COSEWIC
Assessment and Status Report

on the

Gulf of St. Lawrence Aster
Symphyotrichum laurentianum

in Canada

ENDANGERED
2023

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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Previous report(s):

COSEWIC 2004. COSEWIC assessment and update status report on the Gulf of St. Lawrence aster *Symphyotrichum Laurentia* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 39 pp. (https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html).

Houle, F. 1989. COSEWIC status report on the Gulf of St. Lawrence aster *Aster laurentianus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 37 pp.

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Gulf of St. Lawrence Aster, Photograph by David Mazerolle.

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COSEWIC
Assessment Summary

Assessment Summary – May 2023

Common name
Gulf of St. Lawrence Aster

Scientific name
Symphyotrichum laurentianum

Status
Endangered

Reason for designation
This annual plant is endemic to Gulf of St. Lawrence coastal habitats. It grows mainly on brackish sands around coastal lagoons and ponds isolated from the sea by barrier beaches and in coastal marshes. The plant presently occurs in 12 subpopulations: four in the Magdalen Islands of Quebec, three in Prince Edward Island, and five in New Brunswick. An additional 13 subpopulations have not been seen in 15 years or more and are likely extirpated. The number of mature individuals at a site can fluctuate dramatically but long-term population averages that account for fluctuation have indicated population declines of more than 50 percent in the past 10 years. The change in status since the last assessment reflects these declines, which are considered to be primarily due to an increased frequency and severity of storms.

Occurrence
Quebec (Magdalen Islands), New Brunswick, Prince Edward Island

Status history
Designated Special Concern in April 1989. Status re-examined and designated Threatened in May 2004. Status re-examined and designated Endangered in May 2023.

COSEWIC
Executive Summary

Gulf of St. Lawrence Aster
Symphyotrichum laurentianum

Wildlife Species Description and Significance

Gulf of St. Lawrence Aster is a small, halophytic, herbaceous annual aster that is endemic to Canada, occurring in coastal habitats in New Brunswick, Prince Edward Island, and Quebec's Magdalen Islands. It is of evolutionary and phytogeographic interest and often grows with other species of conservation concern.

Aboriginal (Indigenous) Knowledge

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

Distribution

Gulf of St. Lawrence Aster occurs on Gulf of St. Lawrence shores in Quebec, New Brunswick, and Prince Edward Island. In Quebec it is restricted to the Magdalen Islands archipelago with the vast majority of mature individuals at two wetland complexes (Havre aux Basques and Le Barachois). In New Brunswick, the species is known from five subpopulations on the eastern shore, distributed from Kouchibouguac National Park (where recently reintroduced) and north to Val-Comeau and Miscou Island. Prince Edward Island's subpopulations are present on the province's northern coast in Prince Edward Island National Park with an additional historical subpopulation 85 km northwest at Tignish.

Habitat

Gulf of St. Lawrence Aster grows in brackish coastal sands that typically occur along the shores of barachois (coastal lagoon) ponds and in barrier dune salt marshes. Suitable microhabitats are characterized by moist bare sand, mud, or peat in areas of these communities with sparse vegetation cover. These areas are subject to periodic natural and anthropogenic disturbances that can drastically alter the amount of habitat available to the species year to year.

Biology

Gulf of St. Lawrence Aster is an annual that germinates in June, flowers from mid-August to mid-September, fruits in late September, and disperses its fruit in late October. Most Gulf of St. Lawrence Aster seed is produced by self-fertilization, but cross-pollination also occurs. Seed bank viability is relatively high for one year but is much lower over time. Natural seed bank viability is estimated at 10 years. Germination is negatively affected by flooding, low temperatures, and high salinity.

Population Sizes and Trends

Numbers of mature individuals of Gulf of St. Lawrence Aster can exhibit very large year-to-year fluctuations but the soil seed bank is assumed to stabilize the population such that extreme fluctuation does not apply. Because of high variability, the population is estimated as an average over three generations (~15 years, since 2007; 208,186 mature individuals; 88% in Quebec, 12.0% in New Brunswick, < 1% in Prince Edward Island). Most (98%) of the Canadian population is contained within just four subpopulations: Havre aux Basques, QC (68%), Le Barachois, QC (19%), Windsors Malbaie, NB (8%), and Lac Frye / Miscou Lighthouse, NB (3%). This concentration makes the species more sensitive to impacts from stochastic storm events or anthropogenic habitat alteration.

The number of subpopulations is continuing to decline. Of the 25 subpopulations ever documented, eight were extirpated prior to 2000 and five Magdalen Islands subpopulations were potentially extirpated between 2000 and 2008. Of the 12 extant subpopulations, 3 to 5 subpopulations in Prince Edward Island and Kouchibouguac National Parks are potentially dependent on continuing reintroductions.

The Canadian population has experienced a 90% decline over the 15 years (~3 generations) when values from the 2007 to 2022 period are compared against subpopulation counts from the 1999 to 2006 period. Declines were substantial in Prince Edward Island (98.9% decline) and in the Magdalen Islands (90.3% decline), but there was a large increase when comparing the same periods in New Brunswick (1,721% increase).

The cause of long-term decline on the Magdalen Islands may include alterations of habitat by climate change-linked storm events and human alteration of drainage. Large, long-term declines at Blooming Point, PE are attributed to natural succession of vegetation that has removed most of the suitable habitat.

Threats and Limiting Factors

The most significant threats to Gulf of St. Lawrence Aster are habitat change caused by severe storms and sea-level rise associated with climate change, human-driven modifications of water cycles at the site level, and shoreline development. Lesser or potential threats include habitat damage from all-terrain vehicle use and trampling, competition from exotic and native species, and potential hybridization with the introduced species, Rayless Alkali Aster. Insect herbivory and low rates of successful dispersal may be limiting factors for Gulf of St. Lawrence Aster.

Protection, Status and Ranks

Gulf of St. Lawrence Aster is afforded protection as a Threatened species under Schedule 1 of the federal *Species at Risk Act*. The species is legally designated as Threatened in Quebec and Endangered in New Brunswick. In Prince Edward Island, it has no formal protection under the *Wildlife Conservation Act*, but all extant occurrences are protected within Prince Edward Island National Park. In Quebec, all Gulf of St. Lawrence Aster sites (beaches and dune slacks) are under provincial jurisdiction and three of the four extant subpopulations are within designated Plant Habitat or Provincial Faunal Wildlife Reserves. Two extant New Brunswick occurrences are within Kouchibouguac National Park, and one is within a Nature Conservancy of Canada nature reserve.

TECHNICAL SUMMARY

Symphyotrichum laurentianum

Gulf of St. Lawrence Aster

Aster du golfe Saint-Laurent

Range of occurrence in Canada (province/territory/ocean): Quebec (Magdalen Islands), New Brunswick, Prince Edward Island

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)	est. 3–5 years See **Life Cycle and Reproduction** for detailed discussion.
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Yes, inferred.
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations, whichever is longer up to a maximum of 100 years]	Estimated decline of 45–60% in past 10 years.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations, whichever is longer up to a maximum of 100 years].	Estimated decline of > 50%.
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations, whichever is longer up to a maximum of 100 years].	Unknown, but decline suspected to continue given threats.
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any period [10 years, or 3 generations, whichever is longer up to a maximum of 100 years], including both the past and the future.	Estimated and suspected decline > 50%, given threats and past declines.
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	a. no b. no c. no
Are there extreme fluctuations in number of mature individuals?	Possibly. Fluctuations in mature individuals within subpopulations but soil seed bank is assumed to be more consistent. However, seed bank can be removed or buried for a time period exceeding seed viability.

Extent and Occupancy Information

Estimated extent of occurrence (EOO)	30,808 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value).	84 km² for known extant subpops. Possibly up to 20 km² more in Magdalen Islands subpops. considered potentially extirpated.

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. Subpops in Magdalens, Kouchibouguac, north NB and PE are closely spaced. Rare long-distance dispersal is inferred (see **Dispersal and Migration**)
Number of "locations"* (use plausible range to reflect uncertainty if appropriate)	(8) 13–18 Range of 13–18 reflects 5 potentially extirpated locations in Magdalen Islands. 3–5 very tenuous and likely reintroduction-dependent locations are included in the 13, but if not sustained there could be as few as 8 locations.
Is there an [observed, inferred, or projected] decline in extent of occurrence?	Possibly. If potentially extirpated northern Magdalen Is. subpops. are lost, EO declines slightly.
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	Yes. Apparent loss of some IAO in Magdalen Islands and 3–5 very tenuous subpopulations in PE and Kouchibouguac NP, NB.
Is there an [observed, inferred, or projected] decline in number of subpopulations?	Yes. Inferred potential losses of 5 Magdalen Islands subpopulations sometime after 2000–2007. 4–5 PE and Kouchibouguac subpopulations are dependent on reintroduction with some likely to be lost.
Is there an [observed, inferred, or projected] decline in number of "locations"*?	Yes. Inferred potential losses of 5 Magdalen locations sometime after 2000–2008. 4– 5 PE and Kouchibouguac locations are dependent on reintroduction with some likely to be lost.
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat?	Yes. Observed decline with anthropogenic and storm-caused changes in hydrology and inferred decline from large PE and QC subpopulation declines.
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 for more information on this term.

Number of Mature Individuals (in each subpopulation)

Subpopulations	Subpopulation annual counts since 2007, last count, last present	N Mature Individuals (Annual avg. over last 3 generations, since 2007)
Magdalen Islands, Quebec		
Baie du Havre aux Basques	9 counts since 2007, max. <4,000,000 (2001) Last count 2022, last plants 2022	141,857
Le Barachois, QC	9 counts since 2007, max 100,000 to 1,000,000 (2001) Last count 2022, last plants 2022	40,400
Cap de l'Hôpital	3 counts since 2007, max 1,500 (2004) Last count 2016, last plants 2016	140
Bassin aux Huitres	9 counts since 2007, max. >20,000 (2001) Last count 2022, last plants 2022	732
Baie de la Grosse Île	0 counts since 2007, max. 10,000 to 100,000 (2004) Last count 2005, last plants 2007*	(*plants seen but not counted in 2007)
Pointe de l'Est	1 count since 2007, max. 3,000 (2005) Last count 2007, last plants 2007	10
Anse aux Étangs	0 counts since 2007, max. 100 to 1,000 (2000) Last count 2004, last plants 2001	?
Old Harry	0 counts since 2007, max. 10 to 100 (2001) Last count 2004, last plants 2001	?
Baie Clarke	1 count since 2007, max. 1,000 to 10,000 (2001) Last count 2007, last plants 2005	0
Grande-Entrée (extirpated)	0 counts since 2007, No non-zero historical counts Last count 2001, last plants 1985	0
Lac aux Canards (extirpated)	0 counts since 2007, No non-zero historical counts Last count 2001, last plants 1995	0
Étang du Nord (extirpated)	0 counts since 2007, No non-zero historical counts Last count 2001, last plants 1912	0
New Brunswick		
Windsors Malbaie	12 counts since 2007 max. 100,000+ (2021,2022) Last count 2022, last plants 2022	17,361
Val-Comeau (Tracadie Dune)	9 counts since 2007 max. ~10,000 (2022) Last count 2022, last plants 2022	1,339

Kouchibouguac NP, Lac-à-Exilda (*reintroduced 2016)	16 counts since 2007 max. 1,000 to 2,000 (2000) Last count 2022, last plants 2022	2
Kouchibouguac NP, Le Barachois (*reintroduced 2016)	16 counts since 2007 max. 2,689 (2018) Last count and last plants 2022	254
Lac Frye / Miscou Lighthouse	9 counts since 2007 max. >17,000 (2016) Last count and last plants 2022	5,467
Kouchibouguac NP, Cap St.-Louis Wharf (failed reintroduction 2016)	2 counts since 2007 No historic counts Last count 2017, last plants 1977	0
Prince Edward Island		
Prince Edward Island NP (PEI NP) - Blooming Point (*reintroduction 2008–09, 2012–13, 2015–19, 2021–22)	16 counts since 2007 max. 120,400 (2004) Last count 2022, last plants 2022	350
PEI NP - Campbells Pond	16 counts since 2007 max. 3,552 (2016) Last count 2022, last plants 2022	273
PEI NP - Covehead Pond (*lost 2006, reintroduction 2017–19, 2021–22)	16 counts since 2007 max. 763 (1997) Last count 2022, last plants 2020	(2 plants in 2020 after reintroduction were the only ones since 2007) 1
PEI NP - Grand Tracadie (location uncertain, may have been from Campbells Pond or Blooming Point rather than separate occurrence)	Some searching since 2007, No historical counts Last plants 1912	0
PEI NP - Long Pond	16 counts since 2007 max. 1 (1992, 1993) Last count 2022, last plants 1993	0
PEI NP - Brackley Point	Some searching since 2007, max. 12 1983–86 Last plants 1983–1986	0
Tignish	1 count since 2007, No historical counts Last count 2020, last plants 1983–1986	0
Total		**208,186**

Quantitative Analysis

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

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

Was a threats calculator completed for this species? Yes, see Appendix 1. Overall threat impact: Very High – Medium i. IUCN Threat 11: Climate change and severe weather (Very High – Medium impact) ii. IUCN Threat 7.3: Ecosystem modifications (Medium – Low impact) iii. IUCN Threat 7.2: Dams & water management/use (Low impact) iv. IUCN Threat 6.1: Recreational activity (Unknown impact) What additional limiting factors are relevant? - Limited dispersal success Herbivory

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	Canada has the entire global population.
Is immigration known or possible?	N/A
Would immigrants be adapted to survive in Canada?	N/A
Is there sufficient habitat for immigrants in Canada?	N/A
Are conditions deteriorating in Canada?[+]	Possible net decline in habitat quality with climate change associated events (see **Habitat Trends**, and **Threats – Climate Change and Severe Weather**)
Are conditions for the source (i.e., outside) population deteriorating?[+]	N/A
Is the Canadian population considered to be a sink?[+]	N/A
Is rescue from outside populations likely?	N/A

Data Sensitive Species

Is this a data sensitive species?	No

Status History

COSEWIC Status History: Designated Special Concern in April 1989. Status re-examined and designated Threatened in May 2004. Status re-examined and designated Endangered in May 2023.

