) can be confused with Anticosti Aster yet Anticosti Aster is distinct from New York Aster in its number of chromosomes. Because of the difficulty in making definitive morphological identifications, chromosome counts of 15 potential New Brunswick Anticosti Aster specimens were attempted by Bouillé (2011). Precise chromosome counts could not be obtained, but results showed that 13 of the 15 specimens had too few chromosomes to be Anticosti Aster and two were potentially Anticosti Aster (Bouillé 2011; Mazerolle and Blaney 2011).

In 2012, 2013, and 2016 187 narrow-leaved aster specimens were analyzed by flow cytometry[3] at UBC, including 123 specimens collected in New Brunswick, 35 specimens collected in southern Nova Scotia and 29 specimens collected on the Gaspé Peninsula, QC. At all sites visited, specimens were collected from the most Anticosti-like asters. The extent to which specimens matched Anticosti Aster morphology varied by site but no specimens of more broad-leaved forms of New York Aster were collected. The 2C values (nuclear DNA content, measured in picograms) obtained through cytometric analysis clearly separate the specimens into two groups, above and below a threshold of 6 pg. Approximately 95% of specimens in the lower category fall within the range of 4 to 5 pg (corresponding to New York Aster, 2n=6x=48), while all specimens above 6 pg show values of 6.5 to 8 pg (corresponding to Anticosti Aster, 2n=10x=80). Only two specimens fall within the range of 5.5 to 6 pg; these plants, collected on the lower Restigouche River and on the lower Saint John River, may represent hybrids or unusually small White Panicled Aster (*Symphyotrichum lanceolatum*). The results from flow cytometry appear to confirm the presence of Anticosti Aster along the Restigouche River (NB and QC), at five sites on the Saint John River (NB), at Lac Saint-Jean (QC), and along three rivers on the Gaspé Peninsula, QC (Grande Rivière, Petit Pabos, Bonaventure).

Owing to the lack of reliable morphologically-based identification, any reports in the New Brunswick and Maine region of occurrence unverified by flow cytometry are considered potential but unconfirmed in this report; those within the known range of Anticosti Aster on the Saint John River (where most genetic identifications have proven to be Anticosti Aster) are considered probable Anticosti Aster while other potential sites mapped are likely not Anticosti Aster (Figure 8).

HABITAT

Habitat Requirements

Anticosti Aster is typically found on the shores of larger rivers with significant water flow, at least during spring water levels (Figure 9). It can also occur on the shores of lakes that are subject to significant water level fluctuations throughout the year. Anticosti Aster is strongly associated with underlying calcareous sedimentary bedrock and surface materials (mainly limestone), although substrates can vary from basic to circumneutral. Plants are most often found on wide, low gradient shores in unvegetated or sparsely vegetated areas between the highest and lowest water marks. Substrates at known subpopulation sites vary from exposed rock outcrops to beaches or strands of rock, cobble, gravel, and sand, with a few exceptional sites on mud and silt. The species generally occurs in fairly moist sites and does well on seepy banks and wet areas lying at the water's edge, but sometimes also occurs on well-drained upper shores.

[3] Flow cytometry is a process in which cell samples are suspended in a fluid stream and analyzed by a device (cytometer) equipped with high precision optical sensors that measure DNA content, which allows inference of ploidy level and the detection of interspecific hybrids (Dolezel 1991; Negron-Ortiz 2007).

Figure 9. Typical Anticosti Aster (*Symphyotrichum anticostense*) habitat on the lower Restigouche River; wide calcareous cobble shore subjected to seasonal flooding and ice scouring. The area shown in this photograph, dominated by Prostrate Sand Cherry (*Prunus pumila* var. *depressa*), supports several regionally rare calciphilic species. Photo credit: David Mazerolle.

Absence of dense vegetation cover appears to be an important factor in making habitat suitable. The species' ability to establish and thrive seems to depend heavily on the presence of a natural disturbance regime of seasonal flooding, erosion and ice scouring to keep shores in a sparsely vegetated early-successional state where competition for available resources is low. Disruption of this process through artificial regulation of water levels could lead to habitat degradation or loss as more competitive river shore and forest edge species become established. As vegetation cover closes and shrubs become increasingly dominant, river shore habitats become inhospitable for Anticosti Aster.

The species is generally absent from estuaries and is believed to be intolerant of saline conditions, though on the Restigouche River it occurs in fresh to slightly brackish tidal habitats, near the head of tide. Anticosti Aster is also capable of colonizing and persisting in open anthropogenic habitats adjacent to natural habitats. At Matapédia, QC, near the mouth of the Restigouche River, it is locally abundant on roadsides, ditches and railbed embankments, where open gravelly substrates mimic the conditions of natural river shores.

Regionally rare or uncommon species with a strong affinity for calcareous habitats found in association with Anticosti Aster occurrences include Brunet's Milk-vetch (*Astragalus alpinus* var. *brunetianus*), Limestone Meadow Sedge (*Carex granularis*), Alpine Hedysarum (*Hedysarum americanum*), Kalm's Lobelia (*Lobelia kalmii*), Mat Muhly (*Muhlenbergia richardsonis*), Saint John River Locoweed (*Oxytropis campestris* var. *johannensis*), Fen Grass-of-Parnassus (*Parnassia glauca*), Purple False Oats (*Graphephorum melicoides*) and Sticky Tofieldia (*Triantha glutinosa*).

Habitat Trends

At Lac Saint-Jean, limestone shore would have been significantly reduced in 1923 with construction of the Grande Décharge Dam. Although the surface area of limestone shore at Lac Saint-Jean has not further diminished since the last status report, new houses or cottages have been built and associated shoreline disturbances such as trampling and campfires have likely increased proportionately.

There has been no evident decline in habitat quantity or quality on Anticosti Island since the last status report. Although increased deer hunting has likely increased the level of human activity at subpopulation sites since COSEWIC (2000), disturbances are principally limited to areas near roads and bridges, affecting only a small percentage of river shores. Off-road vehicle use occurs on some river flats, but direct impacts from this activity have remained minor. Browsing effects on habitat, caused by introduced White-tailed Deer (*Odocoileus virginianus*), although still very intensive, do not appear to have increased.

In the Gaspé Peninsula, there appears to be some minor decline in habitat quality near bridges and along upper shores, usually where there are trails used by fishers or hunters. However, this decline is limited and usually localized. Similarly, off-road vehicle traffic along some Gaspé Peninsula rivers, most notably the Bonaventure River and Grande Rivière, may have increased somewhat but remains a minor agent of habitat degradation.

Historically, a substantial amount of potential habitat in New Brunswick's Saint John River system was lost due to flooding and artificial regulation of water levels brought about by the construction of hydroelectric dams built in the early and mid-20th century (the Grand Falls, Beechwood, and Mactaquac dams on the Saint John River, the Tobique Narrows dam on the Tobique River and the Tinker Dam on the Aroostook River). The three dams on the Saint John River flooded approximately 180 km of potential habitat, including calcareous gravel and cobble shores and bedrock outcrops rich in rare flora. The Mactaquac and Beechwood dams likely had a particularly significant impact, because the headponds of these two dams overlap the known range of Anticosti Aster on the river. One site at Woodstock, documented only in 1945, is presumed extirpated by flooding from the Mactaquac Dam.

Establishment of highly competitive exotic species, particularly Reed Canary Grass (*Phalaris arundinacea*), seems to have caused significant declines in habitat quality on the Saint John River since the 1980s (Labrecque pers. obs. 1987-2010). Dense stands of Reed Canary Grass now dominate portions of the shoreline zone typically colonized by Anticosti Aster at Bath, Bristol and several potential habitat sites along the most calcareous unflooded section of the river between the Beechwood Dam and Woodstock (Mazerolle pers. obs. 2009; Labrecque and Mazerolle pers. obs. 2010; see Figure 10).

