PROPOSED

Species at Risk Act
Recovery Strategy Series

Amended Recovery Strategy, Action Plan and Management Plan for Multiple Species of Atlantic Coastal Plain Flora in Canada

Recovery Strategy and Action Plan	Management Plan
Pink Coreopsis	Eastern Lilaeopsis
Plymouth Gentian	Goldencrest
Tall Beakrush	Long's Bulrush
Thread-leaved Sundew	New Jersey Rush
Eastern Baccharis	Redroot
Sweet Pepperbush	Tubercled Spike-rush
	Water Pennywort

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Official version

The official version of the recovery documents is the one published in PDF. All hyperlinks were valid as of date of publication.

Non-official version

The non-official version of the recovery documents is published in HTML format and all hyperlinks were valid as of date of publication.

For copies of the recovery strategy, action plan and management plan; or for additional information on species at risk; including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, and other related recovery documents, please visit the Species at Risk (SAR) Public Registry[1].

Cover illustration: Atlantic Coastal Plain Flora lakeshore habitat, Wilsons Lake, Nova Scotia; inset photos (from left) Goldencrest, Pink Coreopsis, Thread-leaved Sundew and Plymouth Gentian. Photos from the Wildlife Division, NS Department of Lands and Forestry (NS DLF).

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[1] www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

Amended Recovery Strategy, Action Plan and Management Plan for Multiple Species of Atlantic Coastal Plain Flora (Proposed 2022)

The Recovery Strategy and Management Plan for Multiple Species of Atlantic Coastal Plain Flora (Environment Canada and Parks Canada Agency 2010) was originally posted as final on the Species at Risk Public Registry in September 2010. The Action Plan for Multiple Species of Atlantic Coastal Plain Flora (Environment and Climate Change Canada 2018) was posted as final on the Species at Risk Registry in June 2018. Under Sections 45, 52 and 70 of the *Species at Risk Act*, the competent minister may amend a recovery strategy, action plan and Management Plan; respectively, at any time. The original Recovery Strategy and Management Plan was amended and posted as final on the Species at Risk Public Registry in February 2016 (Environment Canada and Parks Canada Agency 2016). An amendment is necessary now to:

- include newly listed species;
- update all sections to reflect changes in the COSEWIC status and SARA status of species; and
- revise critical habitat based on new listings and new information.

Additional changes were made to combine the recovery strategy, action plan and management and to align with current guidelines and templates for recovery documents.

Once this amended document is posted on the Species at Risk Public Registry as final, it will replace the 2016 Amended Recovery Strategy and Management Plan for Multiple Species of Atlantic Coastal Plain Flora in Canada (Environment Canada and Parks Canada Agency 2016) and the 2018 Action Plan for Multiple Species of Atlantic Coastal Plain Flora (Environment and Climate Change Canada 2018).

This amended recovery document should be considered along with The Multi-species Action Plan for Kejimkujik National Park and National Historic Site of Canada (Parks Canada Agency 2017).

Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996)[2] agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies and action plans for listed Extirpated, Endangered, and Threatened species and management plans for species of Special Concern. They are also required to report on progress within five years after the publication of the final document on the Species at Risk Public Registry.

This document has been prepared to meet the requirements under SARA of a recovery strategy, an action plan and a management plan. As such, it provides both the strategic direction for the recovery of the species, including the population and distribution objectives for the species, as well as the more detailed recovery measures to support this strategic direction, outlining what is required to achieve objectives. SARA requires that an action plan also include an evaluation of the socio-economic costs of the action plan and the benefits to be derived from its implementation. It is important to note that the setting of population and distribution objectives and the identification of critical habitat are science-based exercises and socio-economic factors were not considered in their development. The socio-economic evaluation only applies to the more detailed recovery measures. The recovery strategy, action plan and management plan are considered part of a series of documents that are linked and should be taken into consideration together, along with the COSEWIC status report.

The Minister of Environment and Climate Change and the Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Atlantic Coastal Plain Flora and has prepared this document, as per section 37, 47 and 65 of SARA. To the extent possible, it has been prepared in cooperation with NS DLF, Atlantic Canada Conservation Data Centre (AC CDC) and others, as per sections 39(1), 48(1) and 66(1) of SARA.

Success in the recovery of the Atlantic Coastal Plain Flora species covered in this document depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this document and will not be achieved by Environment and Climate Change Canada and the Parks Canada Agency or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this document for the benefit of the Atlantic Coastal Plain Flora and Canadian society as a whole.

This recovery document is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

[2] www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2

The recovery strategy sets the strategic direction to arrest or reverse the declines of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When critical habitat is identified, either in a recovery strategy or an action plan, SARA requires that critical habitat then be protected.

In the case of critical habitat identified for terrestrial species including migratory birds SARA requires that critical habitat identified in a federally protected area[3] be described in the *Canada Gazette* within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry. A prohibition against destruction of critical habitat under ss. 58(1) will apply 90 days after the description of the critical habitat is published in the *Canada Gazette*.

For critical habitat located on other federal lands, the competent minister must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies.

If the critical habitat for a migratory bird is not within a federal protected area and is not on federal land, within the exclusive economic zone or on the continental shelf of Canada, the prohibition against destruction can only apply to those portions of the critical habitat that are habitat to which the *Migratory Birds Convention Act, 1994* applies as per SARA ss. 58(5.1) and ss. 58(5.2).

For any part of critical habitat located on non-federal lands, if the competent minister forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament, or the laws of the Province or Territory, SARA requires that the Minister recommend that the Governor in Council make an order to prohibit destruction of critical habitat. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

[3] These federally protected areas are: a national park of Canada named and described in Schedule 1 to the *Canada National Parks Act*, The Rouge National Park established by the *Rouge National Urban Park Act*, a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Birds Convention Act, 1994* or a national wildlife area under the *Canada Wildlife Act* see ss. 58(2) of SARA.

Acknowledgments

This version of the recovery document was written by Sean Blaney (Atlantic Canada Conservation Data Centre) and Julie McKnight (Environment and Climate Change Canada, Canadian Wildlife Service [ECCC-CWS – Atlantic Region]) with input from staff of NS DLF, Parks Canada Agency and the Nova Scotia Atlantic Coastal Plain Flora Recovery Team. Thanks are also extended to Jeffrey Thomas (ECCC-CWS – Atlantic Region) for completing the CH analysis and to Chris Lauzon and Kevin Tayles (ECCC-NCR) for preparing the Canadian occurrence and critical habitat maps. Previous versions of the ACPF recovery documents were developed by Samara Eaton and built on previous iterations of ACPF recovery plans including the original recovery plan drafted by the ACPF Recovery Team in 1998.

Executive Summary

The Atlantic Coastal Plain and Gulf Coastal Plain physiographic regions extend along the United States' eastern coast from southern Massachusetts to eastern Texas. They support a taxonomically diverse suite of 1,600 vascular plant taxa (the Atlantic Coastal Plain Flora) that are largely or entirely endemic to these regions. Some of these Atlantic Coastal Plain Flora (ACPF) extend into southern Canada, most prominently in Nova Scotia, home to 100 species of ACPF, 55 of which are rare in Canada and 37 of which occur nowhere else in Canada. Of these, 13 species are listed under SARA. This document includes the recovery strategy and action plan for the ACPF listed as Endangered or Threatened under SARA:

Pink Coreopsis (*Coreopsis rosea*) – Endangered
Plymouth Gentian (*Sabatia kennedyana*) – Endangered
Tall Beakrush (*Rhynchospora macrostachya*) – Endangered
Thread-leaved Sundew (*Drosera filiformis*) – Endangered
Eastern Baccharis (*Baccharis halimifolia*) – Threatened
Sweet Pepperbush (*Clethra alnifolia*) – Threatened

This document also includes the management plan for the ACPF that are listed as Special Concern under SARA:

Eastern Lilaeopsis (*Lilaeopsis chinensis*)
Goldencrest (*Lophiola aurea*)
Long's Bulrush (*Scirpus longii*)
New Jersey Rush (*Juncus caesariensis*)
Redroot (*Lachnanthes caroliniana*)
Tubercled Spike-rush (*Eleocharis tuberculosa)*
Water Pennywort (*Hydrocotyle umbellata*)

Based on four criteria that Environment and Climate Change Canada uses to establish recovery feasibility, recovery of the listed ACPF was deemed technically and biologically feasible.

This document was prepared to meet the requirements under SARA of a recovery strategy, an action plan and a management plan. As such, it provides both the strategic direction for the recovery of the species as well as the more detailed recovery measures to support this strategic direction, outlining what is required to achieve the objectives. These ACPF were assessed as at risk because of their natural rarity and anthropogenic threats to individuals and their habitats, including cottage and residential development, shoreline disturbance, eutrophication from agricultural effluent, and alterations to natural disturbance regimes. The United States' eastern coast, where most ACPF species' ranges are concentrated, is very heavily impacted by human activity. ACPF occurrences in Nova Scotia are in a region of low human population density and are generally much less impacted by human activities. Four of the ACPF species at risk (Pink Coreopsis, Plymouth Gentian, Long's Bulrush, New Jersey Rush) are globally rare, with Canadian

populations in Nova Scotia representing a significant proportion of the global total, including some of the best and most intact remaining occurrences. The importance of the Canadian population of Long's Bulrush is especially noteworthy because Nova Scotia occurrences are believed to support more than half the global population.