Status and Reasons for Designation:

Status:	**Alpha-numeric codes:**
Endangered	A2abce+4abce

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

Reasons for designation:
This annual plant is endemic to Gulf of St. Lawrence coastal habitats. It grows mainly on brackish sands around coastal lagoons and ponds isolated from the sea by barrier beaches and in coastal marshes. The plant presently occurs in 12 subpopulations: four in the Magdalen Islands of Quebec, three in Prince Edward Island, and five in New Brunswick. An additional 13 subpopulations have not been seen in 15 years or more and are likely extirpated. The number of mature individuals at a site can fluctuate dramatically but long-term population averages that account for fluctuation have indicated population declines of more than 50 percent in the past 10 years. The change in status since the last assessment reflects these declines, which are considered to be primarily due to an increased frequency and severity of storms.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Meets Endangered, A2abce+4abce. Estimated decline of greater than 50% in the number of mature individuals over the past three generations (about 9–15 years) and estimated and suspected decline greater than 50% over three generations spanning past and future. Declines are based on direct observation (a), estimates of population abundance (b), a decline in index of area of occupancy and quality of habitat (c), and the effects of introduced taxa and competitors (e).
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable. May meet Endangered B2b(ii,iii,iv,v)c(iv) as IAO of 84 km^2 is well below the threshold for Endangered and the population may experience extreme fluctuations. There is a continuing decline in IAO, area, extent, and quality of habitat, number of locations and subpopulations, and number of mature individuals.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. Number of mature individuals, of over 200,000, exceeds thresholds.
Criterion D (Very Small or Restricted Population): Not applicable. Estimate of over 200,000 mature individuals exceeds thresholds for D1, and population does not have a very restricted IAO nor does it have few locations, which would make it vulnerable to rapid and substantial decline.
Criterion E (Quantitative Analysis): Not applicable. Analysis not conducted.

PREFACE

Much new information on Gulf of St. Lawrence Aster has been accumulated since the previous status report (COSEWIC 2004). Substantial survey effort has occurred throughout potential habitat in New Brunswick and Prince Edward Island but no new subpopulations have been located since 2002, which suggests that the species is truly very limited on the landscape. Counts of mature individuals have been widely undertaken throughout its range, suggesting that three to five Magdalen Islands subpopulations may have been lost since 2000–2008. Overall numbers appear to be in substantial decline (90% loss when 1999–2006 and 2007–2022 averages are compared). Reintroduction or population augmentation efforts have been undertaken at Kouchibouguac and Prince Edward Island National Parks, although subpopulations at those sites mostly remain small and tenuous. Academic research on the various aspects of the species' genetics, physiology, and adaptability has occurred since 2004 through researchers at Université de Moncton (under Liette Vasseur), University of New Brunswick (under Stephen Heard), Laval University (under Gilles Houle), and University of Prince Edward Island (under Christian Lacroix).

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
(2023)

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.

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Symphyotrichum laurentianum

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2023

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific name: *Symphyotrichum laurentianum* (Fernald) Nesom

Original description: Fernald, M.L. 1914. Some Halophytic, Annual Asters of the Maritime Provinces. Rhodora 16: 57-80.

Type specimen: Prince Edward Island, Brackley Point, August 31, 1912. Fernald, Long and St. John 8166; Holotype: GH!; Isotypes†: BM!, DS!, F!, GH!, MO!, MT!, NY!, UC/JEPS! (!: specimens located by F. Houle, 1988a)

Synonyms:
Aster laurentianus Fernald
Aster laurentianus var. *magdalenensis* Fernald
Aster laurentianus var. *contiguus* Fernald
Brachyactis laurentiana (Fernald) Botschantzev
Brachyactis ciliata ssp. *laurentiana* (Fernald) A.G. Jones

English name: Gulf of St Lawrence Aster, Rayless Aster

French name: Aster du Saint-Laurent; aster du golfe Saint-Laurent

Mi’kmaq name: Pewoqiajkewe’l

Family: Asteraceae

Major Plant Group: Dicots, flowering plants

Morphological Description

Gulf of St. Lawrence Aster is a small, annual halophyte. Stems are 1 to 40 cm long and may be unbranched, or with axillary branches (Figure 1). The fleshy, untoothed leaves are 1.1 to 6.5 cm long by 2 to 9.8 mm wide and widest toward the tip. The small flowers occur in cylindrical involucres 0.5 to 1.4 (2) cm wide in which outer flowers are strictly female and central flowers are male + female. Achenes have a well-developed pappus equalling or overtopping the flowers. Chromosome number: 2n = 14 (Houle and Brouillet 1985).

Figure 1. Gulf of St. Lawrence Aster, photographed at Windsors Malbaie, New Brunswick, in September 2020. Photo credit: David Mazerolle

The species can be distinguished from the only similar local species, the exotic Rayless Alkali Aster (*Symphyotrichum ciliatum*), by the absence of cilia on the margins of its leaves and phyllaries. The absence of ray florets distinguishes it from other co-occurring asters.

Population Spatial Structure and Variability

Gulf of St. Lawrence Aster occurs in 12 subpopulations at present, including four in the Magdalen Islands of Quebec, three in Prince Edward Island, and five in New Brunswick. An additional 13 subpopulations have not been seen in 15 years or more. Eight of these are considered extirpated and five are considered potentially extirpated / potentially extant. Subpopulations are defined as “geographically or otherwise distinct groups in the population where there is little demographic or genetic exchange” (COSEWIC 2019). For Gulf of St. Lawrence Aster, subpopulations are grouped primarily by occurrence within an area of shared hydrology. This is generally consistent with habitat-based plant element occurrence (EO) delimitation standards under which occurrences are grouped when 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 (NatureServe 2020).

Designatable Units

Heard *et al.* (2009) found that Gulf of St. Lawrence Aster has more genetic variation than many rare plants and less population differentiation than other primarily self-pollinating species. They found no significant association between the distance separating subpopulations in the Magdalen Islands and Prince Edward Island and levels of genetic differentiation, and they suggested a distribution model involving the Magdalen Islands as a reservoir of genetic variation and a source for long-distance founding of new subpopulations. Thus, molecular evidence does not support the recognition of more than one designatable unit.

Special Significance

Gulf of St. Lawrence Aster is a Canadian endemic taxon restricted to the Gulf of St. Lawrence (Fernald 1925; Erskine *et al.* 1985; Marie-Victorin 1995; Catling and McKay 1980), where it is occasionally sympatric with other globally or regionally rare species. Survey data (Houle 1988a; Gagnon *et al.* 1995a,b; AC CDC 2021) show that the following species of conservation concern sometimes grow in association with Gulf of St. Lawrence Aster:

- Marsh Felwort – *Lomatogonium rotatum* L. (NB S1)
- Slim-stemmed Reed Grass – *Calamagrostis stricta* (Timm) Koeler ssp. *Stricta*
- (NB S3S4; PE S2S3)
- Peach-leaved Dock – *Rumex persicarioides* L. (NB S2S3; PE S2?)
- Saltmarsh Starwort – *Stellaria humifusa* Rottb. (NB S3; PE S1)
- Connecticut Beggar's-ticks – *Bidens heterodoxa* (Fernald) Fernald & St. John
- (QC S2; NB S1?; PE S2)
- Gaspé Arrowgrass – *Triglochin gaspensis* Lieth & D. Löve (NB S3S4; PE S3)
- Cursed Buttercup – *Ranunculus sceleratus* L. (NB S1)
- Alaska Alkali-grass – *Puccinellia nutkaensis* (J. Presl) Fernald & Weatherby (NB S2)
- Red Goosefoot – *Oxybasis rubra* (L.) S. Fuentes, Uotila & Borsch (QC S2; NB S2)
- Frankton's Saltbush – *Atriplex glabriuscula* var. *franktonii* (Taschereau) S.L. Welsh (NB S2)

There are no known economic uses for Gulf of St. Lawrence Aster.

ABORIGINAL (INDIGENOUS) KNOWLEDGE

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

Cultural Significance to Indigenous Peoples

There is no species-specific ATK in the report. However, Gulf of St. Lawrence Aster is important to Indigenous Peoples, who recognize the interrelationships of all species within the ecosystem.

DISTRIBUTION

Global Range

Gulf of St. Lawrence Aster is a rare endemic species of the southern Gulf of St. Lawrence where it is restricted to Quebec’s Magdalen Islands, New Brunswick’s eastern shore, and the north shore of Prince Edward Island (Figures 2 to 5; Tables 1 to 3; Houle and Haber 1990; Gilbert *et al.* 1999; AC CDC 2021). Its global distribution falls within a latitudinal range of 180 km (from 46.41°N to 48.02°N) and a longitudinal range of 270 km (from 64.90°W to 61.39°W).

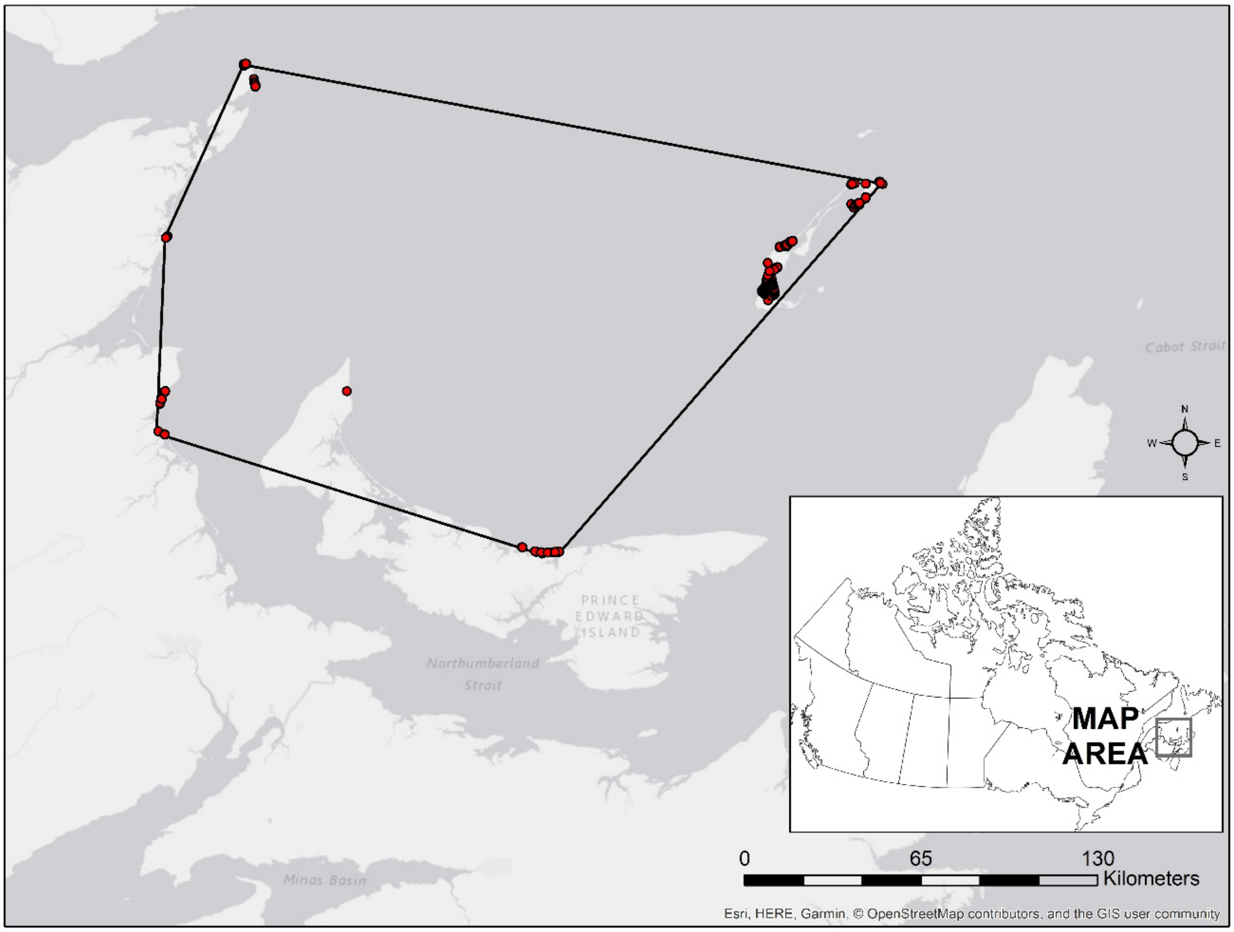

Figure 2. Canadian distribution of Gulf of St. Lawrence Aster showing the minimum convex area polygon representing extent of occurrence. Dots appearing dark reflect a high density of occurrences.