There have been no meaningful declines in habitat quantity or quality documented on the Restigouche River since the status of Anticosti Aster was last assessed in 2000.

Figure 10. Dense stand of the exotic invasive Reed Canary Grass (*Phalaris arundinacea*) dominating Anticosti Aster habitat at the Bath subpopulation site, on the Saint John River, New Brunswick. Habitat encroachment from this and other species may be facilitated by anthropogenic disturbance, alteration of natural water level fluctuations and runoff from agricultural land. Photo credit: David Mazerolle.

BIOLOGY

Little specific information exists on the biology of this species. Most information available refers to the plant family or the genus in general with that information augmented here by observations made at subpopulation sites in recent years.

Life Cycle and Reproduction

Anticosti Aster flowers from late July to late September, although, as in many other aster species, late flowering individuals can likely be found until the first deep frosts. Perennial aster species generally cannot self-fertilize and are essentially obligate outbreeders (Jones 1978; Allen *et al.* 1983). Observations of cultivated plants at the Montréal Botanical Gardens suggest the species does not undergo apomixis (the production of viable seeds in the absence of fertilization; Labrecque and Brouillet 1988). *Symphyotrichum* species, are pollinated by various insects, including bees, wasps, flies, moths, butterflies and beetles (Jones 1978; Semple *et al.* 1996; Robson 2010). It is not known which insect species visiting *Symphyotrichum* flowers act as effective pollinators.

Achene maturation and dispersal occurs from mid-August to the end of fall (Labrecque and Brouillet 1988). The subsequent movement of seeds by river or lakeshore water flow is likely the most significant mode of long-distance dispersal, and could occur up to several years after seed production, depending on seed longevity. Seeds of other *Symphyotrichum* species are known to retain their viability for at least four years (Jones 1978). Germination probably occurs in the spring, and, given ideal growing conditions, plants might produce flowers within the first year (Labrecque and Brouillet 1999) although in the field, time to sexual maturity is likely generally more than one year.

Anticosti Aster reproduces vegetatively via production of clonal shoots at the apex of elongated rhizomes, forming clonal colonies. Fairly dense stands of small shoots that are non-flowering or have only a few flowers are frequently found among more widely scattered tall, abundantly-flowered shoots (Labrecque pers. obs. 1987-2010). Genetic individuals of colonial perennial asters can persist for many years, spreading via vegetative reproduction (Jones 1978). Because individual shoots (or ramets) may become discrete individuals through rhizome fragmentation both flowering and vegetative shoots are counted as mature individuals (referred to as “stems” in this report), including for the determination of generation time within a COSEWIC assessment (COSEWIC 2014). In the strictest sense, new shoots generated from buds at the base of a previous year’s shoot would be considered the same mature individual in order to be consistent with the treatment of non-rhizomatous perennial plants (COSEWIC 2014). Patterns of rhizome spread and yearly regrowth from shoot bases are not known and generation time (defined as the average age of individuals capable of vegetative and/or sexual reproduction) is thus unclear (with a rough estimate of 2-5 years). The genet as a whole could be long-lived. Perennial asters typically survive the dormant season as rosettes produced from late July to the first frosts (Jones 1978).

Physiology and Adaptability

Anticosti Aster is well adapted to survive in shoreline environments cyclically submitted to significant flooding and erosion and is readily capable of colonizing areas where these natural disturbances have removed all vegetation.

Rhizomatous aster species such as Anticosti Aster can survive and persist in sub-optimal habitats that do not allow for flower production. In such cases, and over the course of several growing seasons, genets can gradually migrate vegetatively toward the most suitable habitat over the scale of multiple metres (Jones 1978).

Dispersal and Migration

Anticosti Aster can disperse vegetatively via long rhizomes (probably generally under 0.5 m per year), enabling the species to gradually colonize available habitat. Longer-distance dispersal is accomplished by sexually produced achenes, or by water-borne dispersal of rhizome segments. The sepals at the base of individual flowers are reduced and modified into bristles, collectively known as the pappus, which remains attached to achenes and assists in their wind dispersal by allowing them to remain airborne for a longer period of time.

Most aster seeds disperse limited distances via wind, though infrequent longer distance dispersal events may be the more evolutionarily significant (Chmielewski and Strain 2007). The pappus is also believed capable of augmenting the buoyancy of seeds in water by trapping small air pockets (Lacroix *et al.* 2007), and seeds of some aster species are known to have a buoyancy of several days (Huiskes *et al.* 1995). Many seeds are likely wind-dispersed into water, or are secondarily dispersed by water during seasonal flooding, with subsequent potential dispersal distances likely on the scale of several to many kilometres. Animal dispersal could occur if achenes become lodged in fur or feathers, or if soil containing achenes was transported on animal feet. Adhesion of Perennial Salt Marsh Aster (*Symphyotrichum tenuifolium*) seeds on migratory waterfowl is known (Vivian-Smith and Stiles 1994).

Interspecific Interactions

Aster species are pollinated by a variety of insects, bees, wasps, flies, moths, butterflies and beetles (Jones 1978; Semple and Heard 1987; Semple *et al.* 1996; Robson 2010). Darker-flowered asters are believed to be favoured by butterflies and moths while bees, bumblebees and flies seem to favour paler-flowered asters (Jones 1978). Because Anticosti Aster ray flowers can range in colour from purple to white, a wide variety of insect species could play a role in pollination.

Anticosti Aster is a moderate or poor competitor specializing in low biomass habitats and is subject to exclusion by more highly competitive shrubs, forbs and grasses where these species are not reduced by the natural disturbance cycle of flooding and erosion, as on the Saint John River, where at some sites Anticosti Aster seems to be barely persisting in the gradually closing vegetation cover, often dominated by exotic species such as Reed Canary Grass (Labrecque pers. obs. 1987-2010; Blaney and Mazerolle pers. obs. 2007-2015; see **Threats**).

Hybridization with several other *Symphyotrichum* species has also been noted and hybridization with New York Aster may be relatively common, especially in New Brunswick (Labrecque and Brouillet 1999; Labrecque pers. obs. 1987-2010; Blaney and Mazerolle pers. obs. 2007-2015; see **Threats**). This is discussed further under **Threats**.

Herbivory from White-tailed Deer is a concern on Anticosti Island, where an introduced population is reaching an exceptionally high population density and extensively altering plant community composition and structure (Potvin *et al*. 2003). Signs of repeated browsing on Anticosti Aster were observed at several sites by Labrecque in 1988 and 1991 (Labrecque and Brouillet 1999). Apart from Anticosti Island, herbivory is not believed to be significant for the species.

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

Survey sites in Quebec and New Brunswick were explored through a combination of walking and canoeing, with a considerable portion of high potential habitat covered on foot (see **Search Effort** and Appendix 1 for site details). Because genets cannot be easily delimited in the field, shoot numbers were used to estimate the number of individuals. Detailed counts were made for smaller occurrences, while larger ones were estimated by counting a small representative section and extrapolating based on the entire length of shoreline occupied by the occurrence. On the Restigouche River, where extensive occurrences are present (Figure 7), general outlining of areas of occurrence and relative abundance was done instead of detailed counts that would have been too time-intensive. A detailed account of survey coverage and methods in Quebec can be found in Labrecque (2009) and other survey reports referred to in the **Search Effort** section.