The ACPF species at risk have traits in common that make a single multi-species recovery strategy, action plan and management plan more efficient and practical than individual documents. All the species' occurrences except for New Jersey Rush (restricted to eastern Cape Breton Island) and one Cumberland County occurrence of Eastern Lilaeopsis are within southernmost mainland Nova Scotia (southern Annapolis and Lunenburg counties and southward). The listed species are limited to a small set of habitat types that share common threats and management requirements. Many species occur on lakeshores, within the open zone exposed by low water conditions in summer (Pink Coreopsis, Plymouth Gentian, Tall Beakrush, Goldencrest, Long's Bulrush [to a limited extent], Redroot, Tubercled Spike-rush and Water Pennywort) or in the shrub zone just above (Sweet Pepperbush). Four species occur in peatlands (Goldencrest, Long's Bulrush, New Jersey Rush and Thread-leaved Sundew) and the remaining two species occur in saline estuarine habitats (Eastern Baccharis and Eastern Lilaeopsis). In many cases, two or more of the species co-occur in the same locations or in close proximity, providing additional efficiencies in co-management.

For Pink Coreopsis and Plymouth Gentian with documented site losses due to anthropogenic habitat changes, the population and distribution objectives are increase their population redundancy by re-establishing two populations in suitable areas within their natural range. The population and distribution objectives (for Endangered and Threatened species) and management objectives (for species of Special Concern) for the remaining listed ACPF species are to maintain a stable population within the species' range in Canada (i.e., extent of occurrence 2019), including any new sites that may be found in the future. Meeting these objectives involves conserving suitable habitat to prevent further decline in extent and quality of habitat and to allow for colonization of presently unoccupied habitat. Additionally, for Pink Coreopsis and Plymouth Gentian, meeting these objectives involves restoring habitat and re-establishing populations in areas of former habitat destroyed by human activity, to the extent possible.

The broad strategies, general approaches and recovery measures to be taken to support the population and distribution objectives and address threats to ACPF are presented in the Strategic Direction for Recovery and Measures to be Taken (Section 6.2).

Section 41(1)(c) of SARA requires that the recovery strategy for Endangered and Threatened species include an identification of the species' critical habitat, to the extent possible, as well as examples of activities likely to result in its destruction. Critical habitat is fully identified in this document for the Endangered and Threatened ACPF species.

The direct and societal costs of implementing the measures contained in this document (as part of the action plan content) are expected to be low (between $0 and $5 million) over the short term (five years) and will have limited socio-economic impact and constraints to human land use. Indirect costs are expected to be minimal and resulting benefits relate to the value of biodiversity to Canadians, ecosystem services and conservation of other species.

Recovery Feasibility Summary

Environment and Climate Change Canada establishes recovery feasibility based on the four criteria below. Based on these criteria, recovery is believed to be technically and biologically feasible for the Endangered or Threatened species covered in this document: Pink Coreopsis, Plymouth Gentian, Tall Beakrush Thread-leaved Sundew, Eastern Baccharis and Sweet Pepperbush.

1. Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.

Yes. Reproduction by seed or by vegetative means has been observed or inferred in Nova Scotia for all ACPF species covered by this document.

2. Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.

Yes. Suitable habitat is available and is sufficient to support all the species' current distributions. Within each species' current distributions there is also extensive habitat that is apparently suitable but presently unoccupied. The species' absence from this unoccupied habitat is believed to be unrelated to any anthropogenic influences and probably reflects limitations of post-glacial dispersal and colonization.

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

Yes. Many of the relevant threats can be avoided or mitigated through conservation designation & planning, awareness raising, creating/amending/influencing laws, regulations, or policies and law enforcement & prosecution. Mitigatable threats include those acting directly on sites of species' occurrences (habitat conversion for shoreline recreational development, peat mining or other industrial development, off-highway vehicle (OHV) use, trampling) and threats acting on species' habitats from some distance away (eutrophication caused by mink or pig farm effluent, hydrological or nutrient level changes caused by adjacent forestry).

The threats from water level regulation that is inappropriate for lakeshore species may be more difficult to manage because of competing demands for hydrological power generation, but water level regulation more appropriate to lakeshore species' needs could be undertaken for currently occupied (Pink Coreopsis) and formerly occupied (Plymouth Gentian) shoreline habitats on power dam headponds. Though now-dammed lakes likely once contributed substantially to total populations of these species, subpopulations on these sites are now very small. Thus any difficulty in managing the impacts of dams would not place major limitations on maintaining current populations.

The invasive shrub Glossy Buckthorn presents a future threat primarily for Sweet Pepperbush but also for other ACPF. Glossy Buckthorn can be managed by intensive manual removal, which would be feasible within the relatively limited area occupied by Sweet Pepperbush in Nova Scotia.

Climate change is not known or suspected to be a significant threat to most ACPF but sea level rise and/or increased storm frequency and severity could affect the coastal shrub Eastern Baccharis. Saltwater incursion from sea level rise could also affect the small population of Pink Coreopsis at Pleasant Lake. These threats are not easily avoided, but could be mitigated through management of newly suitable habitat as it migrates landward, and potentially through human-assisted establishment of individuals in newly suitable habitat.

4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.

Yes. Habitat restoration techniques exist to achieve an increase in population and range for Pink Coreopsis and Plymouth Gentian and recovery techniques exist to achieve the population and distribution objectives of maintaining the current range of the listed ACPF. Management and threat reduction approaches exist that could address threats to the species and have the potential to prevent future habitat destruction or to allow for habitat recovery. The COSEWIC status reports suggest that the Canadian populations of all species are likely fairly stable or only moderately declining at present, suggesting that achieving population and distribution objectives is feasible.

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1. COSEWIC* Species Assessment Information

Date of Assessment: November 2012

Common Name (population): Pink Coreopsis

Scientific Name: *Coreopsis rosea*

COSEWIC Status: Endangered

Reason for Designation: This showy perennial lake and river shore plant has a restricted global range with a disjunct distribution limited to southernmost Nova Scotia. There is a concern regarding potential widespread and rapid habitat degradation due to recent increases in levels of phosphorus in lakes, tied to a rapidly growing mink farming industry. Though the population size is now known to be larger than previously documented due to greatly increased survey effort, the species is also at risk due to the continuing impacts associated with shoreline development, and historical hydro-development.

Canadian Occurrence: NS

COSEWIC Status History: Designated Endangered in April 1984. Status re-examined and confirmed Endangered in April 1999, May 2000, and November 2012.

* COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

Date of Assessment: November 2012

Common Name (population): Plymouth Gentian

Scientific Name: *Sabatia kennedyana*

COSEWIC Status: Endangered

Reason for Designation: This showy perennial lakeshore plant has a restricted global range with a disjunct distribution limited to southernmost Nova Scotia. There is a concern regarding potential widespread and rapid habitat degradation due to recent increases in levels of phosphorus in lakes, tied to a rapidly growing mink farming industry. Though the population size is now known to be larger than previously documented due to greatly increased survey effort, the species is also at risk due to the continuing impacts associated with shoreline development, and historical hydro-development.

Canadian Occurrence: NS

COSEWIC Status History: Designated Threatened in April 1984. Status re-examined and confirmed in April 1999 and May 2000. Status re-examined and designated Endangered in November 2012.

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Date of Assessment: November 2014

Common Name (population): Tall Beakrush

Scientific Name: *Rhynchospora macrostachya*

COSEWIC Status: Endangered

Reason for Designation: In Canada, this perennial sedge only occurs along two acidic, peaty lakeshores in southwestern Nova Scotia, where it is disjunct from its main U.S. Atlantic Coastal Plain distribution. Its small population size (ca. 700 individuals total in two subpopulations) and very specific habitat needs make it vulnerable to lakeshore development, water regulation (for hydroelectric power), and shading and competition from introduced invasive plants such as Glossy Buckthorn, which benefit from increased concentrations of nutrients in these two lakes.

Canadian Occurrence: NS

COSEWIC Status History: Designated Endangered in November 2014.

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Date of Assessment: May 2001

Common Name (population): Thread-leaved Sundew

Scientific Name: *Drosera filiformis*

COSEWIC Status: Endangered

Reason for Designation: Peat bog species occurring in only a few sites highly disjunct from the main range of the species along the Atlantic seaboard and subject to ongoing risks of peat extraction.

Canadian Occurrence: NS

COSEWIC Status History: Designated Endangered in April 1991. Status re-examined and confirmed in May 2001.

Date of Assessment: November 2011

Common Name (population): Eastern Baccharis

Scientific Name: *Baccharis halimifolia*

COSEWIC Status: Threatened

Reason for Designation: The species is an Atlantic Coastal Plain Flora species. A rare Canadian disjunct shrub restricted to very specific salt marsh habitat in southern Nova Scotia. Its coastal habitat is declining due to increasing shoreline development. Further, climate change effects, including rising sea level and increasing and more frequent storm surges, will cause habitat loss and degradation as well as impact individuals over the next few decades.

Canadian Occurrence: NS

COSEWIC Status History: Designated Threatened in November 2011.

Date of Assessment: May 2014

Common Name (population): Sweet Pepperbush

Scientific Name: *Clethra alnifolia*

COSEWIC Status: Threatened

Reason for Designation: This disjunct Atlantic Coastal Plain clonal shrub is restricted to the shores of six lakes in a small area of southern Nova Scotia. Newly identified threats from the invasive exotic shrub Glossy Buckthorn and eutrophication have put this species at increased risk of extirpation. Shoreline development also remains a threat.

Canadian Occurrence: NS

COSEWIC Status History: Designated Threatened in April 1986. Status re-examined and confirmed in April 1998. Status re-examined and designated Special Concern in May 2001. Status re-examined and designated Threatened in May 2014.