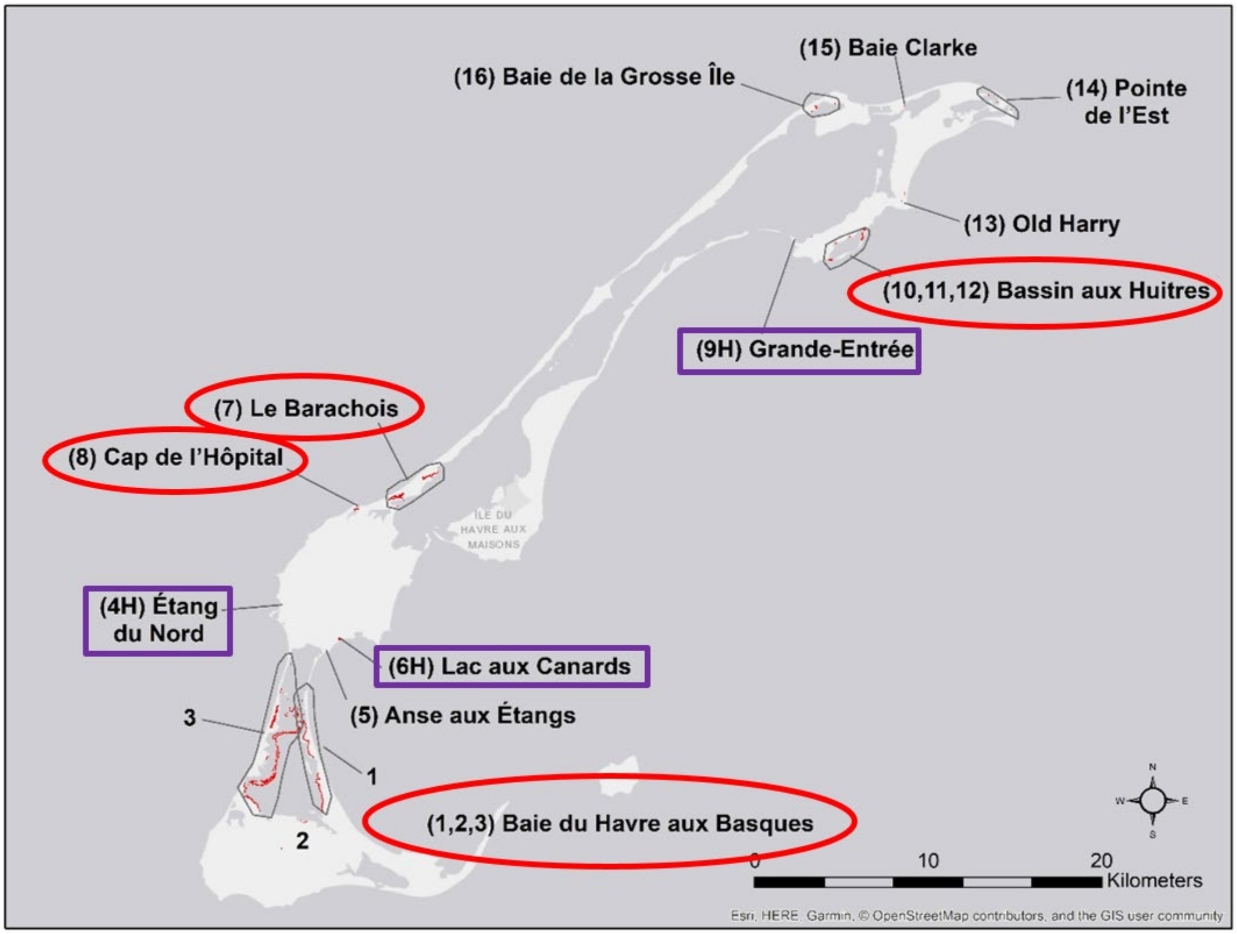

Figure 3. Distribution of Gulf of St. Lawrence Aster in the Magdalen Islands with COSEWIC (2004) subpopulation numbers. Circled subpopulations are considered extant (recorded 2016 or after), boxed subpopulations are extirpated. The status of other subpopulations is unknown but potentially extirpated with no records in the past 15 years. Each named subpopulation on this map is considered one location based on fairly uniform hydrological influences within the subpopulation, except at Le Barachois, where there are two locations that are somewhat hydrologically distinct. H – historical subpopulation and location.

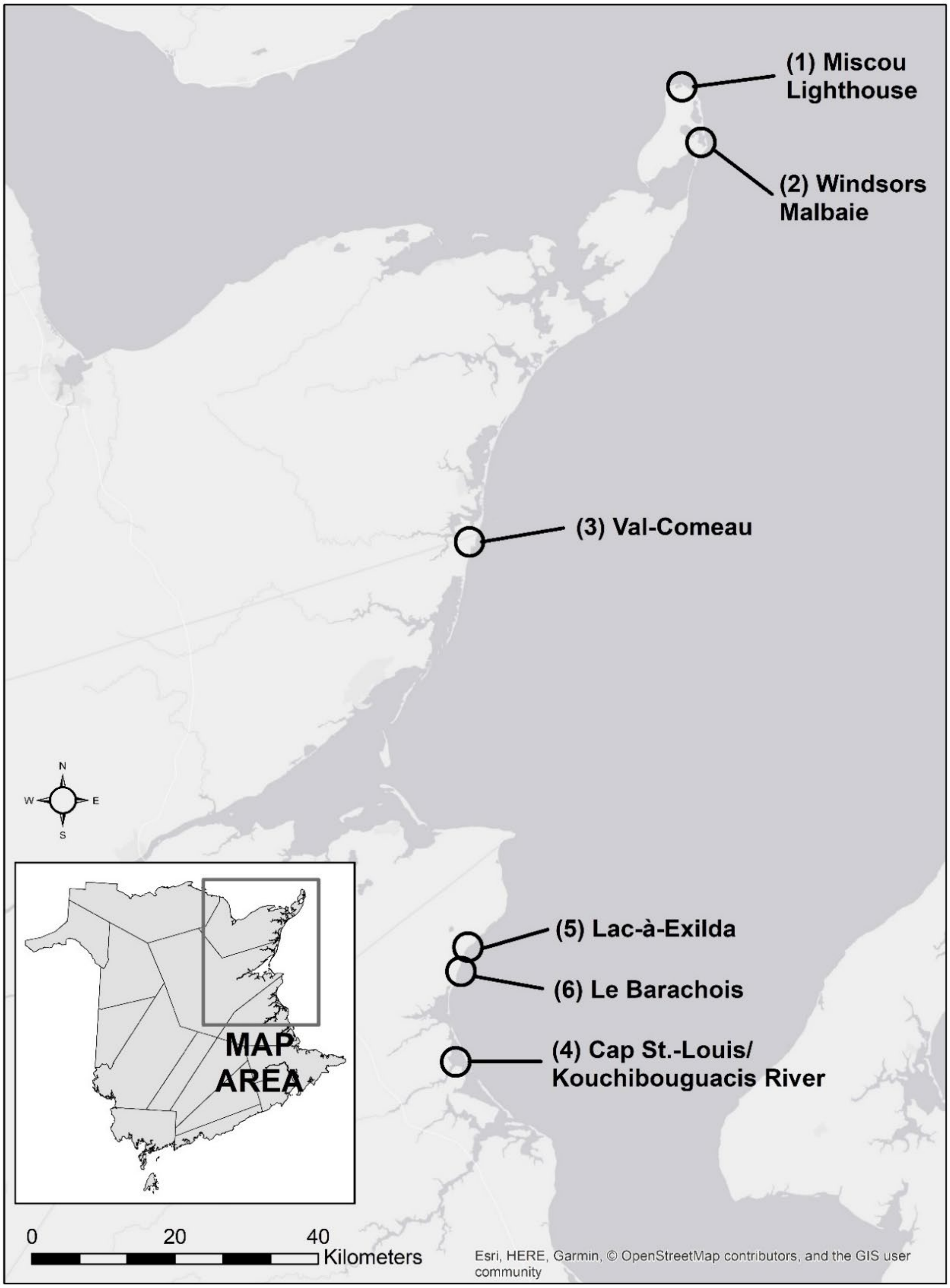

Figure 4. Distribution of Gulf of St. Lawrence Aster in New Brunswick with COSEWIC (2004) subpopulation numbers. Subpopulations 4 to 6 were considered extirpated before reintroduction efforts in 2016 and 2017. Each named subpopulation on this map is considered one location based on fairly uniform hydrological influences within the subpopulation. The Cap St.-Louis subpopulation is extirpated.

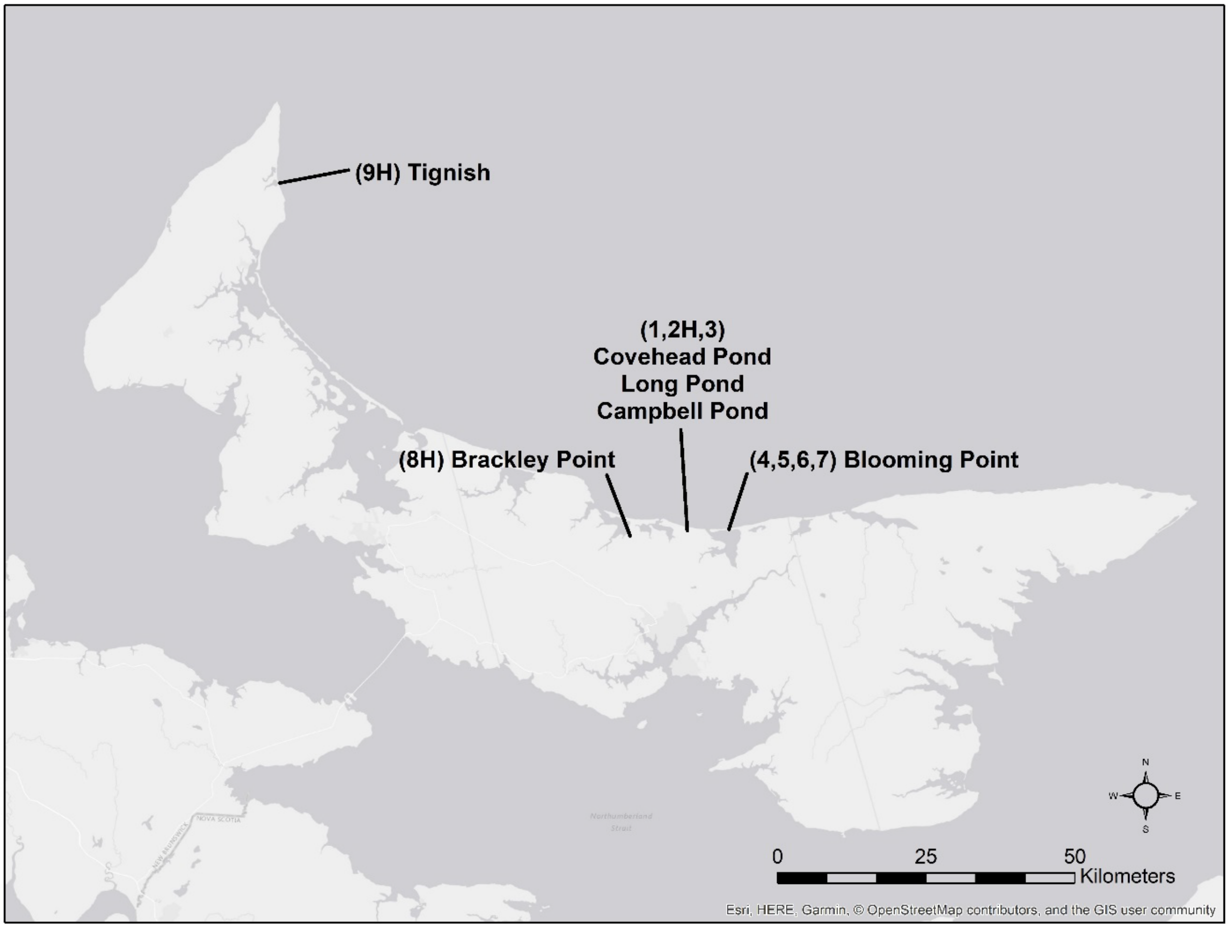

Figure 5. Distribution of Gulf of St. Lawrence Aster on Prince Edward Island with COSEWIC (2004) subpopulation numbers. H – historical subpopulation. Each named subpopulation on this map is considered one location based on fairly uniform shared hydrological influences within the subpopulation.

Table 1. Subpopulation counts of Gulf of St. Lawrence Aster from the Magdalen Islands, Quebec. Blue shaded subpopulations are considered extirpated. Yellow shaded subpopulations are potentially extant but not recently seen. N/A = plants noted but count not recorded.