Abundance

The total population of Anticosti Aster in Canada is roughly estimated at 410,000 to 1,063,000 stems (Table 1) but this number only includes individuals documented at confirmed subpopulation sites, excluding what may be tens of thousands along the Saint John River.

Table 1. Anticosti Aster (*Symphyotrichum anticostense*) subpopulation size estimates. Only subpopulations for which morphological identification has been confirmed or is considered reliable are included.

Region of Occurrence	Subpopulation	Province	Verified by genetic analysis (Y/N)	Date of first observation	Date of last observation	Subpopulation size counts or estimates*
Lac Saint-Jean	Mashteuiatsh	QC	Y	1921	2014 2013	14,827[a] ~2,000
Anticosti Island	Jupiter River	QC	N	1883	2008	30
	Brick River	QC	N	1991	2008	~700
	Galiote River	QC	N	1991	2008	>2,000
	Aux Rats River	QC	N	2008	2008	6
	Chicotte River	QC	N	1999	2008	~300
	Aux Plats River	QC	N	2008	2008	>1,100
	Martin Brook	QC	N	2008	2008	>500
Gaspé/ New Brunswick	Grande Rivière	QC	Y	1931	2010	>68,000
	Petit Pabos River	QC	Y	1931	2009	>5,000
	Bonaventure River	QC	Y	1930	2010	>20,000
	Saint-Jean River	QC	N	2009	2009	~200
	Restigouche River	NB/QC	Y	1928	2015	310,000 to 950,000
	Aroostook, Saint John R.	NB	Y	2010	2010	None available[b]
	Bristol and Bath, Saint John R.	NB	Y	2000	2010	None available[b]
	Stickney, Saint John R.	NB	Y	2002[c]	2010	None available[b]
	Wakefield, Saint. John R.	NB	Y	2009[d]	2010	None available[b]
	McKeens Corner, Saint John R.	NB	Y	1963	2015	None available[b]
Total Canadian population estimate: 410,000-1,063,000						

*Counts or estimates refer to numbers of shoots, following the COSEWIC definition of individuals.

[a]This count includes an unknown proportion of seedlings, which may not represent COSEWIC mature individuals (see *Abundance*). It is treated as a maximum, and the 2013 estimate as a minimum.

[b]Due to uncertainties regarding morphological identifications on the Saint John River system, subpopulation size estimates cannot be provided. Collectively, sites on the Saint John River may contain thousands or tens of thousands of individuals.

[c]Unconfirmed occurrences were documented near this site in 1977, 1983 and 2000.

[d]Unconfirmed occurrences were documented near this site in 1945, 1977, 1983 and 2002

Subpopulations in the Gaspé / western New Brunswick region contain at least 95% of the total known Canadian and global population, with the Restigouche River (NB and QC) supporting the majority of the global population. This subpopulation is more or less continuous and locally abundant over 80 km of river length from Murray Gulch to Tidehead and is too large to have been counted comprehensively. The 40 kilometres from Cross Point to the Upsalquitch River holds the highest known concentration of individuals, with some kilometre-long sections of shore supporting several tens of thousands of stems. Available data and field observations (Blaney and Mazerolle pers. obs. 2007-2015; AC CDC 2016) suggest the average number of individuals per kilometre of Restigouche River shoreline could be 1000 to 5000, equating to 160,000 to 800,000 stems over the 160 km of shoreline in the range of occurrence. At Matapédia, near the downstream limit of occurrence on the river, an additional 150,000 stems were observed on roadsides and railroad embankments over a four kilometre distance, increasing the total Restigouche River subpopulation size estimate to between 310,000 and 950,000 stems.

The Gaspé Peninsula holds the second and third largest known subpopulations, found on the shores of the Grande Rivière (>68,000 stems) and Bonaventure River (>20,000). The Petit Pabos and Saint-Jean rivers, also on the Gaspé Peninsula, support >5000 stems and roughly 200 stems, respectively.

Because Anticosti Aster subpopulations on the Saint John River co-occur with narrow-leaved forms of New York Aster and putative hybrids, stem counts and numbers of mature individuals by subpopulation along this river cannot be assessed with confidence. Data collected on potential Anticosti Aster occurrences (not confirmed by flow cytometry) suggest that the species may be locally common and fairly widespread over the 35 km of river from Bath to Hartland with number of stems potentially in the tens of thousands.

V. Piché and P. Désilets estimated the Lac Saint-Jean subpopulation to have 2,000 stems in September 2009, a total comparable to numbers observed during a 2003 visit (CDPNQ 2016). They extended the boundaries of the occurrence slightly with the discovery of a 40 stem colony at “Camping de la Pointe” (CDPNQ 2016). In August 2013, J. Courtois found 14,827 “individuals” in a count that included seedlings that would probably not become COSEWIC mature individuals within that year. The proportion of seedlings in the count is unknown but seedlings do not typically make up a large proportion of individuals in other subpopulations (Blaney and Mazerolle pers. obs. 2007-2015). Jacques Labrecque (pers. comm. 2016) feels that the higher numbers in 2013 are likely the result of more intensive survey and inclusion of immature plants rather than a population increase.

The extant localities on Anticosti Island have a small number of stems relative to subpopulations in other regions perhaps because of heavy White-tailed Deer browsing over more than a century. Only the Galiote (~2000) and aux Plats (~1100) rivers have more than 1000 stems documented. Other rivers have only a few individuals (Jupiter River and Rivière aux Rats) to a few hundred (Brick, Chicotte, Martin rivers). Of the three extant sites on Anticosti Island lakes, Smith Lake supports over 300 individuals, while Creux Lake and Lac au Rat-musqué only support a few individuals (15 and 10 respectively). The slightly atypical morphology of individuals at these lakeshore sites means their identity is considered

questionable. The estimates above are conservative because of incomplete survey of potential habitat due to limited accessibility and time. There is also a strong potential for discovering new occurrences along unsurveyed rivers of the island's southern shore, and in karstic lakes at the centre of the island.

Fluctuations and Trends

Available field data suggests that Anticosti Aster does not exhibit significant fluctuations in number of mature individuals.

Although anthropogenic disturbance has become more prevalent at the Lac Saint-Jean site since 2000, the subpopulation does not seem to have suffered a noticeable decline. Individuals at the site have likely remained largely unaffected because they occur on shoreline bedrock outcrops, which are not typically favoured for development and recreational activity.

Field surveys suggest that there have been no major fluctuations or declines in Anticosti Island subpopulations, at least on the Brick and Galiote rivers, which were surveyed in both 1991 and 2008 (Labrecque, pers. obs. 1987-2010). Browsing by deer, although still clearly intensive, does not seem to have significantly reduced subpopulations in recent years. Human disturbance of subpopulation sites is not widespread on the island, being localized and largely limited to sites near roads and bridges.

Gaspé Peninsula subpopulations do not seem to have experienced any significant declines. Apart from small numbers of individuals lost due to localized human disturbance from road construction / maintenance and off-road vehicle use, such as on the Petit Pabos and Bonaventure rivers, the subpopulations seem to have remained relatively stable for the last 20 years. The considerable increase in documented individuals during recent surveys is due to a more intensive search effort. Morphological observations and recent flow cytometry analysis suggest that there may be a higher incidence of hybridization with New York Aster on the Bonaventure River, particularly near its mouth and at the original site of the first report (Labrecque and Brouillet 1988) near the St. Elzear Bridge. The extent of this hybridization cannot presently be assessed with any precision.