Date of Assessment: May 2004

Common Name (population): Eastern Lilaeopsis (formerly listed as Lilaeopsis)

Scientific Name: *Lilaeopsis chinensis*

COSEWIC Status: Special Concern

Reason for Designation: Small perennial herb reproducing both by seed and extensively by vegetative spread. It is geographically highly restricted and present in Canada at only three estuaries in Nova Scotia. The area of occupancy is very small but the population is large. No declines of significance have been documented over the last 15 years. It does not appear to have any imminent threats, however, future shoreline development or degradation could destroy extant populations.

Canadian Occurrence: NS

COSEWIC Status History: Designated Special Concern in April 1987 and in May 2004.

Date of Assessment: May 2012

Common Name (population): Goldencrest (formerly listed as Golden Crest)

Scientific Name: *Lophiola aurea*

COSEWIC Status: Special Concern

Reason for Designation: In Canada, this Atlantic Coastal Plain plant is found only in Nova Scotia at a few lake shores and wetlands. The Canadian population primarily reproduces vegetatively and is genetically distinct and geographically disjunct from the nearest populations in New Jersey 800 km to the south. Revisions to the COSEWIC assessment criteria since the species' last assessment account, in part, for the change in its risk status. Recent intensive surveys have also determined that the population is larger than previously thought. However, the species is subject to ongoing threats from development and habitat alteration.

Canadian Occurrence: NS

COSEWIC Status History: Designated Threatened in April 1987. Status re-examined and confirmed in April 1999 and in May 2000. Status re-examined and designated Special Concern in May 2012.

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Date of Assessment: April 2017

Common Name (population): Long's Bulrush

Scientific Name: *Scirpus longii*

COSEWIC Status: Special Concern

Reason for Designation: This globally vulnerable, long-lived wetland plant is restricted in Canada to a small region of Nova Scotia that supports nearly half of the world's population. The species is increasingly threatened by competition and shading from the invasive Glossy Buckthorn and native shrubs. Peat mining could be a future threat. Limited sexual reproduction and hybridization may also reduce survival of this sedge.

Canadian Occurrence: NS

COSEWIC Status History: Designated Special Concern in April 1994. Status re-examined and confirmed in April 2017.

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Date of Assessment: May 2004

Common Name (population): New Jersey Rush

Scientific Name: *Juncus caesariensis*

COSEWIC Status: Special Concern

Reason for Designation: The species is a globally rare plant found along the periphery of 25 bogs and fens in a geographically restricted area of southeastern Cape Breton Island, Nova Scotia. The Canadian population is estimated at 5,000 - 10,000 plants that comprise a large proportion of the global population. The Canadian plants are widely disjunct from sites along the U.S. Atlantic seaboard where the species is also quite rare. It is sensitive to activities that alter the hydrological regime of its habitat such as logging, road construction and in-filling.

Canadian Occurrence: NS

COSEWIC Status History: Designated Special Concern in April 1992. Status re-examined and confirmed in May 2004.

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Date of Assessment: November 2009

Common Name (population): Redroot

Scientific Name: *Lachnanthes caroliniana (formerly listed as Lachnanthes caroliana)*

COSEWIC Status: Special Concern

Reason for Designation: A highly disjunct Atlantic Coastal Plain species restricted in Canada mainly to two connected, extensive, lakeshore populations in southern Nova Scotia. Comprehensive new surveys and other information indicate that the risk of extinction for this species is less than previously thought. Its lakeshore habitat has been subject to slow but steady loss and decline in quality due to cottage and residential development for 30 to 40 years. Losses are likely to continue through the foreseeable future with new development and intensification of existing development, but the proportion of habitat currently developed is still low and the species' locally widespread occurrence and asexual reproduction mitigates the threat of extirpation in the short term.

Canadian Occurrence: NS

COSEWIC Status History: Designated Threatened in April 1994. Status re-examined and confirmed in May 2000. Status re-examined and designated Special Concern in November 2009.

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Date of Assessment: April 2010

Common Name (population): Tubercled Spike-rush

Scientific Name: *Eleocharis tuberculosa*

COSEWIC Status: Special Concern

Reason for Designation: In Canada, this sedge is known to exist only along peaty and sandy shorelines at six lakes in southwestern Nova Scotia. The use of all-terrain vehicles along the shores of the two largest lakes, where most of the Canadian population occurs, has degraded portions of the species' habitat. Cottage development and related impacts (water quality and habitat disturbances) are currently limited threats that have the potential to increase in the future. More intensive surveys of lakeshore habitats indicate that the species is somewhat more abundant than previously documented.

Canadian Occurrence: NS

COSEWIC Status History: Designated Threatened in May 2000. Status re-examined and designated Special Concern in April 2010.

Date of Assessment: May 2014

Common Name (population): Water Pennywort (formerly listed as Water-pennywort)

Scientific Name: *Hydrocotyle umbellata*

COSEWIC Status: Special Concern

Reason for Designation: This species is known from only three disjunct lakeshore locations in southern Nova Scotia, one of which was discovered since the last assessment. Alterations and damage to shorelines from shoreline development and off-road vehicles are ongoing threats, and water level management is a potential threat at one lake. Increased competition from other plants caused by eutrophication is a potential major future threat.

Canadian Occurrence: NS

COSEWIC Status History: Designated Endangered in April 1985. Status re-examined and designated Threatened in April 1999. Status re-examined and confirmed in May 2000. Status re-examined and designated Special Concern in May 2014.

2. Species Status Information

Information on species' global, national and subnational status ranks; listing under Schedule 1 of the *Species at Risk Act* (SARA); listing under the Nova Scotia Endangered Species Act - N.S. Reg. 2017 (NS ESA) and proportion of the population in Canada is summarized in Table 1. Most of the listed species covered in this document are secure in the remainder of their ranges outside of Canada, but four species (Pink Coreopsis, Plymouth Gentian, Long's Bulrush and New Jersey Rush) are globally rare, with Canadian populations in Nova Scotia representing a significant proportion of the global total. The importance of the Canadian population of Long's Bulrush is especially noteworthy because Nova Scotia occurrences are believed to support more than half the global population.

434 **Table 1.** Conservation status ranks (NatureServe 2019) and estimated proportion of global population in Canada for ACPF species listed or under
435 assessment under SARA.

Common Name *Scientific Name*	COSEWIC + Date Last Assessed	SARA Status + Date Status Assigned	NS ESA Status + Year Assigned	National and Subnational Ranks[a]	USA Rank[a]	Global Rank[a]	Est. % Population in Canada
Pink Coreopsis *Coreopsis rosea*	**Endangered November 2012**	**Schedule 1, Endangered 2003-06-05**	**Endangered 2000**	**S1, N1**	**N3**	**G3**	**less than 10%**
Status Elsewhere: DE (S1), GA (S1), MD (S1), MA (S3), NJ (S2), NY (S3), PA (SX), RI (S2), SC (S2)							
Plymouth Gentian *Sabatia kennedyana*	**Endangered November 2012**	**Schedule 1, Endangered 2003-06-05**	**Endangered 2013**	**S1, N1**	**N3**	**G3**	**~25%**
Status Elsewhere: MA (S3), NC (S2), RI (S1), SC (S2). Introduced in VA (SNA).							
Tall Beakrush *Rhynchospora macrostachya*	**Endangered November 2014**	**Schedule 1, Endangered 2019-02-25**	**Endangered 2017**	**S1, N1**	**NNR**	**G4**	**less than 1%**
Status Elsewhere: AL (SNR), AR (SNR), CT (S1S2), DE (S4), DC (SNR), FL (SNR), GA (SU), IN (S2), KS (S2), KY (S1), LA (SNR), ME (S1), MD (SNR), MA (SNR), MI (S3S4), MS (SNR), MO (SNR), NJ (SNR), NY (S3), NC (S3?), OK (SNR), RI (S1), SC (SNR), TN (S1S2), TX (SNR), VT (SNR), VA (S3)							
Thread-leaved Sundew *Drosera filiformis*	**Endangered May 2001**	**Schedule 1, Endangered 2003-06-05**	**Endangered 2000**	**S1, N1**	**N4**	**G4**	**less than 5%**
Status Elsewhere: CT (SH), DE (SX), FL (S1), MA (S4), NJ (S4), NY (S3), NC (S2). Introduced in MD (SNA), PA (SNA), WV (SNA).							