Subpopulation	Baie du Havre aux Basques	Étang du Nord (extirp.)	Anse aux Étangs	Lac aux Canards (extirp.)	Le Barachois	Cap de l'Hôpital	Grande-Entrée (extirp.)	Bassin aux Huîtres	Old Harry	Pointe de l'Est	Baie Clarke	Baie de la Grosse Île
COSEWIC 2004 ID	1, 2, 3	4	5	6	7	8	9	10, 11, 12	13	14	15	16
CDPNQ ID	4135/14761/ 15762	4136	4137	4144	4143	14759	4141	4142	4140	4138	4139	14760
Last obs.	2022	1912	2001	1995	2021	2016	1985	2017	2001	2007	2005	2007
1999	2,510,000	0	100-1,000	0	10,000		0		10-100	100-1,000	1,000-10,000	
2000	3,500,000	0	100-1,000	0			0					

Subpopulation	Baie du Havre aux Basques	Étang du Nord (extirp.)	Anse aux Étangs	Lac aux Canards (extirp.)	Le Barachois	Cap de l'Hôpital	Grande-Entrée (extirp.)	Bassin aux Huîtres	Old Harry	Pointe de l'Est	Baie Clarke	Baie de la Grosse Île
2001	>4,000,000	0	10	0	100,000 - 1,000,000	100 - 1,000	0	>20 000	10-100	100-1,000	1,000-10,000	1-100
2002	500,000											
2003	21,623											
2004	1,500,500		0		100,000	1 500		> 1,000	0		1,000	10,000 - 100,000
2005	603,400				1,000	266		55,000		3,000	1,000	0
Avg. 1999-2005	**1,805,075**	**0**	**253**	**0**	**115,250**	**755**	**0**	**25,333**	**33**	**1333**	**3000**	**16,683**
2007	506,000				10,000	200		100-500		10	0	N/A
2009					>6,500	N/A		>2,000				
2010	>100,000				N/A	N/A						
2011	>50,000				30			390				
2013	79,320				17,676			542				
2014	85,170				24,969	200		322				
2015	44,385				124,881			1,040				
2016	36,953				132,282	20		2,536				
2017	427,444				56,000			50				
2018	101,351				46,789							
2021	1				>15,000			0				
2022	129,800				10,708			137				
Avg. 2007-2022	**141,857**	**0**	**?**	**0**	**40,440**	**140**	**0**	**732**	**?**	**10**	**?**	**?**

Table 2. New Brunswick counts of Gulf of St. Lawrence Aster. N/A = plants noted but count not recorded. † - reintroduced (spring seeding); * - reintroduced (fall seeding). The blue shaded subpopulation is considered extirpated.

Occurrence	Lac Frye / Miscou Lighthouse	Windsors Malbaie & Middle Miscou Beach	Val-Comeau (Tracadie Dune)	Kouchibouguac NP – Lac-à-Exilda	Kouchibouguac NP - Le Barachois	Kouchibouguac NP - Cap St. Louis Wharf (extirpated)
COSEWIC 2004 ID	1	2	3	5	6	4
AC CDC ID	1048832	1048834/ 1048835	1048837	1048836	174551	1048849

Occurrence	Lac Frye / Miscou Lighthouse	Windsors Malbaie & Middle Miscou Beach	Val-Comeau (Tracadie Dune)	Kouchibouguac NP – Lac-à-Exilda	Kouchibouguac NP - Le Barachois	Kouchibouguac NP - Cap St. Louis Wharf (extirpated)
Last observation	2020	2020	2020	2022	2022	1977
1999			100			
2000			1,000	1,000-2,000	4	
2001			15	0	0	
2002		>1,000	12	0	0	
2003		2,400	0	0	0	
2004		300	0	0	1	0
2005		15	1,500	0	0	
2006		40		0	0	
Avg. 1999-2006	**0**	**751**	**375**	**214**	**1**	**0**
2007		1		0	0	
2008		1,000	0	0	0	
2009		1,000	0	0	0	
2010		40	N/A	0	0	
2011		4		0	0	
2012		120	537	0	0	
2013		1,381	1,500	0	0	
2014	12,000			0	0	
2015	> 10,000		0	0	0	
2016	>17,000			†*12	†*835	†0
2017	100			†*4	†*945	0
2018	12	>1,020	0	4	2,689	
2019	3,668	2,500		1	1,224	
2020	>200	1,265	18 (incomplete survey)	12	565	
2021	~220	"Likely 100,000+"	0	0	762	
2022	~6,000	>100,000	~10,000	†3	†165	
Avg. since 2007 (3 generations)	**5,467**	**17,361**	**1,339**	**2**	**254**	**0**

Table 3. Prince Edward Island counts of Gulf of St. Lawrence Aster. Blue shaded subpopulations are considered extirpated. N/A = plants noted but count not recorded. † - reintroduced (spring seeding); * - reintroduced (fall seeding).

Subpop.	PEI NP - Covehead Pond	PEI NP - Long Pond (extirp.)	PEI NP - Campbells Pond	PEI NP - Blooming Point	PEI NP - Brackley Point (extirp.)	Tignish (extirp.)	PEI NP - Grand Tracadie (extirp.)
COSEWIC 2004 ID	1	2	3	4, 5, 6, 7	8	9	10
AC CDC ID	1049102	1048842	1049113	1048845/ 1048846/ 1048847/ 1048848	1049101	1048839	
Last obs.	2020	2005	2022	2022	1983-1986	1983-1986	1912
1992	164	1	30	63,425			
1993	214	1	3	63,000			
1997	763	0	4	15,459			
1998	412	0	0	51,300			
1999	243	0	0	79,500			
2000		0	0	108,000		0	
2001	123-243	0	0	115,000		0	
2002	10	0	0	46,433			
2003	1 to 5	0	0	27,000			
2004	0 to 15	0	0	120,400			
2005	0 to 5	N/A	N/A	150			
2006	0	0	0	3,000	0		
Avg. 1992-2006	**182**	**0**	**3**	**57,722**	**0**	**0**	**0**
2007	0	0	0	482			
2008	0	0	23	*0			
2009	0	0	0	†128			
2010	0	0	0	0			
2011	0	0	0	0			
2012	0	0	0	*302			
2013	0	0	0	*43			
2014	0	0	5	30			
2015	0	0	565	*68			
2016	0	0	3,552	*256			
2017	*0	0	0	*1,073			
2018	*0	0	0	*3,071			
2019	†*0	0	0	†*90			
2020	2	0	1	50		0	
2021	†0	0	0	†0			
2022	*0	0	>226	*4			
Avg. since 2007	**~1**	**0**	**273**	**350**	**0**	**0**	**0**

Canadian Range

As a Canadian endemic, the Canadian range is the same as the global range: the southern Gulf of St. Lawrence, including Quebec's Magdalen Islands, New Brunswick's eastern shore, and the north shore of Prince Edward Island. It is extant or potentially extant in 17 subpopulations, including nine in the Magdalen Islands of Quebec, three in Prince Edward Island, and five in New Brunswick. An additional 8 subpopulations are considered extirpated.

Extent of Occurrence and Area of Occupancy

The calculated extent of occurrence (EOO) is 30,808 km^2 (Figure 2). The previous status report (COSEWIC 2004) estimated EOO at "perhaps ~2,000 km" but does not appear to have analyzed the value in GIS and gave no justification for that value. The current EOO is similar to 2004 levels because all regions of occurrence from 2004 remain extant.

The index of area of occupancy (IAO) is between 84 km^2 and 104 km^2 depending on whether the Old Harry, Pointe de l'Est, Baie Clarke, and Baie de la Grosse Île subpopulations at the north end of the Magdalen Islands are considered extant. No plants have been reported from these sites since 2007 but no survey effort is documented. The IAO values above are substantially more than the "much less than 5 km^2" area of occupancy reported in COSEWIC (2004). The standardized assessment of IAO using 2 km x 2 km grid boxes was not in use in 2004. Population size and area occupied in 2004 would have been at or above the current 104 km^2 maximum potential value, so the IAO may have declined by 20 km^2 (19.2%) or slightly more in the last three generations (since ~2007). Several subpopulations in New Brunswick and Prince Edward Island were possibly extirpated but appear to be persisting with the reintroductions.

Search Effort

A majority of New Brunswick and Prince Edward Island dunes and barachois ponds (small coastal lagoons) with potential to host suitable habitat for Gulf of St. Lawrence Aster have been surveyed in the last 20 years. Because the species takes advantage of irregularly occurring disturbances and exhibits major fluctuations in its above-ground population, there is a possibility that new subpopulations will eventually be discovered in areas already surveyed or in areas not currently considered suitable. However, the fact that extensive survey effort has discovered no new subpopulations since 2002 suggests the species' distribution is fairly well documented.

Search effort for the preparation of the current report was conducted in 2020 by Sean Blaney, Colin Chapman, David Mazerolle, and Lewnanny Richardson (Table 4). Surveys took place in early to late September 2020 across 23 sites: 14 in New Brunswick and 9 in Prince Edward Island. The surveys covered a collective distance of 141.2 km and visited all recently occupied sites in addition to many sites with potential to support the species. Lindsey Burke of Prince Edward Island National Park monitored all sites in the park in

2021. University of Prince Edward Island M.Sc. student Ryan Cheverie visited most of the recently occupied subpopulations in New Brunswick and Quebec's Magdalen Islands in 2021 and 2022, except the Kouchibouguac National Park occurrences, which were monitored by David Mazerolle of Parks Canada.

Table 4. All sites surveyed in September 2020 for the update COSEWIC status report for Gulf of St. Lawrence Aster (*Symphyotrichum laurentianum*). Surveyors: SB – Sean Blaney, DM – David Mazerolle, CC – Colin Chapman, LR – Lewnanny Richardson (Species at Risk Program Director, Nature NB).

Site	Province	Date	Surveyor	Track Length (km)
Bernie Bowie Sr. Nature Preserve	NB	Sep. 2	SB	4.43
Joseph Allain Nature Preserve	NB	Sep. 2	SB	1.72
Val-Comeau	NB	Sep. 3	SB	11.62
Pointe-Sapin	NB	Sep. 12	DM	14.87
Escuminac	NB	Sep. 13	DM	10.67
Île au Cheval	NB	Sep. 21	SB	11.21
Grand Lac	NB	Sep. 10	CC	4.05
Grand Étang	NB	Sep. 10	CC	2.38
Pointe-Canot	NB	Sep. 10	CC	8.13
MacGregors Malbaie	NB	Sep. 11	CC	15.15
Goose Lake	NB	Sep. 11	CC	5.90
Petit-Chockpish	NB	Sep. 26	DM	10.68
Windsors Malbaie	NB	Sep. 27	DM, LR	9.00
Lac Chenière	NB	Sep. 27	DM, LR	6.00
Sheas Pond	PE	Sep. 7	CC	1.59
Doyles Pond	PE	Sep. 7	CC	5.14
Round Pond	PE	Sep. 7	CC	3.86
Foleys Pond	PE	Sep. 7	CC	1.31
Morrisons Pond	PE	Sep.8	CC	2.49
Branders Pond	PE	Sep.8	CC	6.33
Adams Pond	PE	Sep.8	CC	
Cousins Pond	PE	Sep.8	CC	4.69
Campbells Pond area (different pond from the one supporting GOSLA)	PE	Sep.8	CC	

Past search efforts in Quebec include surveys conducted by Gagnon *et al.* (1995a,b, 1996), Houle *et al.* (2002), and Lafontaine (2005). In 2004 and 2005, Mazerolle and Duclos (unpubl. data) surveyed and sampled all known extant Magdalen Islands sites for a Université de Moncton/Laurentian University master's thesis focused on morphometric and genetic analyses. Monitoring of most extant Magdalen Islands sites was conducted by Attention Frag'Îles (summarized in Attention Frag'Îles 2022) and by the Société de conservation des Îles-de-la-Madeleine (Environment Canada 2012). Six historical sites, however, do not appear to have received focused survey attention since 2004 or 2007.

The Piper Project surveyed 46 sites between 1999 and 2004 (Project Siffleur 2004). Godbout (2000, 2001) conducted surveys in Kouchibouguac National Park and the Bouctouche Dune area. Lewnanny Richardson has monitored the Windsors Malbaie and Val-Comeau sites on a nearly annual basis for two decades and has repeatedly surveyed suitable habitat at several sites (Val-Comeau and extending southward along Tracadie Dune, Malbaie North, and Chemin de la Cédrère Sud in particular) (Richardson pers. comm. 2021). Some of his survey efforts, however, have been a secondary priority conducted in conjunction with Piping Plover (*Charadrius melodus melodus*) monitoring activities that take place prior to the optimal detection period for Gulf of St. Lawrence Aster.

Through work with the Irving Eco-Centre (2003-2004), the Atlantic Canada Conservation Data Centre (AC CDC) (2006-2019), and Parks Canada (2019-2020), David Mazerolle has repeatedly visited all known extant and historical sites in New Brunswick (>2 visits to each site) and has conducted yearly monitoring at Le Barachois and Lac-à-Exilda in Kouchibouguac National Park. Over the last two decades, he has surveyed large amounts of suitable habitat along New Brunswick's eastern coast, particularly between Escuminac and Cape Jourimain, but also including several sites on the Acadian Peninsula (Miscou Island, Le Goulet, Grand Passage, Tabusintac). In 2016 (David Mazerolle) and 2019 (Colin Chapman), the AC CDC carried out comprehensive surveys of the Lac Frye subpopulation on Miscou Island.