The considerable increase in the estimated size of the Restigouche River subpopulation is due to a much greater search effort carried out since the last status assessment. The actual size and extent of the subpopulation is not believed to have changed significantly over the last 15 years. Anthropogenic disturbance along the river is mainly limited to the lower 25 km of the range of occurrence, where long-standing bridge, road and railroad embankments had a minor impact on shoreline habitats and likely eliminated small numbers of individuals when they were constructed, but are not believed to have had significant impacts in recent years. Further upstream, detrimental anthropogenic disturbance is minimal and highly localized near a small number of fishing camps. Given the extent of the Restigouche River subpopulation, these disturbances have not caused a meaningful decline. At Matapédia, disturbances related to road and railroad maintenance seem to be encouraging the establishment and spread of Anticosti Aster. The

local abundance of the species in anthropogenic habitats at this site, which may be relatively recent, suggests that it could eventually spread further along road and rail corridors. The common incidence of putative hybrids observed in these habitats, however, puts into the question the long-term viability of this occurrence.

Field observations at two confirmed sites (Bristol and Bath) and several unconfirmed sites within the confirmed range of occurrence on the middle Saint John River indicate that habitat encroachment by exotic invasive species has likely caused declines (Labrecque pers. obs. 1987-2010; Blaney and Mazerolle pers. obs. 2007-2015). Proliferation of these species, particularly exotic Reed Canary Grass, may be associated with sedimentation and high-nutrient runoff from farms and other development, as well as altered water level fluctuation regimes caused by the Beechwood hydroelectric dam (Kercher and Zedler 2004; Townsend and Hebda 2013).

Fragmentation

The species as a whole in Canada is not considered severely fragmented as defined by COSEWIC because most individuals are in large occurrences, which, although isolated, are presumed to have good viability. The same is true for the Gaspé Peninsula / New Brunswick and Anticosti Island regions of occurrence. On Anticosti Island four of eleven occurrences have very small numbers of individuals, one is historical and two others have 300 or fewer individuals. If the identification of lakeshore occurrences is considered valid, these small subpopulations collectively make up 64% of Anticosti Island occurrences but only 17% of individuals.

The Lac Saint-Jean subpopulation is limited to a single site, where an estimated 2,000 individuals are restricted to a very small area (~0.3 ha) with ongoing development and is relatively separated from the other subpopulations (Figure 4).

Rescue Effect

Anticosti Aster's known distribution outside Canada is limited to a very small number of individuals (12 stems, likely representing only a few genetic individuals, in a 0.5 x 0.5 m area) observed at a single site in Maine on the Aroostook River, within 18 km of the New Brunswick border (Haines 2000). Given difficulties in morphologically-based identification experienced in New Brunswick, the identity of this occurrence is considered questionable (see **Canadian Range**). If the species does occur in Maine, any potential rescue from this small population would be limited to the Aroostook River and the downstream portion of the Saint John River.

THREATS AND LIMITING FACTORS

The threat classification below is based on the International Union for the Conservation of Nature - Conservation Measures Partnership's unified threats classification system (IUCN-CMP 2012; see also Master *et al.* 2012). Discussion of threats below only

refers to subpopulations that are considered confirmed. The threats calculator estimated the overall threats for this species to be Medium-low.

Threats

IUCN Threat 8. Invasive & other problematic species & genes

8.1. Invasive non-native/alien species

Although many non-native species co-occur with Anticosti Aster throughout its range on the Saint John River and collectively may be having modest impacts on its abundance, Reed Canary Grass is the only one for which there is strong evidence of local impacts. This tall, rhizomatous grass is a well-documented invasive species of wetlands and shorelines (Lavergne and Molovsky 2004; IPANE 2011) and is common throughout the Saint John River range of Anticosti Aster. This threat is most significant on the Saint John River, where extensive human alteration of the landscape has promoted non-native species occurrence and nutrient-rich farmland runoff may be further facilitating the encroachment of exotic invasives along shorelines. Anticosti Aster appears somewhat protected from Reed Canary Grass in severely flood and ice-scoured sites and rock outcrop sites with limited soil, but Reed Canary Grass abundance has visibly increased within some known Anticosti Aster sites since 1988 and appears associated with reduced subpopulation size (Labrecque pers. obs. 1987-2010; Figure 10). Other recently discovered occurrences in broad cobble shorelines involve very sparse, apparently suppressed Anticosti Aster within dense, overtopping stands of Reed Canary Grass (Blaney and Mazerolle pers. obs. 2007-2015).

Introduced ruderal (growing on waste ground) species are fairly common to abundant throughout Anticosti Aster's range on the Restigouche River (see **Habitat trends**), especially along the lowermost 25 km of river length (Blaney and Mazerolle pers. obs. 2007-2015) where permanent human settlement is present and Reed Canary Grass is locally present. Invasive species is considered a future threat at this and possibly other Gaspé Peninsula occurrences but are not believed to be having major effects at present (Labrecque pers. obs. 1987-2010; Blaney and Mazerolle pers. obs. 2007-2015).

Browsing by White-tailed Deer is included under threats from non-native species because it is only considered a meaningful threat on Anticosti Island, where deer are an introduced species. Deer affect a high proportion of plants at all Anticosti Island subpopulations (Labrecque and Brouillet 1988, 1999; Labrecque 2009) and may be responsible for small subpopulation sizes observed on the island, although aster numbers appear to have been stable over the last 20 years. Since their introduction to the island in 1896, White-tailed Deer have proliferated in the absence of natural predators to an average density of approximately 20 deer / km^2 (Potvin *et al.* 2003; Potvin and Breton 2005), with local densities in the Jupiter region (a key area for Anticosti Aster) reaching 56 deer / km^2 in the summer and up to 80 deer / km^2 in the winter (Tremblay *et al.* 2006). The carrying capacity of the island is estimated at less than 7.5 deer / km^2 (Tremblay *et al.* 2006). Deer use open wetland habitats such as river and lakeshores on Anticosti Island to an especially large extent because these areas have higher quality forage and in the absence of

predators there is no additional exposure to predation in open habitats (Massé and Coté 2009). Over-browsing by the deer population now represents a significant challenge for forest resource and biodiversity managers on the island (Potvin *et al*. 2003; Tremblay *et al.* 2006). Apparent repeated browsing of Anticosti Aster is evident on river shores, where most plants are grazed to a height of a few centimetres (Labrecque and Brouillet 1999) except for occasional individuals protected from deer by fallen logs or occurrence between boulders (Labrecque pers. obs. 1987-2010).

Browsing by White-tailed Deer is unlikely to be a threat for other Anticosti Aster subpopulations, as deer density is significantly lower on the mainland, particularly in the Gaspé Peninsula where densities were estimated at much less than one per square kilometre (Potvin *et al.* 2004).

8.2. Problematic native species

Hybridization with New York Aster has been documented on the Bonaventure, Grande, Restigouche and Saint John Rivers (Labrecque pers. obs. 1987-2010; COSEWIC 2000; Bouillé 2011; Whitton pers. comm. 2013). This hybridization of two native species is considered a potential threat rather than a limiting factor because Labrecque and Brouillet (1988) suggest that human disturbance had allowed New York Aster (a species widely associated with roadside disturbances) to establish, spread and subsequently hybridize with Anticosti Aster at the Bonaventure and Jupiter rivers, resulting in a higher frequency of putative hybrids (Labrecque pers. obs. 1987-2010). The present scope and extent of hybridization are unclear due to difficulties in identifying hybrids in situ, yet thought to be negligible due to the low level of backcrossing typically observed between species with different chromosome counts.