Common Name *Scientific Name*	COSEWIC + Date Last Assessed	SARA Status + Date Status Assigned	NS ESA Status + Year Assigned	National and Subnational Ranks[a]	USA Rank[a]	Global Rank[a]	Est. % Population in Canada
Eastern Baccharis ***Baccharis halimifolia***	**Threatened** **November 2011**	**Schedule 1, Threatened** **2017-06-02**	**Threatened** **2013**	**S1, N1**	**N5**	**G5**	**less than 1%**
Status Elsewhere: AL (SNR), AR (SNR), CT (SNR), DE (S5), DC (SNR), FL (SNR), GA (SNR), KY (SNA), LA (SNR), MD (SNR), MA (SNR), MS (SNR), NJ (S5), NY (S5), NC (S5), OK (SNR), PA (S3), RI (S2), SC (SNR), TX (SNR), VA (S5). Introduced in Europe and Australia.							
Sweet Pepperbush ***Clethra alnifolia***	**Threatened** **May 2014**	**Schedule 1, Threatened** **2018-02-02**	**Vulnerable** **2000**	**S1, N1**	**N5**	**G5**	**less than 1%**
Status Elsewhere: AL (S5), CT (SNR), DE (S5), DC (SNR), FL (SNR), GA (SNR), LA (SNR), ME (S2), MD (SNR), MA (SNR), MS (SNR), NH (SNR), NJ (S5), NY (S5), NC (SNR), PA (SNR), RI (SNR), SC (SNR), TX (SNR), VA (S5). Introduced in Belgium, The Netherlands and England.							
Eastern Lilaeopsis ***Lilaeopsis chinensis***	**Special Concern** **May 2004**	**Schedule 1, Special Concern** **2005-07-14**	**Vulnerable** **2006**	**S2, N2**	**N5**	**G5**	**less than 1%**
Status Elsewhere: AL (SNR), CT (S3), DE (S4), FL (SNR), GA (S2?), LA (SNR), ME (S2), MD (SNR), MA (S2?), MS (SNR), NH (S1), NJ (S4), NY (S2), NC (S3?), RI (S1), SC (SNR), VA (S5)							
Goldencrest ***Lophiola aurea***	**Special Concern** **May 2012**	**Schedule 1, Special Concern** **2017-02-03**	**Vulnerable** **2013**	**S2, N2**	**N4**	**G4**	**less than 5%**
Status Elsewhere: AL (S3S4), DE (SX), FL (SNR), GA (S1?), LA (S2S3), MS (S4?), NJ (S4), NC (S2)							
Long's Bulrush ***Scirpus longii***	**Special Concern** **April 2017**	**Schedule 3, Special Concern** **[undated]**	**Vulnerable** **2001**	**S3, N3**	**N2**	**G3**	**50%+**
Status Elsewhere: CT (SH), ME (S2), MA (S2), NH (S1), NJ (S2), NY (SX), RI (S1)							

Common Name *Scientific Name*	COSEWIC + Date Last Assessed	SARA Status + Date Status Assigned	NS ESA Status + Year Assigned	National and Subnational Ranks[a]	USA Rank[a]	Global Rank[a]	Est. % Population in Canada
New Jersey Rush ***Juncus caesariensis***	**Special Concern May 2004**	**Schedule 1, Special Concern 2005-07-14**	**Vulnerable 2001**	**S2, N2**	**N2**	**G2G3**	**20%+**
Status Elsewhere: MD (S1), NJ (S2), NC (S1), VA (S2)							
Redroot ***Lachnanthes caroliniana***	**Special Concern November 2009**	**Schedule 1, Special Concern 2012-06-20**	**Vulnerable 2013**	**S2, N2**	**N4**	**G4**	**less than 5%**
Status Elsewhere: AL (SNR), CT (S1), DE (S1), FL (SNR), GA (SNR), LA (S3), MD (S1), MA (S3), MS (SNR), NJ (S5), NY (S1), NC (S4), RI (S1), SC (SNR), TN (S1), VA (SH)							
Tubercled Spikerush ***Eleocharis tuberculosa***	**Special Concern April 2010**	**Schedule 1, Special Concern 2012-06-19**	**Vulnerable 2013**	**S2, N2**	**N5**	**G5**	**probably less than 1%**
Status Elsewhere: AL (SNR), AR (SNR), CT (SNR), DE (S4), DC (SNR), FL (SNR), GA (S4), KY (SNR), LA (SNR), ME (S1), MD (SNR), MA (SNR), MS (S5), NH (SH), NJ (S4), NY (S2), NC (S5), PA (S1), RI (SNR), SC (SNR), TN (SNR), TX (SNR), VA (S5)							
Water Pennywort ***Hydrocotyle umbellata***	**Special Concern May 2014**	**Schedule 1, Special Concern 2018-02-02**	**Endangered 2001**	**S2, N2**	**N5**	**G5**	**less than 1%**
Status Elsewhere: AL (SNR), AR (SNR), CA (SNR), CT (S1), DE (S5), FL (SNR), GA (SNR), IN (SNR), LA (SNR), MD (SNR), MA (SNR), MI (SNR), MS (SNR), NJ (S4), NY (S3), NC (S5), OH (S1), OK (SNR), OR (SNR), PA (SH), RI (SNR), SC (SNR), Tennessee (SNR), TX (SNR), VA (S5). Reportedly introduced to IL. Native throughout Central America, the Caribbean and most of South America, occurring south to Chile (where possibly introduced). Introduced in south Asia (India to Taiwan) and New Zealand.							

[a] Conservation Status Rank: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable – Vulnerable in state/province; 4 = Apparently Secure—Uncommon but not rare (some cause for long-term concern due to declines or other factors); 5 = Secure – Common, widespread, and abundant in the state/province; SU = Status Unrankable – available information deficient; SNR = Unranked (usually because species is considered secure); SNA = Conservation status not applicable (i.e. introduced or falsely / questionably reported).

3. Species Information

The species listed in this report are members of a larger group of 100 species in Nova Scotia collectively called the Atlantic Coastal Plain Flora (hereafter ACPF; Appendix B).

3.1 Introduction to ACPF

The Atlantic Coastal Plain region of the eastern United States and the adjacent and similar Gulf Coastal Plain support a very distinctive flora that includes about 1300 species and 300 varieties or subspecies of endemic[4] or near endemic vascular plants (Sorrie and Weakley 2001). In Canada the ACPF occur disjunct from the Atlantic Coastal Plain of the eastern United States, to a limited degree in southwestern New Brunswick (Blaney and Mazerolle 2007), with a greater diversity in the southern Georgian Bay region of Ontario (Keddy and Reznicek 1982; Reznicek 1994), and most extensively in southern Nova Scotia, where 100 taxa occur (Appendix B). The ACPF come from a wide range of plant families and are grouped together based on shared biogeography (occurrence predominantly on the Atlantic Coastal Plain of the United States, with disjunct occurrence in Nova Scotia, mostly in the southwestern part of the province) and habitat requirements (river and lakeshores, bogs, fens and saltmarshes, with a lesser representation in sand or rock barrens, all within a region of relatively warm climate). The degree to which species' ranges or ecological niches extend beyond those most typical of ACPF varies greatly and there is thus some subjectivity in determining what species qualify as ACPF in Nova Scotia. Species are considered ACPF if they meet at least two of the following three criteria:

- Coastal plain range overall (predominantly US east coast, limited occurrence on the west side of the Appalachian Mountains),
- Coastal plain range in Nova Scotia (predominantly south of the line between Halifax and Windsor, potentially including spread further north along the Atlantic coast),
- Coastal plain habitat (lake & river shore or aquatic, peatland, swamp forest, sand barren, saltmarsh or estuarine shore).

The ACPF in Nova Scotia are highly unique for Canada. The 100 species of ACPF in Nova Scotia include 55 taxa that are rare in Canada, 37 of which occur nowhere else in Canada (Blaney 2019).

The United States' eastern coast, where most ACPF species' ranges are concentrated, is very heavily impacted by human activity. ACPF occurrences in Nova Scotia are in a region of low human population density and are generally much less impacted by human activities. Four of the ACPF species at risk (Pink Coreopsis, Plymouth Gentian, Long's Bulrush and New Jersey Rush) are globally rare, with Canadian populations in Nova Scotia representing a significant proportion of the global total, including some of the best and most intact remaining occurrences.

[4] native and restricted to a certain place

ACPF are generally poor competitors and are therefore often limited to habitats where low fertility and continuous disturbance minimize competition from more aggressive plants (Keddy and Wisheu 1989, Morris et al. 2002). In Nova Scotia, ACPF are at the northern limit of their range and their distribution may be further limited due to scarcity of suitable habitat, marginal climatic conditions, slow growth and low rates of reproduction and dispersal (Sweeney and Ogilvie 1993). The listed ACPF species are ‘at risk’ as a result of natural rarity combined with anthropogenic threats to individuals and their habitats, including cottage and residential development, shoreline disturbance, eutrophication from agricultural effluent, and alterations to natural disturbance regimes.

ACPF species at risk in Nova Scotia can be grouped by habitat, with some species occurring in more than one habitat type. Seven species occur primarily or exclusively on seasonally flooded lakeshores (Pink Coreopsis, Plymouth Gentian, Tall Beakrush, Goldencrest [also occurs extensively in open peatland], Redroot, Tubercled Spikerush and Water Pennywort [also occurs to some extent in deeper lake water to about 1 m summer depth]). A small proportion of Long’s Bulrush also occurs on seasonally flooded lakeshores. Ideal lakeshore conditions for these ACPF are most likely to be found on larger lakes with a relatively large watershed above them (Holt et al. 1995; Keddy 1983; 1984; 1985). Higher watershed lakes have greater water level fluctuation so that shoreline plants are flooded and thereby protected from cold temperatures in the winter, and extensive low shorelines are exposed during low water conditions in mid to late summer. Larger lakes also have heavier disturbance from ice movement and wave action that, along with seasonal flooding, limits woody shrubs and taller herbaceous plants to create broader open shoreline zones for the ACPF species. Substrates on lakeshore areas supporting ACPF include fine sand, gravel and small rocks but generally have limited coverage of large boulders. Thin layers of peat often occur over these substrates.

Sweet Pepperbush is a shrub associated with lakeshores but growing higher up, near the shoreline to forest transition zone, or in shrubby or forested wetlands just back from the lakeshore. It will grow among upper shoreline boulders or in organic wetland soils but is unable to establish on open, seasonally-flooded shores because of ice damage.

Three ACPF species at risk occur primarily or exclusively in open peatlands (Thread-leaved Sundew, Long’s Bulrush and New Jersey Rush) and a fourth occurs extensively in both peatlands and lakeshores (Goldencrest). In all of these species, occupied portions of the peatland tend to be wetter and less densely vegetated (especially relative to woody vegetation) than in the surrounding peatlands as a whole. Thread-leaved Sundew and New Jersey Rush are known only from larger peatlands not directly associated with lakes or rivers, and most Goldencrest occurrences in peatlands are similar. Long’s Bulrush often occurs in similar large, non-shore peatlands but also occurs where peatland has developed adjacent to lakes, rivers and streams. Tall shrub and tree cover is absent or limited in occupied peatlands, except occasionally for New Jersey Rush. It can occur in small openings in peaty Black Spruce forest, though these habitats are likely sub-optimal.