Targeted surveys in PE include Houle (1988b), Guignion *et al.* (1995), Island Nature Trust with Jean Gagnon (unpubl.; September and October 2002, visits to Blooming Point, Tignish, and 19 potential habitat sites where Gulf of St. Lawrence Aster was not found), and Prince Edward Island National Park, which has monitored all extant sites on an annual basis since 1997 (Gamble and Atkinson pers. comm. 2022). In 2006, 2008, 2012, 2013, 2017 and 2019, the AC CDC surveyed many potential habitat sites along the province's northern coast, including several brackish coastal ponds, barrier island salt marshes, and tidal lagoon salt marshes (AC CDC 2021). These survey efforts also included visits to all extant sites and most historical sites.

HABITAT

Habitat Requirements

Gulf of St. Lawrence Aster is a small, annual pioneer species found on brackish coastal sands that typically occurs along the shores of barachois ponds (small coastal lagoons) and in barrier dune salt marshes (Mazerolle 2020). Suitable microhabitats are characterized by moist bare sand, mud, or peat in areas of these communities with sparse vegetation cover. Natural disturbances can expose suitable substrate and reduce shading from competing vegetation. This creates habitat for Gulf of St. Lawrence Aster, which otherwise exhibits a decreased relative growth rate in low light conditions (Reynolds *et al.* 2001).

Although saltmarsh and tidal lagoon habitats are extensive in the Gulf of St. Lawrence, substantial fieldwork searching for Gulf of St. Lawrence Aster suggests optimal habitat is quite uncommon and newly created habitat often lasts for only a few years before competitive marsh vegetation completely colonizes the substrate. Persistence of subpopulations may therefore be dependent upon the formation of large seed banks from which re-establishment can occur after disturbance.

The following factors are associated with the species' habitat: a maritime climate, a slow current favouring fine sediment deposition, the deposition of silt or sand during extreme high waters and storm floods, a particular tidal flood frequency during the growing season, limited soil salinity in the germination and growth period, availability of fresh water, some protection from wind, a high percentage of exposed substrate, little interspecific competition, full sunlight, and exposure to certain natural (waves, storms), or artificial changes (Jacques Whitford Env. Ltd. 1994; Gilbert *et al.* 1999; Houle and Belleau 2000; Houle *et al.* 2001, 2002; Reynolds *et al.* 2001; Reynolds and Houle 2003).

Typical species found in Gulf of St. Lawrence Aster's brackish habitats include Seaside Arrow-Grass (*Triglochin maritima*), Seaside Plantain (*Plantago maritima*), Sea Milkwort (*Lysimachia maritima*), saltbushes (*Atriplex* spp.), New York Aster (*Symphyotrichum novi-belgii* var. *novi-belgii*), Creeping Bent Grass (*Agrostis stolonifera*), Tierra de Fuego Dock (*Rumex fueginus*), Baltic Rush (*Juncus balticus*), Toad Rush (*Juncus bufonius*), Salt Meadow Cordgrass (*Sporobolus pumilus*), Freshwater Cordgrass (*Sporobolus michauxianus*), cattails (*Typha* spp.), Salt-marsh Spikerush (*Eleocharis uniglumis*), Three-square Bulrush (*Schoenoplectus pungens*), Saltmarsh Bulrush (*Bolboschoenus maritimus*), and Hard-stemmed Bulrush (*Schoenoplectus acutus*).

Habitat Trends

Gulf of St. Lawrence Aster is associated with dynamic, naturally patchy habitats whose extent and physiography fluctuates from year to year. It is unclear whether the total amount of suitable habitat is changing, but the apparent trend toward a reduced Canadian population since the early 2000s (see **Fluctuations and Trends**) could suggest a decline in habitat quantity or quality.

Habitat loss or alteration due to anthropogenic shoreline alteration has been suggested as the possible cause of historical subpopulation losses at Tignish (COSEWIC 2004), Long Pond and Brackley Point, PE (Gamble and Atkinson pers. comm. 2022) and Étang-du-Nord, QC (COSEWIC 2004). More recent declines in habitat quantity or quality possibly associated with drainage alterations have been noted at Anse aux Étangs, Le Barachois, and Bassin aux Huîtres in the Magdalen Islands and at Val-Comeau and Windsors Malbaie in New Brunswick.

Although Gulf of St. Lawrence Aster depends on habitat created by natural disturbance, coastal changes associated with increased sea levels and increased storm frequency and severity also have the potential to reduce suitable habitat, particularly in places where habitats cannot migrate landward because of shoreline hardening (coastal squeeze) or topography. All occurrences of Gulf of St. Lawrence Aster are located at or within a few metres of sea level and are thus very susceptible to rapid change such as occurred at Kouchibouguac National Park, New Brunswick. The two reintroduced subpopulations there were initially extirpated as a result of two severe storms in fall and winter 2000, which covered the subpopulations in deep sand (Le Barachois) and closed an outlet channel, which flooded the habitat (Lac-à-Exilda) (Mazerolle 2020). Declines observed in Prince Edward Island National Park subpopulations have similarly been attributed to the deposition of sand or Eelgrass (*Zostera marina*) wrack after storms (Environment Canada 2012). The Baie du Havre aux Basques subpopulation on the Magdalen Islands, which supported as many as 4,000,000 plants in the early 2000s, had very few plants after Hurricane Dorian caused substantial water level change in 2019; however, numbers recovered significantly in 2022 (Attention Frag'Îles 2022; ECCC 2022; Labrecque pers. comm. 2022).

Habitat can also be diminished by insufficient disturbance. A recent decline in habitat quantity and quality caused by natural succession affecting tall graminoid vegetation has been noted in the East Marsh and Dune Slack portions of the Blooming Point, PE subpopulation (Gamble and Atkinson pers. comm. 2022), and at Lac Frye, NB (Chapman pers. obs. 2020).

BIOLOGY

Gulf of St. Lawrence Aster is a well-studied species. Major contributions to understanding its biology have been made by Christian Lacroix and many students at the University of Prince Edward Island; Justin Ancheta and Stephen Heard at the University of New Brunswick; and Gilles Houle, Francine Houle, Christina Reynolds, and Guillaume de Lafontaine at Université Laval. Substantial experience with population augmentation and reintroduction has been gained through efforts in Kouchibouguac and Prince Edward Island National Parks. The work of these researchers and of others cited in this report provides a strong understanding of Gulf of St. Lawrence Aster biology.

Life Cycle and Reproduction

Gulf of St. Lawrence Aster is an obligate annual species that germinates, produces seeds, and dies within a single season. Germination occurs mostly in June (Houle *et al.* 2001; Stewart and Lacroix 2001), followed by flowering from late August to mid-September, fruiting in late September, and seed dispersal in October (Houle 1988; Houle and Haber 1990).

Generally, asters (*Symphyotrichum* and related genera) are insect-pollinated plants that have poor seed set after self-pollination (Jones 1978; Brouillet 1981) and are visited by a wide diversity of flying insects (Semple *et al.* 2002). Gulf of St. Lawrence Aster is self-fertile (Houle 1988a) and there is evidence for self-pollination via pollen transfer within capitula (Houle 1988a). Its floral morphology displays characteristics of self-fertile species: small or absent ligules and nectaries, style generally included in stamen tube, and pappus overtopping corolla even before anthesis. Heard *et al.* (2009) found that only ~16% of adult plants were the product of outcrossing.

Although it does not require insect pollinators, seed set may be enhanced by insect pollination. Lacroix *et al.* (2007) found laboratory-grown plants (presumably exposed to few or no pollinators) produced filled achenes in only ~17.6% of their florets, one third the rate observed in the field.

The flower heads of Gulf of St. Lawrence Aster are gynomonoecious, producing few central bisexual disc florets encircled by numerous pistillate florets (Lacroix *et al.* 2007). When both pistillate and disc florets are considered, Gulf of St. Lawrence Aster produces 19-55 or more florets per capitulum (Flora of North America Editorial Committee 2006). These asters may produce as few as one capitulum in diminutive individuals to many capitula in the dense paniculiform arrays of vigorous plants. Fruit set in natural subpopulations has been documented to occur in 60% of all florets (Houle 1988a; Lacroix *et al.* 2007).

Asexual reproduction is not documented in Gulf of St. Lawrence Aster; its survival depends on reproduction by seed. Longevity of the in situ seed bank has been estimated to be 10 years based on ex situ experimentation (Houle 1988b; Gilbert *et al.* 1999; Stewart and Lacroix 2001; Kemp and Lacroix 2004). Kelly and Lacroix (2019) found that seeds stored in optimal conditions at UPEI retain high viability up to at least 14 years. Mazerolle (2004) observed in situ seed viability of at least four years. The transient seed bank (i.e., seeds 1 year old) has relatively high viability (~53%); however, viability falls dramatically for the persistent seed bank (>1 year old, ~2%) (Kemp and Lacroix 2004).

Generation time for plants with seed banks is calculated as juvenile period + either the half-life of seeds in the seed bank or the median time to germination, whichever is known more precisely (IUCN 2022). Average juvenile period is estimated at approximately two years from seed dispersal to seed production, with the time beyond one year added because some seeds spend multiple seasons in the seed bank. Kemp and Lacroix (2004) found a very short half-life (~53% viability at one year, meaning almost exactly one year half-life). This is atypical seed biology for an obligate annual in highly variable habitat, where seed banking is highly adaptive, and the one-year figure for seed bank half-life should be taken with some caution. Total generation time is thus estimated at 3 to 5+ years.

Physiology and Adaptability

Gulf of St. Lawrence Aster tends to occur in a narrow band a few metres wide around pond margins (Reynolds and Houle 2003; Mazerolle pers. obs. 2003-2021; AC CDC 2022), which suggests that it has a narrow range of physiological tolerance in the wild. Salinity (strongly correlated with microtopography) and wrack deposition are important factors limiting germination and growth within this zone (Houle *et al.* 2001; Reynolds and Houle 2003; Ancheta *et al.* 2010; Heard and Ancheta 2011). Substrate salinity limits inter-specific competition, but high salinity reduces germination and survival of individuals (Houle *et al.* 2001; Mazerolle 2020; Mazerolle pers. obs. 2003-2021). Ungerminated seeds are, however, quite resistant to salt and germinate well in fresh water after being immersed in salt water (Houle *et al.* 2001, 2002), but they do not require salt exposure (Mazerolle pers. obs. 2003-2021.).

Seed germination is limited by low temperatures (Houle *et al.* 2001; Heard and Ancheta 2011). In a greenhouse germination experiment, Heard and Ancheta (2011) found temperature to be more limiting than salinity. Delayed germination can further impact growth and survivorship because it further disadvantages Gulf of St. Lawrence Aster relative to perennial or hardier annual competitors.

The presence of freshwater input from small inflowing watercourses or adjacent wetlands is an important feature of suitable habitat. Water availability during bud differentiation appears to be critical, with drought conditions causing reproductive failure, which can make subpopulations potentially susceptible to local extinction (Houle and Belleau 2000). Early developmental stages appear to be highly susceptible to drought (Mazerolle pers. obs 2003-2021). Where the plants occur above mean high-tide level, maintenance of soil moisture through air humidity and precipitation is likely crucial. Substrate particle size appears to be of little importance as the aster can occur on fine sand, coarse sand, gravel, clay, mud, and salt marsh peat (Houle 1988b; Mazerolle 2020). In Kouchibouguac National Park, soils in successful seeding plots were often characterized by a thin mucky algal layer which became a dry crust during dry periods (Mazerolle 2020). In addition to helping maintain soil moisture, this algal buildup may also contribute to nutrient availability. The average pH of its substrate ranges from 5.5 (Grandtner 1967) to 6.9 (CDPNQ 2002).

Seeds from two occurrences have been collected and are being stored at Acadia University (Nova Scotia) and Irving Research Nursery (Sussex, New Brunswick) for use in future restoration work (NBDNR 2007), and in 2014 seeds from Campbells Pond, Prince Edward Island were sent to Agriculture and Agri-Food Canada's seed bank in Saskatoon. Christian Lacroix at the University of Prince Edward Island also has considerable seeds in storage, mostly from Blooming Point. Propagation in the greenhouse does not require cross-pollination (Heard *et al.* 2009), though Lacroix *et al.* (2007) found a two-thirds reduction in filled achenes in laboratory-grown plants compared to field-grown plants. Kelly and Lacroix (2019) found significantly enhanced germination rates with cold moist treatments and hormone treatments.

Reintroduction efforts were undertaken at Prince Edward Island National Park in 2008, 2009, 2012, 2013, 2015–2019, 2021, and 2022, including transplantation of greenhouse-grown seedlings into natural habitat and, more recently, seed bank augmentation at the Blooming Point and Covehead Pond subpopulations (Atkinson and Lacroix 2013; Gamble and Atkinson pers. comm. 2022; Burke pers. comm. 2023). Introduction to an unoccupied site at Robinson's Island was unsuccessful (Gamble and Atkinson, pers. comm. 2022). Mazerolle (2020) reported successful transplanting of cultivated individuals to the three historical sites in Kouchibouguac National Park in 2016 and 2017, with possibly self-sustaining subpopulations having been established at Lac-à-Exilda and Le Barachois. He concluded that reintroduction is both feasible and cost-effective. Additional seeding occurred at Lac-à-Exilda and Le Barachois in 2022 (Mazzerolle pers. comm. 2023).