River-associated forms of New York Aster (especially *Symphyotrichum novi-belgii* var. *villicaule*) are naturally common along both the Saint John and Restigouche rivers and it is unclear whether anthropogenic habitat disturbance has increased the prevalence of New York Aster along these rivers.

<u>IUCN Threat 6. Human intrusions and disturbance</u>

6.1 Recreational activities

Most Anticosti Aster habitat is frequently flooded and is thus less susceptible to conversion for human infrastructure development than adjacent areas above the zone of frequent flooding. Impacts from development are thus primarily secondary and fall under the category of recreational activities - docks, boat launches and associated increases in foot traffic and off-road vehicle traffic. These have caused very localized declines in Anticosti Aster subpopulations and habitat at a few sites.

On the Restigouche River, development is mainly concentrated on the lower 25 km section, from the confluence with the Upsalquitch River to Tidehead. Along the remaining 55 km of the range of occurrence on the river, development is limited to a few fishing camps and cabins. At salmon fishing camps and some other access points, large numbers of canoes are often stored on Anticosti Aster habitat, vehicles frequently access the shore for boat delivery and vegetation is sometimes managed using gas-powered string trimmers over distances up to about 100 m (Blaney and Mazerolle pers. obs. 2007-2015). The impact is, however, probably small for the very large Restigouche River subpopulation as a whole. Similar disturbances may be more important for very localized occurrences, most significantly at Mashteuiatsh, site of the only known occurrence in the Lac Saint-Jean region. Since the status of Anticosti Aster was last assessed in 2000, nearly all of the available waterfront land adjacent to the species' habitat has been developed at this site. Although minor shoreline disturbances have certainly increased at Mashteuiatsh, there is no clear evidence of subpopulation decline.

In the Gaspé Peninsula, recreation-related development is considered a threat on the Bonaventure River, where cottage and boat ramp construction have caused habitat degradation and loss of plants near the site where the road to Saint-Elzéar crosses the river (Labrecque and Brouillet 1999). Serious site degradation had occurred there between surveys in 1985 and 1988 and some plants had been destroyed (Labrecque and Brouillet 1988). Overall, recent impacts on Anticosti Aster at the Bonaventure River and elsewhere in the Gaspé Peninsula appear rather local, limited to small sections of shoreline.

Subpopulations on the Saint John River in western New Brunswick are within an area having significant residential and agricultural development, with frequent shoreline use by fishers, walkers and all-terrain vehicles (Blaney and Mazerolle pers. obs. 2007-2015). There have, however, been no observed direct impacts to colonies (Labrecque pers. obs. 1987-2010; Blaney and Mazerolle pers. obs. 2007-2015).

The wide, sparsely vegetated low-gradient beaches and strands typically favoured by Anticosti Aster are attractive to some recreational all-terrain vehicle (ATV) users. Crushing of plants and compaction of soils caused by ATV traffic is known at several sites, most notably on Anticosti Island and along the Gaspé Peninsula's Bonaventure River, and Grande Rivière. In New Brunswick, off-road vehicle use has been observed in the vicinity of occurrences on the Saint John River and at a few sites on the lower Restigouche River, but is only causing minor and localized habitat degradation. ATV damage is not known to affect a meaningful portion of any subpopulation and does not presently appear to be a significant threat.

IUCN Threat 4. Transportation & service corridors

4.1 Roads & railroads

The construction and maintenance of roads, railroads and bridges can cause localized degradation of Anticosti Aster habitat, typically only affecting small portions of shorelines where embankments are built or strengthened following erosion.

The construction of a new bridge has destroyed an approximately 50-m-long section of habitat at the Petit Pabos River in the Gaspé Peninsula (Labrecque pers. obs. 1987-2010). Likewise, small portions of habitat have been affected along the Brick, Galiote, and Chicotte rivers on Anticosti Island.

On the lower Restigouche River, small portions of habitat have been lost following the construction and strengthening of road and bridge embankments in the vicinity of Runnymede and Matapédia. No direct impacts to Anticosti Aster were observed and affected areas represent an insignificant portion of habitat on the river.

IUCN Threat 7. Natural system modifications

7.2 Dams and water management / use

Water-level fluctuations play an essential role in maintaining species richness and habitat zonation patterns on shorelines (Dynesius and Nilsson 1994) and four New Brunswick dams regulate flow within Anticosti Aster range. The Grand Falls, Beechwood and Mactaquac dams, built in 1920, 1955 and 1967 respectively, impact water levels over more than 200 km and alter water level fluctuations over a much larger distance of the river's lower basin. Confirmed Anticosti Aster occurrences on the river are restricted to areas above and below the large headponds of the Mactaquac and Beechwood dams, strongly suggesting that flooding eliminated undocumented subpopulations. Additionally, the Tinker Dam on the Aroostook River in New Brunswick, constructed in 1923, flooded an Anticosti Aster occurrence at Fort Fairfield, Maine, a few kilometres upstream, and may have affected undocumented occurrences on the Canadian portion of the river.

Water-level fluctuations constitute a key factor in the success of Anticosti Aster occurrences. Disruption or loss of these natural disturbances on river shores can lead to encroachment by riparian and forest edge species that crowd out pioneer species specializing in more dynamic shoreline habitats (Nilsson and Jansson 1995; Hill *et al*. 1998; Nilsson and Berggren 2000). Encroachment by weedy and more competitive plants has been observed at two confirmed Anticosti Aster subpopulations (Bristol and Bath) and several sites between the Beechwood Dam and Woodstock, where river shores are much more densely vegetated than is typical at sites with unaltered water flow (Labrecque and Brouillet 1990a,b; Blaney and Mazerolle pers. obs. 2007-2015). The extent to which this is a consequence of water level management or other human influences in this comparatively heavily settled region is unclear. Severe flood events have been more frequent in all New Brunswick portions of the Saint John River since the 1967 construction of the Mactaquac Dam (Cunjak *et al*. 2011), suggesting increased flood frequency is unrelated to the dam. The Beechwood Dam, immediately upstream of the region of densest occurrence on the Saint John River (from Bath to Wakefield) has, however, reduced the frequency of extreme low flow events (Cunjak *et al*. 2011). Both Mactaquac and Beechwood dams cause significant unnatural daily fluctuations. Culp *et al*. (2007, in Cunjak *et al.* 2011) state that water level "...was found to fluctuate by ~1.5m daily and large portions (sometimes greater that 50%) of the river bottom and the benthic community was exposed daily."

The construction of the Grande Décharge Dam at the Lac Saint-Jean outflow in the late 1920s, flooded a significant portion of the limestone outcrop shoreline on the lake and is believed to have had a negative impact on the Lac Saint-Jean subpopulation (COSEWIC 2000).

Long-term artificial water-level regulation has not affected other rivers known to support Anticosti Aster. No new hydroelectric projects are known to be contemplated on rivers where Anticosti Aster occurs, although some may have hydroelectric development potential.

IUCN Threat 11. Climate change & severe weather

11.4 Storms & flooding

Flooding from exceptionally large precipitation events can remove plants and might thus represent a threat to very small and localized Anticosti Aster subpopulations, though this type of disturbance is crucial to the natural persistence of the species in general. The probability of occurrence of these stochastic events may become greater with ongoing climate change and projected increases in storm frequency and severity (Houghton *et al*. 1996; Shaw 2001; Environment Canada 2006).

Limiting Factors

Habitat Specificity

Anticosti Aster is found almost exclusively on calcareous river and lake shores where low gradient gravel or cobble flats and rock outcrops are maintained in a relatively unvegetated state by seasonal flooding and ice scouring. Because these particular environmental conditions are only found along certain sections of a small number of watercourses, suitable habitat represents only a very small portion of the landscape within the species' geographic range.