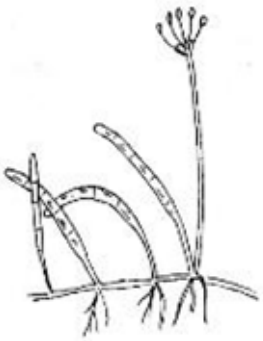
Two ACPF species at risk are found in estuarine locations. Eastern Lilaeopsis occurs on mud or fine gravel on brackish river estuaries within the zone flooded at high tide. Eastern Baccharis occurs in the uppermost saltmarsh and along the saltmarsh to forest transition zone within bays that are well protected from the heaviest wave action.

All ACPF species at risk occurrences except for New Jersey Rush (in southeastern Cape Breton) and the River Philip, Cumberland County occurrence of Eastern Lilaeopsis are within southernmost part of mainland Nova Scotia, south of a line roughly between the towns of Digby on the Bay of Fundy coast and Chester on the Atlantic coast. Within that zone, the watersheds of the Tusket River and the Medway River support the highest diversity of ACPF species.

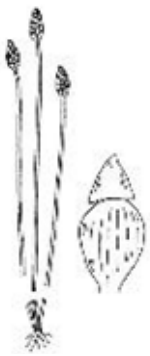
3.1.1 Species Descriptions

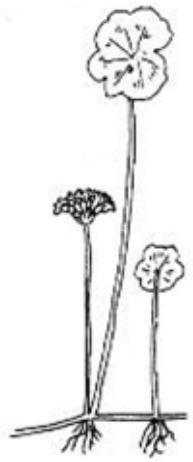
Pink Coreopsis (Endangered) ©NS Museum 	Pink Coreopsis is a perennial herb of lakeshores with showy compound inflorescences growing at the ends of stalks 20-60 cm high. It flowers from mid to late summer and the daisy-like, composite inflorescences are made up of small yellow inner disk flowers and elongate pink (sometimes white) outer ray flowers. The leaves are 2 to 5 cm long, linear, untoothed and arranged in opposite pairs. The achenes (fruit) are 2 mm long, narrow and wingless.
Plymouth Gentian (Endangered) ©NS Museum 	Plymouth Gentian is a showy herbaceous perennial herb of lakeshores with stems arising from leafy basal rosettes. It grows to a height of 30-50 cm in NS. Each plant bears 1 to 10 large pink flowers with yellow centers on the ends of long stalks. The plant has a single stem with opposite, sessile, lance-shaped leaves. The plants spread vegetatively via stolons (prostrate, creeping stems) that produce new leafy, yellow green rosettes at their tips. The seed capsules are cylindrical and measure 7 to 11 mm in length.

Tall Beakrush (Endangered) 	Tall Beakrush is a perennial, herbaceous sedge of peaty lakeshores. Flowering stems, arising from a dense clump of basal leaves, reach 150 – 170 cm in the United States and about 100 cm in Canada. Flowers are enclosed within brown scales, with each flower having male and female parts and six elongate, barbed bristles. Fertilized flowers develop into a hard, flattened achene 5 to 6 mm long, topped by a greatly elongated tubercle.
Thread-leaved Sundew (Endangered) ©NS Museum 	Thread-leaved Sundew is a perennial, carnivorous herb that grows to a height of 15 to 25 cm. It survives in nutrient-poor, acidic peatlands by trapping insects as a source of digestible nitrogen. Its leaves are long, erect, and linear, arising from a spherical, whitish tuber at or just under the peat surface. Insects are attracted and trapped by reddish-purple, sticky, hair-like glands that cover the leaves. Plants secrete additional fluid and enzymes to digest and absorb trapped insects. Six to fifteen violet, five-petalled flowers with yellow centres open sequentially from bottom to top along an elongate leafless stem.
Eastern Baccharis (Threatened) 	Eastern Baccharis is a multi-stemmed, woody shrub in the aster family occurring in the upper margins of saltmarshes and beaches. It reaches 1 to 3 metres tall in Canada, but can be 6 m in more southern areas. Eastern Baccharis is evergreen southward but is semi-deciduous or deciduous in the northern United States, and completely deciduous in Canada. Male and female flowers are on separate plants. Flower heads contain 20 to 30 whitish florets (small individual flowers). Profuse pollen production often gives male flowers a yellow colour. The achenes (seeds) are firmly attached to a tuft of 10 to 14 mm white bristles (the pappus), which aids in wind and water dispersal and protrudes from the receptacle in fruit, making female shrubs much showier during seed dispersal than during flowering.

Sweet Pepperbush (Threatened) ©NS Museum 	Sweet Pepperbush is a long-lived perennial, deciduous shrub of 1-3 m that commonly spreads by rhizomes to form dense lakeshore thickets. It has oval or oblong leaves that are shiny, alternate, serrated and 7 to 15 cm long. Its flowers are small, white, and fragrant, with five petals that are approximately 8 mm in length. The flowers are in a raceme, meaning they are on short stalks clustered together along a central elongated axis. It flowers from mid-August to mid-October, and produces globular, pubescent fruit (approximately 0.5 cm wide) that become grey by late autumn or early winter. Seed production may be limited in Nova Scotia. The species' name is derived from its sweetly fragrant flowers and peppercorn-shaped seed capsules.
Eastern Lilaeopsis (Special Concern) ©NS Museum 	Eastern Lilaeopsis is a small, semi-aquatic, perennial herb in the carrot family that grows on shorelines in the intertidal zone. The short, dark green, club-shaped leaves are a few centimetres long occur at irregular intervals along a network of slender horizontal rhizomes that can form large patches. The peduncle or flower stalk is up to 8 cm tall. Tiny white flowers with five petals occur in groups of 5 to 7 at the top of the flowering stem. The flowers are arranged in an umbel, meaning each pedicel (the stalk supporting the individual flower) originates from the same point. The fruit is ovoid and approximately 2 mm in length.
Goldencrest (Special Concern) ©NS Museum 	Goldencrest is a perennial herb that grows up to 50 cm tall. It has a conspicuous whitish to pinkish-grey flowering stalk that is branched and covered by woolly hairs. Numerous small yellow flowers are at the tips of the branching inflorescence. The basal leaves are ensiform (iris-like; vertically oriented, long, narrow, pointed and folded in half with the edges sealed along most of their length down to the base). They are up to 30 cm long, bluish-green, slightly hairy and reddish at the base. In the spring, it can be distinguished by the presence of persistent dried fruiting stalks from the previous season.

Long’s Bulrush (Special Concern) Hill and Johansson (1992) 	Long's Bulrush is a long-lived perennial sedge. Leafy shoots arise at the ends of thick rhizomes that run just under the surface of the substrate. Over time the plants develop into ring-shaped clonal stands of up to 5 to 10 m in diameter that have been estimated to be 150 to 400 years old (based on 1 m width at 40 years old). The tough leaves are 60 to 100 cm long by 5 to 10 mm wide, and arched toward the top. Flowering stems reach 1.5 m, though flowering is rare throughout its range and is often associated with disturbances. The flowers are grouped in spikelets of 5-8 mm that are in turn grouped within a large branching inflorescence up to 20 cm long. Involucral bracts (modified leaves at the base of flower clusters) are black and on humid days are sticky. Achenes (fruit) are brown or reddish and 0.8 mm long with five bristles. In early September the leaves turn a golden colour and the plant dies back to its base. The plants are submerged from November until April.
New Jersey Rush (Special Concern) ©NS Museum 	New Jersey Rush is a perennial rhizomatous herb reaching a height of 40-70 cm. The stems and leaves are rough to the touch, which is a key feature distinguishing New Jersey Rush from other superficially similar rush species. The leaves are elongated and cylindrical, with regularly spaced divided walls (septa) inside. The small, green flowers are composed of six equal tepals (one of the outer parts of a flower) around the male and female parts. Flowers are arranged in clusters in an irregularly branched inflorescence. The dark brown seed capsules are sharply pointed and extend beyond the surrounding floral parts. They hold many small seeds 2.0-2.3 mm long with well-developed tail-like appendages.

Redroot (Special Concern) ©NS Museum 	Redroot is a perennial herb with yellow-green foliage, a pale green stem and a flowering stalk 20 to 40 cm tall. The bright yellow-green basal leaves are ensiform (iris-like; vertically oriented, long, narrow, pointed and folded in half with the edges sealed along most of their length down to the base). The leaves are up to 40 cm long and 1 cm wide. A very low proportion of basal rosettes flowers in any given year in Nova Scotia. Inflorescences consist of a cluster of 10 to 30 dull light-yellow flowers at the crown of the flowering stem. Pale, dense yellow hairs cover the top of the stem and the flower cluster. The capsule contains reddish-brown seeds that have a diameter of 2-3 mm. The name Redroot refers to the slender, blood-red underground roots.
Tubercled Spike-rush (Special Concern) © NS Museum 	Tubercled Spike-rush is a grass-like plant in the sedge family, reaching a height of 10-40 cm. Its leaves are reduced to basal sheaths around the stiffly erect, flattened flowering stems that grow in dense clumps. The individual flowers are tiny and inconspicuous and are clustered into a distinct oval spike at the top of the stem. It can be distinguished from other spike-rushes by the unusually large knob-like tubercle, which is nearly as long and wide as the honeycombed achene (fruit) that it grows upon. The achene (fruit) is surrounded at the base by six bristles that are typically longer than the achene but do not reach past the top of the tubercle.