Dispersal and Migration

Heard *et al.* (2009) found reduced allelic diversity in Prince Edward Island subpopulations compared to those sampled from the Magdalen Islands, but only modest isolation by distance. This suggests that the Magdalen Islands act as a reservoir of genetic variation and a source for long-distance founding of new subpopulations, presumably dependent on strong storms or ocean currents. Lacroix *et al.* (2007) found that seeds travelled up to 23 cm from their release point with horizontal wind velocities of 1–2.1 m / s, with distances reduced when surrounding vegetation was present. Occasional dispersal over much longer distances is likely possible in severe winds, via longshore currents, or possibly in fur, feathers, or clinging mud on birds or mammals, including humans (Sorenson 1986; Stiles 2000).

Despite extensive survey effort in suitable habitat within the Maritimes, no new subpopulations have been discovered since 2002 (AC CDC 2021), which suggests that the establishment of new subpopulations through long-distance founding events is infrequent. Surveys conducted in 2020, during the preparation of this report, documented the colonization of new habitat at the Windsors Malbaie subpopulation, over 900 m from the nearest known plants.

Little is known about the potential for short- or long-distance pollen transfer. Heard *et al.* (2009) found that 16% of adult plants sampled were the product of outcrossing. This could indicate either an outcrossing rate of ~16% or a lower rate of outcrossing with increased fitness of outcrossed individuals relative to self-pollinated individuals.

Interspecific Interactions

Interspecific competition has been shown to limit local distribution and abundance of Gulf of St. Lawrence Aster (Houle *et al.* 2002; Houle and Valéry 2003). When competition is eliminated, the aster becomes more abundant, particularly in the upper portion of the topographic gradient, where abiotic conditions are less limiting (e.g., lower salinity and reduced exposure to waves and deposition of Eelgrass wrack and sand). Similarly, overall reproductive success (number of fruits produced) increases when interspecific competition is absent. Competitor plants affect Gulf of St. Lawrence Aster primarily by reducing available light.

Two exotic species are noted as potential competitors: Brass Buttons (*Cotula coronopifolia*) and the closely related Rayless Alkali Aster (NBDNR 2007). These species are of similar stature to Gulf of St. Lawrence Aster but might grow densely enough to restrict its growth. Brass Buttons is present in Gulf of St. Lawrence Aster occurrences in the Magdalen Islands (Couillard and Jolicoeur 2008) and New Brunswick (AC CDC 2021), and Rayless Alkali Aster has been observed in coastal habitats in New Brunswick (NBDNR 2007) and Prince Edward Island (AC CDC 2021) but has not yet been noted within Gulf of St. Lawrence Aster sites. Potential for hybridization impacts from Rayless Alkali Aster is discussed under Threats – Invasive Species.

Native moth (order Lepidoptera) larvae have been observed on Gulf of St. Lawrence Aster individuals at Havre aux Basques (Boudreau and Houle 1998). The larvae appeared to be feeding on the leaves. Steeves *et al.* (2008) reported up to 53% seed predation by *Coleophora triplicis*, a casebearing moth (family Coleophoridae), otherwise known as a seed predator of Seaside Goldenrod (*Solidago sempervirens*). In 1994, a few individuals of Missouri Goldenrod Flea Beetle (*Trirhabda borealis,* family Chrysomelidae) were found feeding on Gulf of St. Lawrence Aster on a small island in the Havre aux Basques lagoon (Jean Gagnon pers. comm. 2004). Ancheta *et al.* (2010) found that simulated herbivory reduced both survivorship and seed set in some trials, although salinity had more consistently strong negative effects.

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

Estimated abundances at the larger subpopulations in the Magdalen Islands are believed to be calculated using the sampling and extrapolation methods described by de Lafontaine (2005a,b). Subpopulations in New Brunswick and Prince Edward Island are generally small enough for abundances to be determined with simple counts, except at Windsors Malbaie, New Brunswick in 2021, where Ryan Cheverie of University of Prince Edward Island provided a rough estimate of “minimum 50,000 and likely 100,000+ over 2.5 km”.

Abundance

For a species with substantial fluctuation in number of mature individuals, COSEWIC advises using lower values than the maxima in the range of fluctuation. Population size is estimated here by averaging annual counts across each subpopulation over the past three generations (~15 years, since 2007). The number of individuals over time and annual averages since 2007 for each subpopulation are provided in Tables 1 to 3. The average annual Canadian (and global) population since 2007 is estimated at 208,186 mature individuals, of which 183,139 (88.0%) are in Quebec, 24,423 (11.7%) are in New Brunswick, and 624 (0.3%) are in Prince Edward Island. These totals do not include numbers in the potentially extant Magdalen Islands subpopulations at Anse aux Étangs, Old Harry, Pointe de l’Est, Baie Clarke, and Baie de la Grosse Île. There is no record of these subpopulations having been surveyed after 2007. In the early 2000s, numbers at these subpopulations were typically smaller than the large subpopulations mentioned below but one value of 10,000 to 100,000 was recorded at Baie de la Grosse Île and several other annual counts exceeding 1,000 were recorded at other potentially extant Magdalen subpopulations in the 1999 to 2004 period.

Almost all (98.2%) of the average annual Canadian population is contained within just four of the subpopulations: Havre aux Basques, Quebec (141,857; 68.1%), Le Barachois, Quebec (40,440; 19.4%), Windsors Malbaie, New Brunswick (17,361; 8.3%), and Lac Frye / Miscou Lighthouse, New Brunswick (5,467; 2.6%). This concentration at a small number of sites makes the species more sensitive to impacts from stochastic storm events or anthropogenic habitat alteration.

The Canadian population includes mature individuals at sites with reintroductions (Tables 2 and 3) as these are intra-limital and the reintroductions are considered to have a net positive impact on the population. Seed from Gulf of St. Lawrence Aster, an annual, has been demonstrated to be produced in the first year and thus the reintroductions contribute to the ongoing viability of the subpopulations. The reintroductions were performed using seeds, or transplants from seeds, collected from Prince Edward Island subpopulations.

Fluctuations and Trends

Gulf of St. Lawrence Aster numbers at a subpopulation can exhibit year-to-year fluctuations far beyond one order of magnitude in response to the year's conditions and previous years' seed production (see Tables 1 to 3). However, fluctuations do not generally extend uniformly across the entire Canadian population. There are no documented year-to-year fluctuations in the Canadian population exceeding an order of magnitude (Tables 1 to 3), although incomplete annual sampling limits conclusions. Fluctuations of an order of magnitude in the Canadian population might be possible given that an average of 98.2% of the annual population is located within the Magdalen Islands where similar conditions might occur across multiple subpopulations. Even if fluctuations in mature individuals did exceed an order of magnitude, that would not generally qualify as an "extreme fluctuation" based on IUCN (2022) guidelines, because a store of seeds is assumed to remain in the soil. However, it is possible that the entire seed bank could be destroyed by a single storm, at least for a smaller subpopulation. Therefore, extreme flucations are possible. It should also be noted that the apparently short-lived seed bank (half-life ~one year in Kemp and Lacroix 2004) and the regular and often prolonged reductions in number of mature plants within subpopulations place most subpopulations at relatively high risk of extirpation by stochastic events.

The number of subpopulations has declined over the longer term. Of the 25 subpopulations ever documented, only 12 have had plants recorded in the past three generations (15 years; Tables 1 to 3). The following 13 subpopulations are currently considered extirpated or potentially extirpated by CDPNQ (2020) and AC CDC (2022):

<u>Extirpated</u>

- Étang du Nord, QC (last seen: 1912)
- Lac aux Canards, QC (last seen: 1995)
- Grande-Entrée, QC (last seen: 1985)
- Cap St. Louis Wharf, NB (last seen: 1977)
- Tignish, PE (last seen: 1983-1986)

- Brackley Point, PE (last seen: 1983-1986)
- Grand Tracadie, PE (last seen: 1912; may have been Campbells Pond or Blooming Point subpop.)
- Long Pond, PE (last seen 1993)

Potentially extirpated / potentially extant

- Anse aux Étangs, QC (last seen: 2001)
- Old Harry, QC (last seen: 2001)
- Baie Clarke, QC (last seen: 2005)
- Pointe de l'Est, QC (last seen: 2007)
- Baie de la Grosse Île, QC (last seen: 2007)

If the latter three potentially extirpated Magdalen Islands subpopulations are now lost, the loss has occurred within the past three generations (15 years).

An additional three subpopulations have been extirpated since 2000 but they have had plants in recent years as a result of reintroduction efforts:

- Covehead Pond, PE (barely extant, average <1 individual since reintroduction)
- Lac-à-Exilda, NB (barely extant, average 2 individuals since reintroduction)
- Kouchibouguac National Park - Le Barachois, NB (fairly well established)

Covehead Pond and Lac-à-Exilda are very tenuous in their persistence but have shown some self-seeding and they are tentatively considered extant subpopulations in this report, although their persistence longer-term will likely depend on continued reintroduction efforts.

The Canadian population has experienced a long-term decline over the 15 years (~3 generations) since 2007. Mean subpopulation counts declined by 90% when comparing the sum of subpopulation averages from the 2007-2022 period (202,607 individuals) against subpopulation counts from the 1999-2006 period (1,942,406 individuals), for subpopulations with counts in both periods (Table 5). The declines in Prince Edward Island (98.9% decline) and in the Magdalen Islands, Quebec (90.3% decline) were substantial, but a large increase is observed in New Brunswick (1,712% increase) when the same periods are compared.

Table 5. Number of mature individuals in each period for determination of decline.

Province	Individuals 1999-2006	Individuals 2007-2022	Subpopulations*

Province	Individuals 1999-2006	Individuals 2007-2022	Subpopulations*
Quebec	1,883,158	183,028	Baie du Havre aux Basques, Le Barachois, Bassin aux Huîtres
Prince Edward Island	57,907	623	Covehead Pond, Campbells Pond, Blooming Point
New Brunswick	1,341	18,956	Windsors Malbaie and Middle Miscou Beach, Val-Comeau (Tracadie Dune), Kouchibouguac – Lac-à-Exilda, Kouchibouguac – Le Barachois
Total	**1,942,406**	**202,607**	

* Lac Frye / Miscou Lighthouse subpopulation not included in calculation of decline as it was unknown in the early time period.

Another way of calculating decline is to graph annual totals and calculate the trend over the past three generations using a trendline. The challenge with this approach is that not all subpopulations are evaluated every year. However, using all years where the larger subpopulations were sampled, in particular, those on the Magdalen Islands, results in a 15-year decline of 60% to 85% using fitted curves (3rd order polynomial vs. exponential (Figure 6).

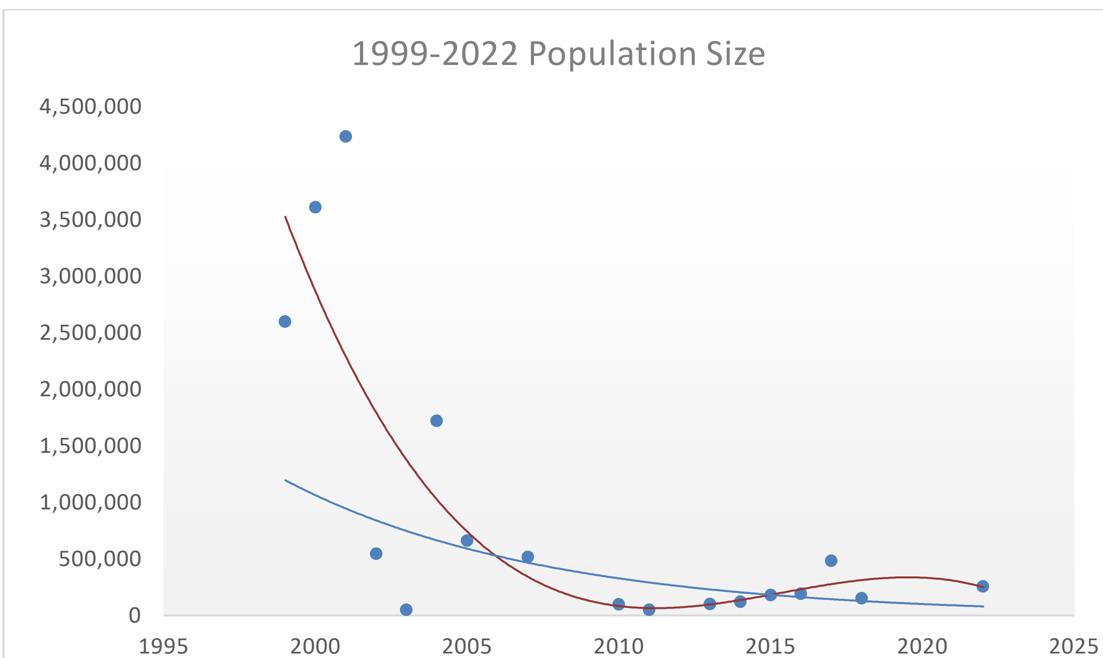

Figure 6. Population trend from 1999 to 2022. Data excluded for 2006, 2008, 2009, 2012, and 2019-2021 due to lack of sampling in the larger subpopulations. Red line is the 3rd polynomial curve (R^2 = 67%); blue line is the exponential curve (R^2 = 60%).