Subpopulations and Number of Locations

Subpopulations are defined in this report using habitat-based plant element occurrence delimitation standards (NatureServe 2004), under which occurrences are lumped into a single element occurrence (i.e., COSEWIC subpopulation) if 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. Under this definition, there are 18 subpopulations for which identification has been confirmed or is considered reliable (Table 1).

For the purposes of COSEWIC assessment, locations are defined by the scale of the most immediate threat. Primary threats differ from region to region across the species' range and are discussed in further detail under **Threats**.

Habitat encroachment by exotic invasive flora (particularly Reed Canary Grass) represents the largest threat to subpopulations in the Gaspé Peninsula / western New Brunswick region of occurrence which collectively supports 95+% of the global population.

Damming associated with hydroelectric development likely impacted past occurrences but there is no conclusive evidence that existing dams are substantially impacting existing subpopulations, and there are no known current or near-future proposals for new hydroelectric development within Anticosti Aster range. Exotic species are not a large immediate threat to the extensive Restigouche River subpopulation that is believed to contain a majority of the global population. The smaller subpopulations of Anticosti Aster are impacted by exotic species to varying degrees (see **Threats**) and "locations" are considered equivalent to subpopulations in this status report (COSEWIC 2014). Details on number of locations for Lac Saint-Jean and Anticosti Island are given below.

The Lac Saint-Jean subpopulation is restricted to a single site along the shores of the Mashteuiatsh First Nation reserve, where plants are scattered over roughly 2.7 km of lakeshore. Although waterfront development at this site is significant and associated human activities may be impacting colonies, the foremost threat to this occurrence is a further raising of water levels from the Grande Décharge. Even a modest increase in water level could impact most of the subpopulation. The Lac Saint-Jean occurrence is therefore considered a single location.

The Lac Saint-Jean subpopulation is restricted to a single site along the lakeshore. Although waterfront development at this site is significant and associated human activities may be impacting colonies, the foremost threat to this occurrence is a further raising of water levels from the Grande Décharge. Even a modest increase in water level could impact most of the subpopulation. The Lac Saint-Jean occurrence is therefore considered a single location.

On Anticosti Island, browsing by over-abundant introduced White-tailed Deer represents the primary threat to the species, affecting all occurrences to a similar degree. All subpopulations situated on Anticosti Island can thus be conceivably considered a single location.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

Anticosti Aster is currently a Schedule 1 species listed as Threatened under the federal *Species at Risk Act*. It is provincially Endangered and legally protected in New Brunswick under the New Brunswick *Species at Risk Act* and provincially Threatened and protected in Quebec under the *Loi sur les espèces menacées ou vulnérables*. Under these acts, it is prohibited to possess, trade, or harm this species, or to disturb its habitat. In the United States, Anticosti Aster has no federal status but is listed as Endangered in the state of Maine (Maine Department of Conservation 2004). Although this does not confer it any legal protection, the species may receive some generalized protection under Section 12 of the state's *Site Location Law*, which addresses the conservation of "Unusual Natural Areas" (Cameron pers. comm. 2011).

Non-Legal Status and Ranks

Anticosti Aster has a global conservation status rank of Vulnerable (G3, last assessed in 2005) with national status ranks of Vulnerable (N3) in Canada and Critically Imperiled (N1) in the U.S. (NatureServe 2016). It has a subnational status rank of Vulnerable (S3) in Quebec, Vulnerable to Imperilled (S2S3) in New Brunswick and Critically Imperiled (S1) in Maine (AC CDC 2016; NatureServe 2016). Anticosti Aster is ranked At Risk in Quebec, New Brunswick, and Canada under the General Status of Wildlife process (CESCC 2011).

Habitat Protection and Ownership

In both Quebec and New Brunswick, the boundary of public land ownership along larger non-tidal watercourses is generally defined by the average or mean high water mark. Because Anticosti Aster is typically found in lower shoreline zones below the average high water mark, occurrences are most often completely or predominantly situated on Crown land, even in areas of privately owned water frontage. Riverfront landowners, however, are often not aware of or respectful of this ownership distinction and may alter shore frontage within the Crown land zone.

The Lac Saint-Jean subpopulation is situated on federal land within the Mashteuiatsh First Nations reserve, which affords the species and its habitat full protection under the *Species at Risk Act*, although limited knowledge of the plant and of Species at Risk regulations by local residents likely lessens actual protection on the site. None of the known occurrences on Anticosti Island are situated on protected land.

The Grande Rivière subpopulation in the Gaspé Peninsula is included in the *Habitat Floristique des Platières-de-la-Grande Rivière*, an area protected under provincial legislation (*Règlements sur les foristiques menacées ou vulnérables et leurs Habitats* of the provincial *Loi sur les espèces menacées ou vulnérables*). Although no other Gaspé Peninsula subpopulations are in protected areas, they are all located on the shores of salmon rivers (*rivières à saumon*), which indirectly confers a certain measure of protection. Rivers with this special provincial designation are subject to monitoring by the *Société de la faune et des parcs du Québec* and benefit from a regulated 60 m-wide riparian buffer zone under the *Loi sur les forêts.*

On the New Brunswick side of the Restigouche River, Anticosti Aster occurs in the Upper Thorn Point Brook Protected Natural Area, which encompasses a roughly 3.5 km section of river shore. Within the species' range of occurrence on the river, approximately 60% of the New Brunswick shoreline is under private ownership, while the Quebec shoreline is predominantly private.

Confirmed subpopulations along New Brunswick's Saint John River all occur along the Crown land margin of unprotected privately owned shorelines. The Bristol and Stickney occurrences are both in the vicinity of small protected parcels of crown land (Green Island and Stickney Protected Natural Areas respectively) and may extend into these areas.

ACKNOWLEDGEMENTS AND AUTHORITIES CONTACTED

Luc Brouillet at the University of Montreal's plant biology research institute (IRBV) examined and offered tentative identifications for a large number of potential Anticosti Aster specimens collected in New Brunswick through AC CDC fieldwork. Richard Fournier at the University of Moncton's Edmundston campus provided assistance in identifying potential habitat and collecting specimens on the upper Saint John River. Funding for fieldwork, chromosome counts and flow cytometry was provided by the New Brunswick Wildlife Trust Fund, the New Brunswick Environmental Trust Fund, the Canadian Wildlife Service and the Government of Quebec. Laval University provided laboratory space and equipment for chromosome counts at no cost. Marie Bouillé carried out chromosome counts and assisted in the interpretation of results. Jeannette Whitton, Adam Wilkinson and Evan Hersh at the University of British Columbia performed flow cytometry analysis on specimens collected in New Brunswick, Quebec and Nova Scotia. The report writers acknowledge the contribution of all co-authors of the previous status reports: Jacques Labrecque, Luc Brouillet, and Frédéric Coursol.

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BIOGRAPHICAL SUMMARY OF REPORT WRITERS

David Mazerolle holds an undergraduate degree in Biology and a Master's degree in Environmental Studies from the University of Moncton, where he studied the biogeography of exotic vegetation in relation to habitat and disturbance regimes, producing an exotic invasive vegetation management strategy for Kouchibouguac National Park, on New Brunswick's eastern shore. After various research assistant positions, he worked from 2003 to 2005 as coordinator for plant survey and monitoring projects at the Bouctouche Dune Eco-centre, focusing on the rare coastal plants of New Brunswick's Northumberland Coast, including several Species at Risk. Since 2006, David has worked as a botanist for the Atlantic Canada Conservation Data Centre, a position that requires extensive knowledge on the region's flora, including both native and exotic species. An accomplished field botanist, he has over fifteen years of experience working on various research, survey and monitoring projects and has authored and coauthored a large number of technical reports pertaining to rare plants in Atlantic Canada as well as numerous national and provincial Species at Risk status reports.