Water Pennywort (Special Concern) © NS Museum 	Water Pennywort is a small herbaceous perennial plant. Slender creeping stems spread along the substrate to form large clonal patches. Leaves and flowers emerge at intervals along the stems. The leaf petioles grow 10 to 30 cm high when out of the water, and can reach about 1 m to bring floating leaves to the surface when stems are deeply submerged. The small round leaves have shallow lobes. Those occurring above the water measure can be as small as 1 cm in diameter while those occurring below or at the water surface measure 3 cm in diameter. A single cluster of about 12 white flowers is found at the top of leafless flowering stems. These are produced only when stems are out of the water. In the NS population, seeds are not produced, possibly due to low genetic diversity or the short northern season.

3.2 Species Population and Distribution

Species Population and Distribution information is adapted from COSEWIC (2001, 2004a, 2004b, 2009, 2010, 2011, 2012a, 2012b, 2012c, 2014c, 2014b, 2014a and 2017).

Pink Coreopsis (Endangered)

Pink Coreopsis occurs along the Atlantic Coastal Plain in the United States from Georgia to Massachusetts (Figure 1), with a disjunct population in southwestern Nova Scotia. In Nova Scotia it is found on the shores of eight lakes (Figure 2). These are in Yarmouth County in the Tusket River system (Wilsons, Bennetts and Gillfillan lakes), the Carleton River system (a branch of the Tusket River; Raynards and Sloans lakes), and the Annis River system (emptying into the Tusket River estuary; Agard, Salmon and Pleasant lakes). The population size is roughly estimated at 276,600 to 328,000 stems. Wilsons Lake and Sloans Lake each support over 100,000 stems, with all other lakes having significantly fewer stems. Pink Coreopsis has been extirpated from Gavels Lake and Lake Vaughan on the Tusket River as a result of alterations to water levels with the construction of a reservoir dam in 1929. The range of Pink Coreopsis in Canada is 133 km^2. The population trend is unknown. There is no suggestion of substantial decline, but small losses associated with localized shoreline development or alteration may be occurring.

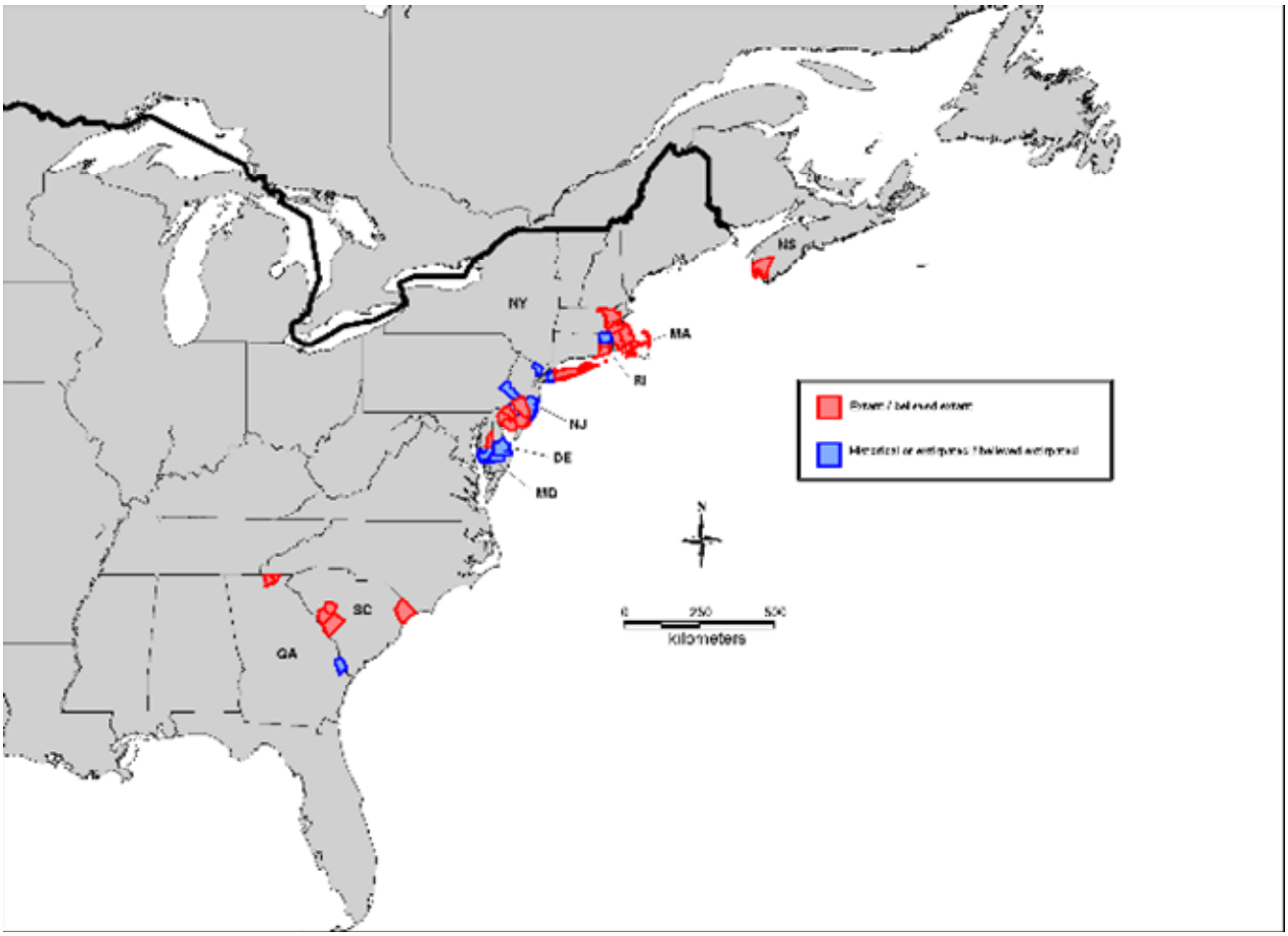


Figure 1. Global distribution of Pink Coreopsis based on county-level distribution (modified from Kartesz 2015).

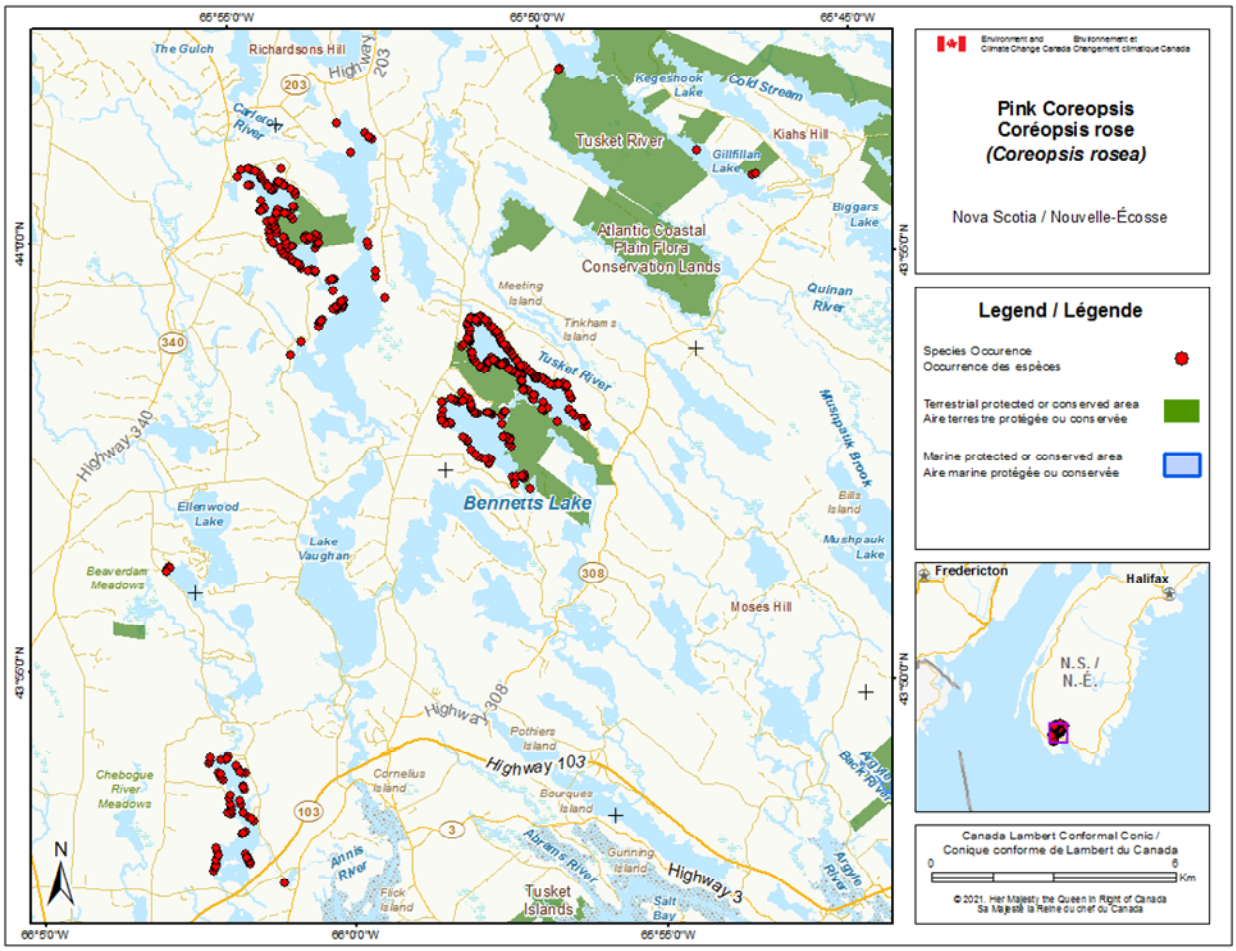


Figure 2. Canadian occurrences of Pink Coreopsis (red dots). Extirpated occurrences (not shown): Lake Vaughan, Tusket Falls and Gavels Lake.