The cause of long-term decline at Havre aux Basques, QC, which averaged 1.8 million plants during the 1999-2006 period but only 141,000 during the 2007-2022 period, is probably habitat-related but is not well understood. Large, long-term declines at

Blooming Point, PE are attributed to natural succession of vegetation which has removed essentially all suitable habitat in the East Marsh portion and is expected to lead to continued decline in the Dune Slack portion (Gamble and Atkinson, pers. comm. 2022).

Hurricane Fiona hit the Atlantic area in September 2022. Six subpopulations were evaluated after the hurricane: Baie du Havre aux Basques, Bassin aux Huîtres, Campbells Pond, Lac Frye / Miscou Lighthouse, Windsors Malbaie and Middle Miscou Beach, and Val-Comeau (Tracadie Dune) (Cheverie pers. comm. 2022). Only one, Campbell's Pond, PE, showed a decline over the 2022 numbers shown in Table 3, where the number of individuals declined to about 50.

Rescue Effect

Since the Gulf of St. Lawrence Aster is an endemic of the southern Gulf of St. Lawrence, there is no possibility of rescue from outside Canada.

THREATS AND LIMITING FACTORS

Threats

The direct threats to Gulf of St. Lawrence Aster assessed in this report were organized and evaluated based on the IUCN-CMP (International Union for Conservation of Nature – Conservation Measures Partnership) unified threats classification system (Master *et al.* 2012). Threats are defined as the proximate activities or processes that directly and negatively affect the population. Results on the impact, scope, severity, and timing of threats are presented in tabular form in Appendix 1. The overall calculated and assigned threat impact is Very High – Medium.

Gulf of St. Lawrence Aster is susceptible to the stochastic effects of severe storms and to anthropogenic modifications of habitat conditions. Severe storms led to extensive habitat alteration and extirpation of two subpopulations which were subsequently reintroduced in Kouchibouguac National Park (Mazerolle 2014). Given the species' coastal distribution, all occurrences are potentially vulnerable to increased storm frequency and severity, and other climate change-related phenomena including sea-level rise. Direct anthropogenic habitat alterations caused the extirpation of the Brackley Beach subpopulation in Prince Edward Island National Park and have affected some subpopulations on the Magdalen Islands (Gilbert 2004). Permanent or temporary anthropogenic alterations to pond or lagoon drainage have been widely noted in New Brunswick and the Magdalen Islands and are also believed to have eliminated the Tignish and Long Pond, Prince Edward Island subpopulations (Gilbert 2004; PEI National Park pers. comm. 2023).

IUCN Threat 11: Climate change and severe weather (Very High – Medium impact)

Climate change is substantially impacting the Gulf of St. Lawrence coast (Environment Canada 2006; O'Carroll *et al.* 2006; Parkes *et al.* 2006; Arcand 2007; Savard *et al.* 2016). It may be impacting Gulf of St. Lawrence Aster habitat already and is very likely to do so in the future. The interacting climate-linked factors that cause coastal impacts include warmer air and water temperatures which fuel more frequent and intense storms and reduce protective winter ice cover, and rising sea levels associated with melting glaciers, thermal expansion of ocean water and altered oceanography related to the reduced strength of the Gulf Stream current (Savard *et al.* 2016). The Gulf of St. Lawrence has always been one of the stormiest regions in North America (Savard *et al.* 2016) and there has been a statistically significant regional increase in severe windstorms since the 1980s (Parkes *et al.* 2006), resulting in increased flooding, erosion, and breaching of coastal barrier dunes (Environment Canada 2006).

Gulf of St. Lawrence Aster's habitat is dynamic, being shaped by wave action and storms, which create or maintain low-competition habitats suitable for the plant and can also impair or completely eliminate habitat through prolonged flooding, deposition of sand or Eelgrass wrack, or erosion.

In Kouchibouguac National Park, the two recently reintroduced subpopulations were first extirpated in 2000 following two severe storm events in fall and winter. At Lac-à-Exilda, the subpopulation was located on the shores of a brackish tidal pond protected by a dune with an open outlet that ensured the outflow of freshwater and allowed at least some inflow of salt water during very high tides and storms. Significant sand deposition from storm wave overwash obstructed the pond's opening, preventing the inflow of salt water and blocking the outflow of freshwater. As a result, suitable habitat at this site was flooded and has since remained under approximately 0.5 m of water, while adjacent wetlands have transitioned to dense emergent freshwater marsh communities. At Le Barachois, the subpopulation was extirpated after sand deposition buried the habitat under more than 10 cm of sand.

Ongoing effects of sea-level rise and more severe and frequent storms will continue to reshape the coastal habitats supporting Gulf of St. Lawrence Aster. For the period from 2010 to 2100, James *et al.* (2014) project a net sea-level rise of up to 119.4 cm in Charlottetown (PE) and 118.6 cm in Escuminac (NB). Projections for 2010–2050 for sections of New Brunswick's coast include predictions of a sea-level rise of 24 cm for Miscou Island, 25 cm for Val-Comeau, and 27 cm for northern Kent County (Daigle 2020). Estimates for the same period project up to 27 cm of mean relative sea-level rise at Cap-aux-Meules, Magdalen Islands, and up to 25 cm at Tracadie Harbour, Prince Edward Island (Can-EWLAT 2021). The actual threat posed by coastal change is unknown, but all the Gulf of St. Lawrence Aster subpopulations are located at or just above sea level, meaning that significant declines or extirpation are hard to rule out for any subpopulation. The resilience of subpopulations will vary with the extent to which local topography allows for landward movement of habitat and the extent to which reproduction and seed banking are compromised.

<u>IUCN Threat 7.3: Ecosystem modifications (Medium – Low impact)</u>

Interspecific competition for light, moisture, nutrients, and space plays a key role in restricting the distribution and abundance of the Gulf of St. Lawrence Aster (see **Biology**).

Two species of aster found in saltmarsh habitats similar to those used by Gulf of St. Lawrence Aster are considered potential threats through competition: the western North American Rayless Alkali Aster, from which Gulf of St. Lawrence Aster likely evolved, and the South African species Brass Buttons (NBDNR 2007).

Rayless Alkali Aster has expanded eastward along salted roads in the past 30 years reaching coastal habitats in New Brunswick and Prince Edward Island. It remains uncommon but is known from relatively undisturbed salt marshes in New Brunswick (e.g., Bouctouche Dune, Escuminac) and Prince Edward Island (e.g., Conway Sandhills). It seems likely that it will colonize Gulf of St. Lawrence Aster occurrences in future decades. Direct competitive effects of Rayless Alkali Aster are possible, but hybridization may be a greater threat. Houle (1998a) performed artificial crosses between Gulf of St. Lawrence Aster, Rayless Alkali Aster, and Short-rayed Alkali Aster (*Symphyotrichum frondosus*). The experiments showed a relatively high degree of interfertility between the former two and also documented the fertility of F2 hybrids that self-pollinated naturally.

Brass Buttons is present in Gulf of St. Lawrence Aster occurrences in the Magdalen Islands (Couillard and Jolicoeur 2008) and at Lac Frye / Miscou Lighthouse and Windsors Malbaie in New Brunswick (AC CDC 2021). It is a prostrate to erect perennial that roots at the nodes (Flora of North America Editorial Committee 2006) and produces large, dense colonies. Its perennial nature could allow it to outcompete Gulf of St. Lawrence Aster by remaining established in suitable habitat and reducing available areas in which the latter could germinate. Direct impacts on Gulf of St. Lawrence Aster have not yet been noted.

Another exotic of potential significance is the European species Marsh Cudweed (*Gnaphalium uliginosum*). At Le Barachois in Kouchibouguac National Park, dense carpets of Marsh Cudweed seedlings appear to have locally excluded or limited Gulf of St. Lawrence Aster (Mazerolle pers. obs. 2003-2021; in 2019).

Exotic cattails (including the hybrid Blue Cattail (*Typha* × *glauca*) and Narrow-leaved Cattail (*Typha angustifolia*)) have become common and locally abundant in southeastern and eastern New Brunswick. Optimal Gulf of St. Lawrence Aster habitat at the north and sound ends of the reintroduced Kouchibouguac National Park – Le Barachois subpopulation are being taken over by these cattails and an unidentified cattail species is present at the reintroduced Lac-à-Exilda subpopulation (Mazerolle pers. obs. 2003-2021; in 2019).

European Reed (*Phragmites austrails* ssp*. australis*) is common along roadways in southeastern New Brunswick and has steadily been spreading north along the province's eastern coast. Although this species has not been observed at a Gulf of St. Lawrence Aster site yet, it is well suited to take over brackish coastal ponds.

<u>IUCN Threat 7.2: Dams & water management/use (Low impact)</u>

Anthropogenic ecosystem modifications caused by dredging lagoon or barachois pond openings have been frequently observed in Gulf of St. Lawrence Aster subpopulations and can significantly alter water levels, hydrology, flooding regime, salinity, water circulation patterns, and substrate deposition, which in turn can lead to flood, drought, or salinity levels that kill growing plants or to development of dense freshwater or saltmarsh communities that outcompete Gulf of St. Lawrence Aster.

Such changes can be relatively short-lived, if openings are closed by natural sand deposition, or more permanent, if new openings are reinforced. The extirpation of the Tignish, PE subpopulation some time after 1986 and the Long Pond, PE subpopulation some time after 1993 are thought to have been caused by the alteration of the lagoons' openings (Tignish) and clearing/alteration of outflow (Long Pond), which modified the systems' hydrology (Gilbert 2004; PEI National Park pers. comm. 2023).

In the Magdalen Islands, Gilbert (2004) identified artificial modifications of lagoon openings as the main driver behind sharp declines at Anse aux Étangs, Le Barachois (whose population has since proven relatively stable), and Bassin aux Huîtres and the possible cause of the extirpation at Étang-du-Nord (Gilbert 2004). In New Brunswick, short-term manipulation of barrier dune openings to lower pond water levels has occurred in recent decades at Val-Comeau and Windsors Malbaie (Mazerolle pers. obs. 2003-2021). The impacts on subpopulations at these sites are not clear.

<u>IUCN Threat 6.1: Recreational activities (Unknown impact)</u>

Recreational use of all-terrain vehicles in Gulf of St. Lawrence Aster habitat can lead to direct mortality of individuals and to habitat alteration through increased competition, soil compaction, and weakening of the dune that shelters the habitat (Couillard and Jolicoeur 2008). ATV impacts on sheltering dunes could contribute to storm breaches that have the potential to substantially alter occurrences on a larger scale.

ATV tracks have been observed in several occurrences in Quebec, including Le Barachois, Baie de la Grosse Île, Baie Clarke, Pointe de l'Est, and Bassin aux Huîtres (Couillard and Jolicoeur 2008). ATV activity is also evident in New Brunswick at Windsors Malbaie (Mazerolle pers. obs. 2003-2021) and Lac Frye (Chapman 2020), as well as in Prince Edward Island's Blooming Point subpopulation at East Marsh (Chapman 2020).

ATV disturbance can enable aster establishment by exposing substrate. At some Magdalen Islands sites and Windsors Malbaie, NB, concentrations of individuals occur in ATV trails, with the disturbance appearing to allow the species to colonize suboptimal areas of denser plant communities. The extent to which ATV traffic might be beneficial at the subpopulation level is unclear, but it would need to be light enough in summer and early fall to allow Gulf of St. Lawrence Aster to develop and produce seed.

Trampling associated with other recreational activities, such as hunting and fishing, can also damage or kill individual Gulf of St. Lawrence Aster plants. Couillard and Jolicoeur (2008) identified these activities as threats for the Magdalen Islands subpopulations of Baie du Havre aux Basques, Cap de l'Hôpital, Bassin aux Huîtres, and Le Barachois.

Limiting Factors

Herbivory

Invertebrate herbivory can limit Gulf of St. Lawrence Aster's ability to reproduce. For example, Steeves *et al.* (2008) documented up to 53% seed predation by a casebearer moth, *Coleophora triplicis* (family Coleophoridae; see **Interspecific Interactions**). This species is known primarily from Seaside Goldenrod, which is widespread and common near Gulf of St. Lawrence Aster occurrences, suggesting that *Coleophora triplicis* could affect many aster subpopulations. Ancheta *et al.* (2010) found that simulated herbivory on leaves reduced both survivorship and seed set in some instances. A few individuals of a leaf beetle, *Trirhabda borealis* (family Chrysomelidae), were found feeding on Gulf of St. Lawrence Aster on a small island in the Havre aux Basques lagoon in 1994.

Apparent lack of successful dispersal and habitat specificity are also likely limiting, as discussed under **Dispersal and Migration** and **Habitat Requirements**.

Number of Locations

Occurrences are grouped into locations based on their presence in a single wetland or barrier dune system which would be affected relatively uniformly by a hydrological change associated with storm events, anthropogenic channel alteration, or sea-level rise. The groupings mapped in Figures 3, 4, and 5 are subpopulations and each subpopulation is considered one location except for Le Barachois, Magdalen Islands, where occurrences in close proximity are considered two locations because of differing hydrology (an isolated dune pond and a saltmarsh shoreline).