Sean Blaney is the Executive Director and Senior Scientist of the AC CDC, where he is responsible for maintaining status ranks and a rare plant occurrence database for plants in each of the three Maritime provinces. Since beginning with the AC CDC in 1999, he has discovered dozens of new provincial records for vascular plants and documented over 15,000 rare plant occurrences during extensive fieldwork across the Maritimes. Sean is a member of the COSEWIC Vascular Plant Species Specialist Committee and the Nova Scotia Atlantic Coastal Plain Flora Recovery Team, and has authored or co-authored numerous COSEWIC and provincial status reports. Prior to employment with AC CDC, Sean received a BSc in Biology (Botany Minor) from the University of Guelph and an MSc in Plant Ecology from the University of Toronto, and worked on a number of biological inventory projects in Ontario as well as spending eight summers as a naturalist in Algonquin Park, where he co-authored the second edition of the park's plant checklist.

Jacques Labrecque holds a Master's degree in plant taxonomy from the Université de Montréal. He has been, for more than 20 years, botanist at the Quebec Ministry of Environment and also botanist at the Quebec Conservation Data Centre. He has a broad knowledge of the Quebec flora, with emphasis on rare vascular plant species. He is in charge of updating the Quebec list of rare, threatened or vulnerable plant species. He has authored or co-authored three COSEWIC reports, on False-hop Sedge (*Carex lupuliformis*), Mountain Holly Fern (*Polystichum scopulinum*), Gulf of St. Lawrence Aster (*Symphyotrichum laurentianum*) and the previous versions of the Anticosti Aster report. He has also authored or co-authored a number of provincial status reports, identification guides, and collaborated for the third Edition of the Flore laurentienne, and the upcoming Flore nordique du Québec et du Labrador. He is also a jurisdictional member for Quebec at COSEWIC.

COLLECTIONS EXAMINED

Specimens collected from the Saint John River (NB) and upper Restigouche River (NB) in 1993 and housed at the Connell Memorial Herbarium (UNB) were examined. Most potential Anticosti Aster specimens collected in New Brunswick through AC CDC fieldwork from 2007 to 2010 were examined by both Luc Brouillet at the University of Montreal's plant biology research institute (IRBV) and Jacques Labrecque of Quebec's Ministère du Développement Durable, de l'Environnement et de la Lutte aux changements climatiques. A large number of collected specimens were studied through chromosome counting and flow cytometry analysis (see **Search Effort**).

Appendix 1: Threats Calculation for Anticosti Aster

THREATS ASSESSMENT WORKSHEET

Species or Ecosystem Scientific Name	Anticosti Aster (*Symphyotrichum anticostense*)
Element ID	**Elcode**
30/09/2016	
Assessor(s):	Sean Blaney, Dwayne Lepitzki, Bruce Bennett, Del Meidinger, David Mazerolle, Jacques Labreque, Mary Sabine, Jeannette Whitton, Stephanie Pellerin, Luc Brouillet, Jana Vamosi, Emmanuelle Fay, Joanna James
References:	COSEWIC report and references/personal experience described therein

	Level 1 Threat Impact Counts	
Threat Impact	**high range**	**low range**
A Very High	0	0
B High	0	0
C Medium	1	0
D Low	1	2
Calculated Overall Threat Impact:	Medium	Low
Assigned Overall Threat Impact:	**D = Low**	
Impact Adjustment Reasons:	The group decided to assign an overall threat impact of Low, given that none of the threats are particularly severe, unless the situation changes for the worse over the next 10 years.	
Overall Threat Comments	A generation time of 10 to 15 years was used given that there is some uncertainty. Shoots are annual; however, it could take 2 to 3 years for a plant to progress from seed to flower. Individual counts are based on rhizome segments. Seventy-five percent of the population occurs in one location (Restigouche river). At least 95% estimated population on Gaspé P. (most 76-90% along Restigouche R., ~17% Grande R.,~5% Bonaventure R., 1% Petit Pabos R.), < 1% at Lac Saint-Jean, ~ 1% on Anticosti Island. There are 18 subpopulations. There is some evidence that could support 3 DUs; however, the data aren't strong enough to justify this conclusion. Therefore, it was decided to proceed with one DU for this species. The threats calculator is based on the number of individuals and not the number subpopulations.	