Plymouth Gentian (Endangered)

Plymouth Gentian occurs in Massachusetts, North and South Carolina, Rhode Island, and southwestern Nova Scotia (Figure 3). A small introduced population is also known from Virginia. In Nova Scotia, it is found on the shores of ten lakes (Figure 4). These are in Yarmouth County in the Tusket River system (Bennetts, Wilsons, Lac de l'École, Kegeshook, Gillfillan, Pearl,Third and Travis lakes) the Carleton River system (a branch of the Tusket River; Lake Fanning), and the Annis River system (emptying into the Tusket River estuary; Agard Lake). A small number of plants also occur along the Tusket River between Pearl and Third lakes and between Gillfillan and Wilsons lakes. It has been extirpated from Gavels Lake and Lake Vaughan by flooding from construction of a reservoir dam in 1929. It has also been extirpated from Canoe Lake for unknown reasons. Previous reports of occurrence at Kempt Snare Lake and Tusket Lake are now considered to have been based on erroneous interpretations of confusing specimen labels. These lakes have been comprehensively searched for the species with no plants found. The range of Plymouth Gentian in Canada is 182 km².

The Nova Scotia population represents a significant proportion of the total global population. The largest subpopulation is on Wilsons Lake with an estimated several hundred thousand rosettes. The other lakes have significantly fewer plants; Gillfillan Lake has thousands of rosettes but most are vegetative in any one season. The population trend is unknown. There is no suggestion of substantial decline, but small losses associated with localized shoreline development or alteration may be occurring.

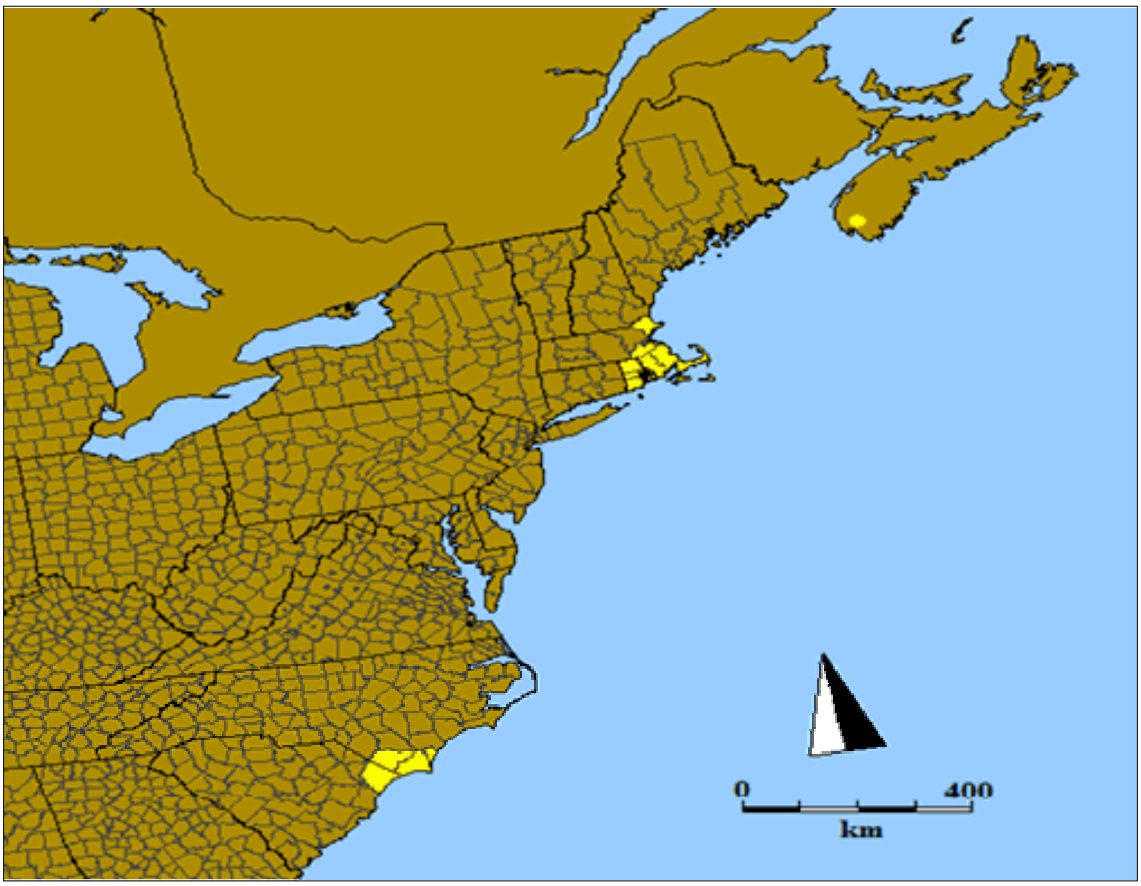


Figure 3. Global native range of Plymouth Gentian (pale yellow shading; modified from Kartesz 2015) Distribution is given by county in the United States so that a whole county is shaded if at least one record is known. The species has also been reported as an established introduced species in Virginia (NatureServe 2019).

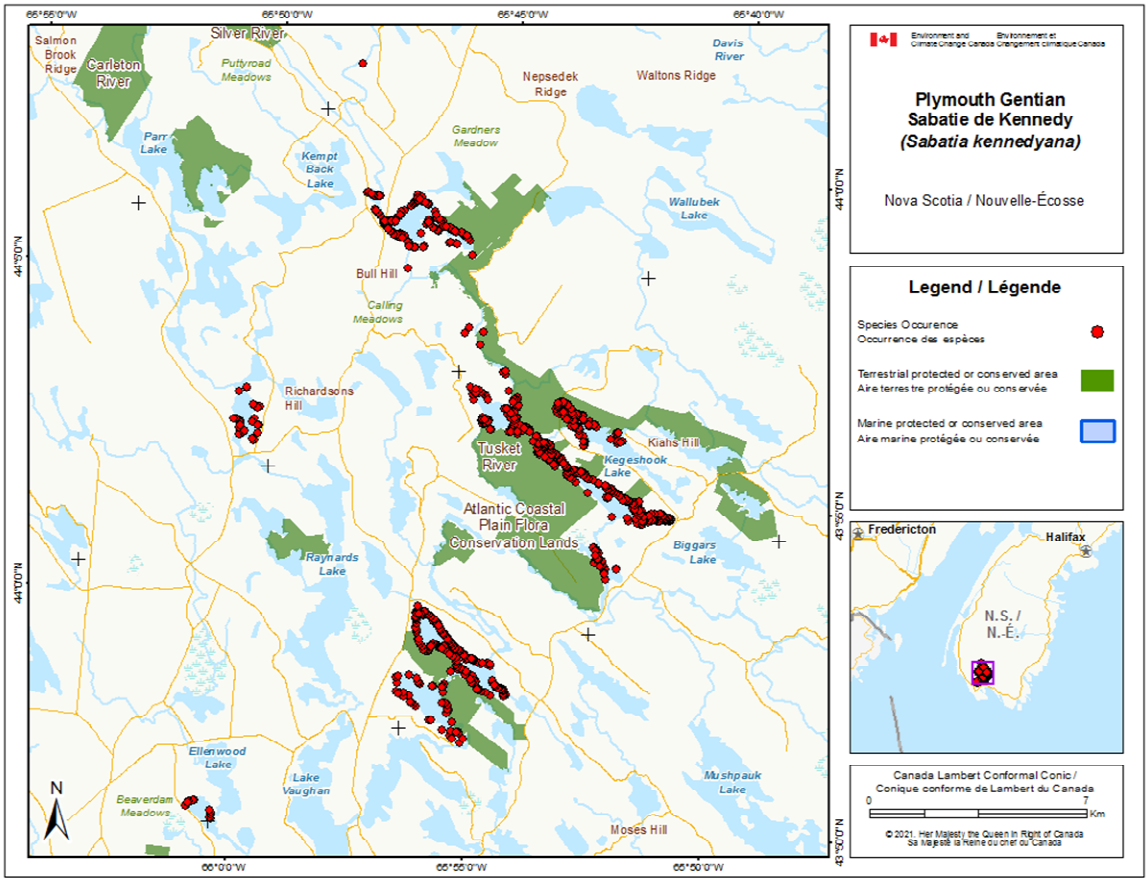


Figure 4. Canadian occurrences of Plymouth Gentian (red dots). Extirpated sub-populations (not shown): for unknown reasons - Canoe Lake; *Extirpated sub-populations on dam-controlled reservoirs* - Raynards Lake, Lake Vaughan, Tusket Falls and Gavels Lake. *Falsely reported locations* based on confusing specimen labels: Long Tusket Lake, Kempt Back Lake, Kempt Snare Lake.