The number of extant locations of Gulf of St. Lawrence Aster is thus estimated at 13 to 18 (5 to 10 in Quebec, depending on whether the five subpopulations not seen in the past 15 to 22 years are extant, five in New Brunswick, three in Prince Edward Island). It should also be noted that almost all subpopulations experience very low numbers of reproductive plants and the two Kouchibouguac National Park, New Brunswick subpopulations and the three Prince Edward Island subpopulations are especially tenuous with their long-term persistence potentially dependent on ongoing reintroduction efforts. Number of locations could be interpreted as less than 10 if subpopulations not seen since 2001 to 2007 and the five especially tenuous New Brunswick and Prince Edward Island subpopulations were not considered locations.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

Gulf of St. Lawrence Aster was assessed as Threatened by COSEWIC in 2004 (Gilbert 2004) and subsequently added to Schedule 1 of the *Species at Risk Act* in 2005, under which its critical habitat is protected on federal lands. Environment Canada (2012) defines critical habitat as the area of suitable habitat within 300 m of each observation point for 16 occurrences (nine in Quebec, four in New Brunswick, and three in Prince Edward Island) identified as “priority occurrences” having larger and more recently observed subpopulations. Critical habitat outside of federal land is protected via provincial means.

The species is currently designated Threatened in Quebec under the *Act Respecting Threatened or Vulnerable Species* (Tardif *et al.* 2005) and Endangered in New Brunswick (*New Brunswick Species at Risk Act*, 2012). Prince Edward Island does not list the species under its *Wildlife Conservation Act*, so Gulf of St. Lawrence Aster is not protected under any provincial legislation there. The New Brunswick *Species at Risk Act* prohibits direct harm to individuals except under a permit issued for research, recovery or education purposes.

Occurrences in Kouchibouguac and Prince Edward Island National Parks are protected under the *Species at Risk Act* and the *National Parks Act*.

Non-Legal Status and Ranks

Gulf of St. Lawrence Aster is considered Critically Imperiled to Imperiled globally (G1G2) and nationally in Canada (N1N2) and is considered Critically Imperiled (S1) in all subnational jurisdictions (Quebec, New Brunswick, and Prince Edward Island) (NatureServe 2021).

Habitat Protection and Ownership

In Quebec, all Gulf of St. Lawrence Aster sites are under provincial jurisdiction, as beaches fall under the department of environment and wildlife and dunes and dune slacks fall under the Department of Energy and Resources (Chap. 20 of the *Loi des terres des Îles-de-la-Madeleine*, 1958-59: An Act to facilitate the redemption of constituted rents in the Magdalen Islands. Chapter 20, *Statuts de Québec*. 1958-59, Assented to, the 18th of December,1958). Gulf of St. Lawrence Aster habitat in the Magdalen Islands is, in theory, protected from ATV traffic by the *Environment Quality Act* (*Regulation respecting motor vehicle traffic in certain fragile environments*) (c. Q-2, r. 9).

The Baie du Havre aux Basques, Le Barachois, and Bassin aux Huîtres subpopulations in the Magdalen Islands have been designated as Plant Habitat according to the *Act Respecting Threatened and Vulnerable Species*. The extirpated or historical subpopulations at Baie Clarke, Baie de l’Est, and Old Harry are within the Pointe-de-l’Est National Wildlife Area administered by Environment and Climate Change Canada under the *Canada Wildlife Act* and within a provincial Wildlife Reserve protected under the *Act Respecting the Conservation and Development of Wildlife* (R.S.Q., c. C-61.1).

All federally identified critical habitat in New Brunswick is also protected from willful destruction since it is designated “Survival Habitat” under the New Brunswick *Species at Risk Act*. The Lac-à-Exilda and Le Barachois subpopulations are fully protected within Kouchibouguac National Park. Habitat for the Lac Frye / Miscou Lighthouse subpopulation is afforded protection within the Nature Conservancy of Canada’s Frye Lake Nature Reserve. Gulf of St. Lawrence Aster is the trigger species for a proposed Key Biodiversity Area comprising the entirety of Miscou Island. This does not confer any legal protection but can guide future land securement. The Val-Comeau and Windsors Malbaie subpopulations occur on a combination of private land and provincial Crown land. The northern portion of the Windsors Malbaie subpopulation has recently been included within a new Nature Legacy Protected Area by the provincial government.

Under the provincial *Trespass Act*, New Brunswick habitat is legally protected from impacts of motorized vehicles on ocean shoreline areas (below and within 300 m of the ordinary high water mark of any ocean or ocean inlet, including any bed, bank, beach, shore, bar, flat, mudflat, or sand dune associated with the ocean or inlet whether or not it lies within that portion of land). Shoreline habitat alteration is regulated in New Brunswick under the *Watercourse and Wetland Alteration Regulation*, passed under the NB *Clean Water Act*, which provides that anyone seeking to undertake construction, vegetation removal or drainage within 30 m of a wetland must obtain a permit. Habitat protection on and around coastal lands, salt marshes, dunes, and beaches is also promoted by the Coastal Areas Protection Policy for New Brunswick. The New Brunswick Wetlands Conservation Policy affords protection for coastal marshes, which are considered Provincially Significant Wetlands under the policy and receive the highest degree of protection.

In Prince Edward Island, all extant sites are located within Prince Edward Island National Park and are afforded full protection under the *Species at Risk Act* and the *National Parks Act*. The wet sand marsh at the presumed extirpated Tignish site is on littoral land under provincial jurisdiction.

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Colin Chapman is Botanist and Lichenologist with the AC CDC. His work focuses on improving understanding of plant and lichen conservation statuses and collection of rare species occurrence data through extensive fieldwork and collaboration with partners in the Maritimes provinces. He is also involved with the ongoing development of the online Illustrated Flora of Prince Edward Island, an interactive biodiversity tool for regional naturalists. Colin joined the AC CDC in 2018 and has since documented over 4,000 locations for plants of conservation concern across Atlantic Canada. He has authored or co-authored over a dozen reports with the AC CDC and contributed fieldwork for COSEWIC and provincial status reports. Among these were two projects specifically targeting Gulf of St. Lawrence Aster at field sites in northeast NB and in PE, and primary authorship of a Nova Scotia provincial status report on Wild Leek (*Allium tricoccum*). Colin completed an Honours B.Sc. in Biology at the University of Ottawa, and an M.Env.Sc. at the University of Toronto. He worked on biological inventory and herbarium projects in Ontario, producing multiple new provincial and national records for vascular plants.

David Mazerolle is an Ecosystem Scientist at Kouchibouguac National Park, New Brunswick. He holds an undergraduate degree in Biology and a Master's degree in Environmental Studies from the Université de Moncton, where he studied the biogeography of exotic vegetation in relation to habitat and disturbance regimes and produced an exotic invasive vegetation management strategy for Kouchibouguac National Park. 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 and from 2006 to 2018 as a botanist for the Atlantic Canada Conservation Data Centre. An accomplished field botanist, he has over 20 years of experience working on research, survey and monitoring projects and has authored and co-authored many 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 Atlantic Canada Conservation Data Centre, where he is responsible for maintaining status ranks and a rare species occurrence database for vascular plants in each of the three Maritime provinces. Since beginning with the AC CDC in 1999, he has discovered over 23,000 rare plant occurrences during extensive fieldwork across the Maritimes. Sean is a member of the COSEWIC Vascular Plant Species Specialist Subcommittee, the New Brunswick Committee on the Status of Species at Risk, and the Nova Scotia Atlantic Coastal Plain Flora Recovery Team, and has written 25 COSEWIC and provincial status reports. Prior to joining AC CDC, Sean received a B.Sc. in Biology (Botany Minor) from the University of Guelph and an M.Sc. in Plant Ecology from the University of Toronto. He also worked on biological inventory projects in Ontario and spent eight summers as a naturalist in Algonquin Park, where he is a co-author of the park's plant checklist.

COLLECTIONS EXAMINED

No collections were examined in the course of this update status report.

APPENDIX 1. Threat Calculator Assessment for Gulf of St. Lawrence Aster

THREATS ASSESSMENT WORKSHEET				
Species or Ecosystem Scientific Name	Gulf of St Lawrence Aster - *Symphyotrichum laurentianum*			
Date (Ctrl + ";" for today's date):	2022-09-09			
Assessor(s):	Del Meidinger & Bruce Bennett (SSC Co-chairs); Sean Blaney & David Mazzerolle (SSC, report writers); Brenda Costanzo & Anna Lesley Hargreaves (SSC members), Jacques Labrecque & Benoit Tremblay (QC); Mary Sabine (NB), Garry Gregory (PE), Lindsay Burke (Parks Canada), Ryan Cheverie (UPEI), Lewnanny Richardson (Nature NB), Hubert Askanas (UNB), Patricia Desilets (ECCC), Kerry-Lynn Atkinson (PEI Island Nature Trust)			
References:				
Overall Threat Impact Calculation Help:			Level 1 Threat Impact Counts	
	Threat Impact		high range	low range
	A	Very High	1	0
	B	High	0	0
	C	Medium	1	1
	D	Low	0	1
Calculated Overall Threat Impact:			Very High	Medium
Assigned Overall Threat Impact:			AC = Very High - Medium	
Impact Adjustment Reasons:			No adjustment. The participants agreed that a Medium to Very High threat impact suggesting a decline in the population of 3-100% over 10-15 years was reasonable. Although it was considered unlikely that the decline could be as high as 90-100%, it could be greater than 70%, which placed the impact within the Very High threat category.	
Overall Threat Comments			Generation time estimated 2-5 years; three generations up to 15 years.	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
1	Residential & commercial development						
1.1	Housing & urban areas						
1.2	Commercial & industrial areas						
1.3	Tourism & recreation areas						Direct impact from development has been an issue in the past; not a current threat.
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						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3.1	Oil & gas drilling						
3.2	Mining & quarrying						
3.3	Renewable energy						
4	Transportation & service corridors						
4.1	Roads & railroads						
4.2	Utility & service lines						
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						
5.4	Fishing & harvesting aquatic resources						
6	Human intrusions & disturbance		Unknown	Restricted - Small (1-30%)	Unknown	High (Continuing)	
6.1	Recreational activities		Unknown	Restricted - Small (1-30%)	Unknown	High (Continuing)	Off-road vehicles can damage plants, resulting in mortality or altered local hydrology. Human activities can also trample plants, but the impact is less severe. Light disturbance from ATV use can create suitable microsites by reducing competing vegetation. and plants have been seen growing in ATV tracks. It is unknown whether overall impact is negative or positive, so Severity considered unknown.
6.2	War, civil unrest & military exercises						
6.3	Work & other activities						
7	Natural system modifications	CD	Medium - Low	Restricted (11-30%)	Serious - Moderate (11-70%)	High (Continuing)	
7.1	Fire & fire suppression						
7.2	Dams & water management/use	D	Low	Small (1-10%)	Serious - Moderate (11-70%)	High (Continuing)	Anthropogenic modification due to dredging lagoon or barachois pond openings; can be a short-lived impact but is also suspected cause of extirpation of several subpopulations. Presently relevant only in northeastern NB sites north of Kouchibouguac National Park.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
7.3	Other ecosystem modifications	CD	Medium - Low	Restricted (11-30%)	Serious - Moderate (11-70%)	High (Continuing)	Ecosystem modifications include anthropogenic alteration of the coastline by adding riprap along coast or roads, which changes sand deposition and can reduce resilience of barrier beaches that protect lagoons; and competitive exclusion due to invasion by aggressive introduced plants, including European Common Reed, Narrow-leaved Cattail and hybrid cattails, Brass Buttons, Marsh Cudweed, and Rayless Alkali Aster.
8	Invasive & other problematic species & genes						
8.1	Invasive non-native/alien species/diseases		Not Calculated (outside assessment timeframe)	Unknown	Unknown	Low (Possibly in the long term, >10 yrs/3 gen)	Hybridization with Rayless Alkali Aster may be a future threat.
8.2	Problematic native species/diseases						
8.3	Introduced genetic material						
8.4	Problematic species/diseases of unknown origin						
8.5	Viral/prion-induced diseases						
8.6	Diseases of unknown cause						
9	Pollution						
9.1	Domestic & urban waste water						
9.2	Industrial & military effluents						
9.3	Agricultural & forestry effluents						
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	AC	Very High - Medium	Pervasive (71-100%)	Extreme - Moderate (11-100%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
11.1	Habitat shifting & alteration						Reduction of winter sea ice protection due to warmer water, and sea-level rise reducing potential habitat are aspects of this category that could impact species over the longer term. Within the time frame of this assessment, the impact of rising sea level is included under 11.4 - Storms & flooding.
11.2	Droughts		Unknown	Pervasive (71-100%)	Unknown	Unknown	Droughts can kill plants before they produce seed, but seed bank can contribute unless multiple years of drought. Plant survival over the summer is a continuing issue but the impact of climate change in terms of exacerbating this issue is unknown.
11.3	Temperature extremes						
11.4	Storms & flooding	AC	Very High - Medium	Pervasive (71-100%)	Extreme - Moderate (11-100%)	High (Continuing)	More frequent and intense storms can bury sites in sand, or plug outlet channels. Storms have impacted sites in the past and will continue to do so, with the possibility of extirpation of some subpopulations. The seed bank can play a role in recovery but its contribution is unknown. Some sites have never recovered from extreme storm events.
11.5	Other impacts						
Classification of Threats adopted from IUCN-CMP, Salafsky et al. (2008).							