Threat		**Impact (calculated)**		**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
1	Residential & commercial development		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
1.1	Housing & urban areas						Very little development occurs directly on top of the species' shoreline occurrences because of the site's potential for flooding and the existence of watercourse regulations. Impacts are thus more secondary via increased human traffic on foot and ATVs (which would fall under 6.1 Recreation). Threat from development is not high in large and extensive occurrences because development footprint would be small relative to area occupied. Threat from housing is most significant at the small and isolated Lac Saint-Jean occurrence, where virtually all of the available waterfront land has been developed. There is, however, some potential for minor impacts from new housing anywhere where Anticosti Aster occurs on private land in proximity to permanent population centres and near existing roads. This includes most subpopulations except those on Anticosti Island and the upstream portion of the extensive Restigouche River subpopulation. Housing and residential development is unlikely to affect this species because it is doubtful that development would occur directly along water's edge, where this species is found.
1.2	Commercial & industrial areas						
1.3	Tourism & recreation areas		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	Dock infrastructure along waterfront on Lac Saint-Jean, which could affect the proportion of the population that is present at this subpopulation (less than 1% of total population in Canada).
2	Agriculture & aquaculture						
2.1	Annual & perennial non-timber crops						
2.2	Wood & pulp plantations						
2.3	Livestock farming & ranching						
2.4	Marine & freshwater aquaculture						
3	Energy production & mining						
3.1	Oil & gas drilling						Oil exploration is occurring on Anticosti Island, but is unlikely to occur along waterways, where this species is found.
3.2	Mining & quarrying						Not applicable because it is illegal to mine for gravel in riverbeds.
3.3	Renewable energy						
4	Transportation & service corridors		Negligible	Negligible (<1%)	Unknown	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
4.1	Roads & railroads		Negligible	Negligible (<1%)	Unknown	High (Continuing)	Road and railway crossings of Anticosti Aster-occupied rivers were mostly completed long ago, outside the period relevant for status assessment. However, wherever bridges cross or corridors run immediately parallel to occupied shoreline, road maintenance and upgrading activities could occur at any time and would generally involve intensive but localized habitat disturbance. At most Anticosti Aster subpopulations transportation crossings or other affected areas represent a very small portion of the total occupied habitat and thus disturbances associated with them are unlikely to have large subpopulation impacts. Anticosti Aster is a disturbance-adapted species and is thus relatively likely to recolonize disturbed shoreline from upstream subpopulations if substrate characteristics remain suitable. Extensive colonization of gravelly roadsides and railroad beds involving very large numbers of individuals has been observed in the lower part of the Restigouche subpopulation. Because this species is disturbance-adapted, the construction of a road/railroad bridge could have a positive impact. Negative impacts could also occur if habitat is destroyed for construction of bridge footings. The potential for new bridge construction is unknown, although a bridge is currently being constructed on the Petit Pabos River.
4.2	Utility & service lines						Not applicable because the Energy East pipeline is not within the range of this species.
4.3	Shipping lanes						
4.4	Flight paths						
5	Biological resource use						
5.1	Hunting & collecting terrestrial animals						
5.2	Gathering terrestrial plants						
5.3	Logging & wood harvesting						This is only identified as a threat in the distant past, in association with log-driving on rivers, and is therefore not applicable. Logging no longer occurs within 30 m buffer zones around waterways.
5.4	Fishing & harvesting aquatic resources						
6	Human intrusions & disturbance	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
6.1	Recreational activities	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	Trampling and localized damage from boat launching and hauling occurs in many of the subpopulations, as does ATV use, all often in association with salmon and trout fishing. None of these activities are believed to be having significant impacts on any subpopulation. Gaspé River - public swimming has been more frequent in the last 10 years, with increased access roads to the water. This has also increased ATV use along the shoreline. ATV use is also occurring along the Restigouche and Saint-John rivers (possibly less so along the Restigouche). This species is also threatened by lawnmowers (Restigouche) and trampling; however, trampling is less severe.
6.2	War, civil unrest & military exercises						
6.3	Work & other activities		Negligible	Negligible (<1%)	Negligible (<1%)	Moderate (Possibly in the short term, < 10 yrs)	Some limited plant collection by researchers is planned for certain parts of the population.
7	Natural system modifications		Not Calculated (outside assessment timeframe)	Restricted - Small (1-30%)	Extreme (71-100%)	Low (Possibly in the long term, >10 yrs)	
7.1	Fire & fire suppression						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
7.2	Dams & water management/use		Not Calculated (outside assessment timeframe)	Restricted - Small (1-30%)	Extreme (71-100%)	Low (Possibly in the long term, >10 yrs)	Within the Anticosti Aster's known areas of occurrence, large hydroelectric dams are in place at Mactaquac and Beechwood on the Saint John River in New Brunswick, and at Tinker on the Aroostook River (a major Saint John River tributary, with Anticosti Aster occurring upstream from the head pond in Maine) and at the outlet of Lac Saint-Jean, Quebec (Grande Décharge Dam). All of these dams, especially those on the Saint John River, likely eliminated large areas of suitable shoreline habitat in periods outside that which is relevant for current status assessment. Increases in the height of any of these dams would increase areas affected upstream. No new dams on Anticosti Aster rivers are currently planned but some rivers have hydroelectric potential. The Mactaquac Dam in New Brunswick is currently being evaluated for refurbishment or decommissioning, so some changes in its water level may occur within a decade, but this is unlikely to affect a large portion of the existing Saint John River subpopulation as height could not be greatly increased and resulting flooding would not extend far into the currently occupied zone. Downstream effects on flood disturbance regimes from the Mactaquac, Beechwood and Tinker dams may be contributing to increased cover of invasive exotics and competing common native species in Anticosti Aster habitats on the Saint John River. This is mainly a historical threat. New dams could be constructed or existing dams could be heightened, which could produce upstream and downstream effects through habitat loss and flooding or loss of natural flooding cycles or ice scouring in the spring (however, dams on area river systems have been present for decades and large floods and ice scouring are still occurring - i.e. Mactaquac Dam). If such an event were to occur it could affect a portion of the Saint John subpopulation. The Mactaquac Dam may be rebuilt, but a decision won't be made on this until 2018.
7.3	Other ecosystem modifications						
8	Invasive & other problematic species & genes	CD	Medium - Low	Restricted (11-30%)	Serious - Moderate (11-70%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
8.1	Invasive non-native/alien species	CD	Medium - Low	Restricted (11-30%)	Serious - Moderate (11-70%)	High (Continuing)	Effects of extreme densities of introduced White-tailed Deer on Anticosti Aster subpopulations are significant, with most plants heavily browsed and reduced in height, and number of mature individuals potentially reduced. Anticosti Island represents a very small portion of the known Canadian population (though it may support a considerable number of undocumented occurrences of unknown size) but does constitute a significant portion of the extent of occurrence and subpopulations. Invasive exotic plants are very prevalent throughout the Saint John River subpopulation in New Brunswick, with decreases in ideal habitat noted over the last 20 years as a result. Reed Canary Grass is the most significant invasive on the Saint John River. A high diversity of widespread and moderately invasive exotic species occurs throughout the largest subpopulation on the Restigouche River as well and may be having modest population impacts, although densities generally do not appear sufficient to be eliminating local occurrences. The presence of White-tailed Deer may affect the Anticosti Aster and other floodplain species through changes to carbon cycling from excess manure; however, this threat is being scored based on the presence of invasive plant species. Canary Reed Grass is considered the biggest threat, especially on the Saint-John river (25% of total Anticosti Aster population), and less of a threat on the Restigouche, Gaspé, and on Anticosti Island. Where present, Reed Canary Grass is considered a competitive weed that can degrade the natural habitat, although the specific effect on the Anticosti Aster is not well documented.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
8.2	Problematic native species		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	Hybridization with co-occurring aster species, especially New York Aster, has likely always occurred naturally. Incidence of hybridization could be increasing in association with human disturbance in some areas (especially the Gaspé Peninsula of Quebec), where New York Aster may be spreading in disturbed roadsides from coastal strongholds upstream into Anticosti Aster habitat, so that the two species are now more frequently in proximity than would have been the case historically. Evidence of the extent that this presents a threat to particular subpopulations is very limited. In New Brunswick, the two species co-occur extensively in what appears to be a natural distribution pattern so there is even less evidence that hybridization is a human-influenced threat. Anticosti Aster is known to hybridize with the New York Aster, which occurs across the same range as the Anticosti Aster. Hybridization likely occurs naturally but may also be encouraged by human-caused disturbances; however, it is difficult to determine to what extent human activity is promoting hybridization between these two species. Hybridization is more likely to be natural along the Restigouche River, where the majority of the Anticosti Aster population resides.
8.3	Introduced genetic material						
9	Pollution						
9.1	Household sewage & urban waste water						
9.2	Industrial & military effluents						
9.3	Agricultural & forestry effluents						Sedimentation doesn't seem to be a concern for this species because it has been seen growing in this substrate.
9.4	Garbage & solid waste						
9.5	Air-borne pollutants						
9.6	Excess energy						
10	Geological events						
10.1	Volcanoes						
10.2	Earthquakes/tsunamis						
10.3	Avalanches/landslides						
11	Climate change & severe weather		Unknown	Small (1-10%)	Unknown	High - Moderate	
11.1	Habitat shifting & alteration						
11.2	Droughts						
11.3	Temperature extremes						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
11.4	Storms & flooding		Unknown	Small (1-10%)	Unknown	High - Moderate	Flood-impacted habitats are crucial for Anticosti Aster, so severe flood impacts (potentially at greater frequency and severity than historical regimes because of climate change and forest clearance) are only considered a threat on rivers where number of mature individuals is very small and stochastic events might result in local extirpations. These are mostly on Anticosti Island (Jupiter, Brick, aux Rats, Chicotte, Martin; but note that population estimates on Anticosti Island may be significantly underestimated) and Gaspé Peninsula (Saint-Jean). The total population potentially affected at these sites is very low relative to the large numbers present on the Restigouche River and elsewhere, but the proportion of subpopulations potentially affected is fairly high. Flooding is considered beneficial for this species; however, flooding events could become more frequent and severe with climate change, which could impact small populations of this species. There is evidence that flooding has increased on the Saint-John river in the last ~50 years. This could be caused by climate change or reduced forest cover - more information is needed. It is difficult to predict how this threat would impact other river systems in the future.
Classification of Threats adopted from IUCN-CMP, Salafsky *et al.* (2008).							