Tall Beakrush (Endangered)

Tall Beakrush is predominantly a species of the Atlantic and Gulf Coastal Plains between southern Maine, northeastern Florida, and Louisiana, but it also occurs in southeast Michigan and adjacent Indiana, eastern Oklahoma and adjacent areas of Kansas, Missouri and Arkansas, and along the Tennessee-Alabama border (Figure 5). Kentucky and northern New York also support isolated occurrences. Reports from Illinois, Mississippi and Vermont are erroneous. The Canadian occurrence is restricted to sites on two southern Nova Scotia lakes which are 23 km apart, Carrigan Lake in the Mersey River watershed and Molega Lake in the Medway River watershed (Figure 6). Roughly 95% of the estimated 684 individuals in Canada are found on Carrigan Lake. Nova Scotia plants are isolated from the United States range by 468 km and are the northernmost worldwide. The range of Tall Beakrush in Canada is 12 km^2. The population trend is unknown but there is no suggestion of substantial decline. The very limited range leaves the species susceptible to shoreline development were it to overlap with occupied habitat.

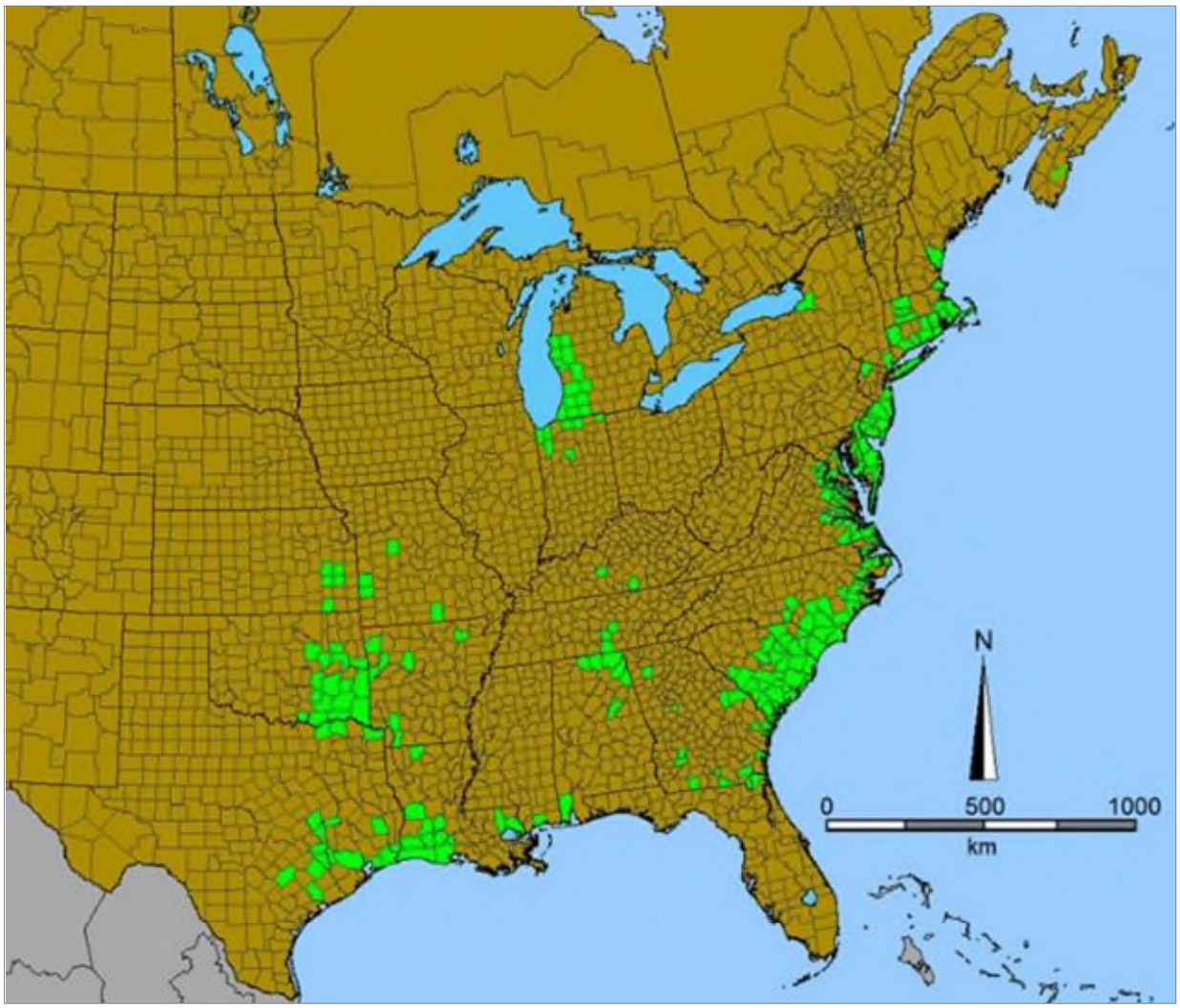


Figure 5. Native range of Tall Beakrush, modified from Kartesz (2015). In the United States a whole county is shaded light green if at least one record is known. The Mississippi record may be in error.

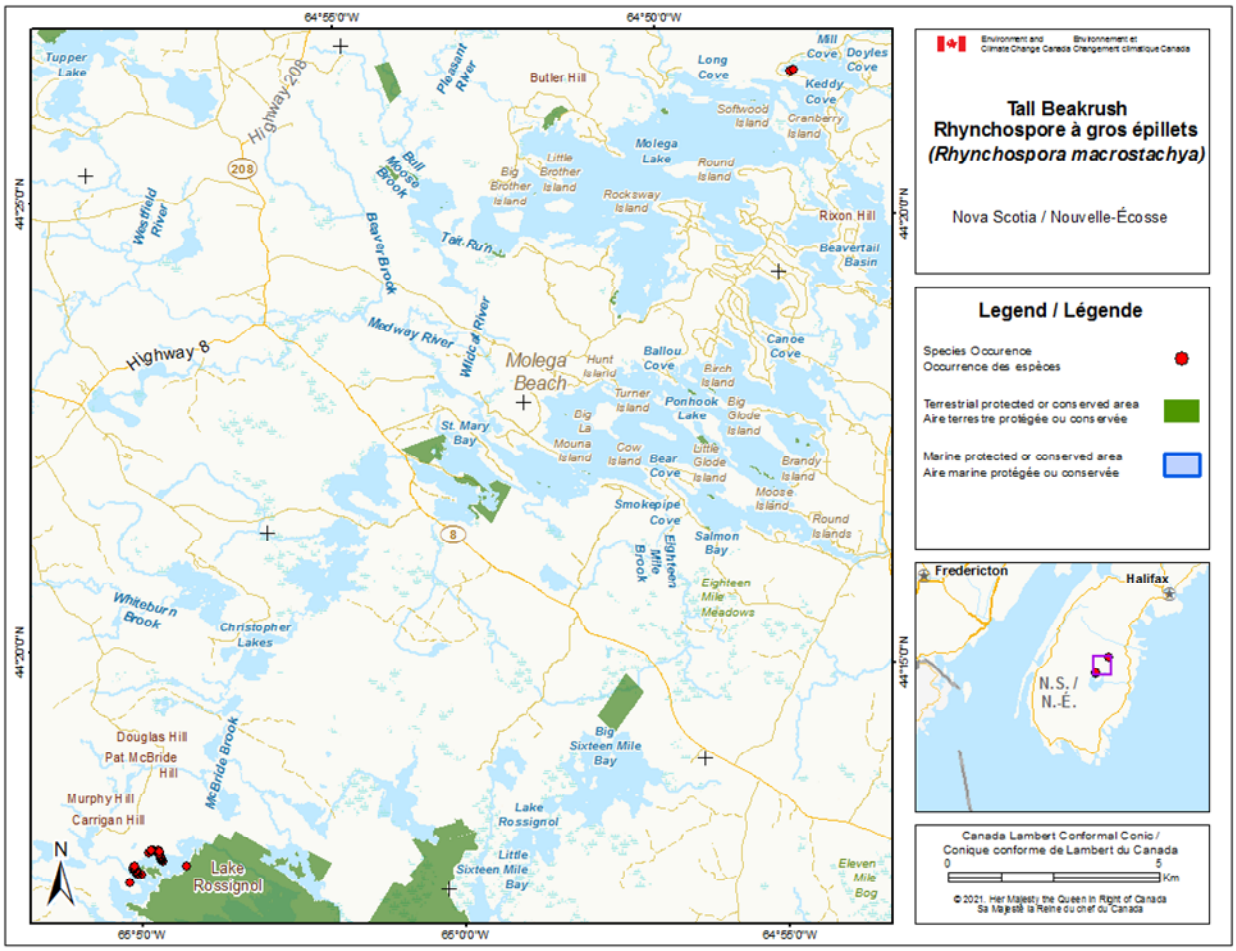


Figure 6. Canadian occurrences of Tall Beakrush (red dots).

Thread-leaved Sundew (Endangered)

Thread-leaved Sundew is found along the United States' eastern coast from Massachusetts to southern New Jersey with disjunct regions of occurrence in North Carolina and northeastern Florida (Figure 7). It is extirpated from Connecticut and Delaware, and introduced in Pennsylvania, West Virginia and Virginia. The COSEWIC (2001) global range map shows occurrence in Alabama, Mississippi and Louisiana, but these records are now considered to represent Tracy's Sundew (*Drosera tracyi*). The disjunct Canadian occurrence is restricted to five bogs in a small area of Shelburne County in southwestern Nova Scotia: Swaines Road, Quinns Meadow, Port La Tour, Villagedale, and West Baccaro (Figure 8). These bogs are all within a zone roughly 25 km x 5 km. The total Canadian population of the Thread-leaved Sundew has not been carefully estimated but includes tens of thousands of plants. The range of Thread-leaved Sundew in Canada is 77 $km^{2.}$ Surveys in 2015 suggest the spatial distribution is unchanged (Brad Toms, personal communication, 2021). The population trend is unknown but there is no suggestion of substantial decline now or in the future, unless peat extraction or development was proposed or initiated.

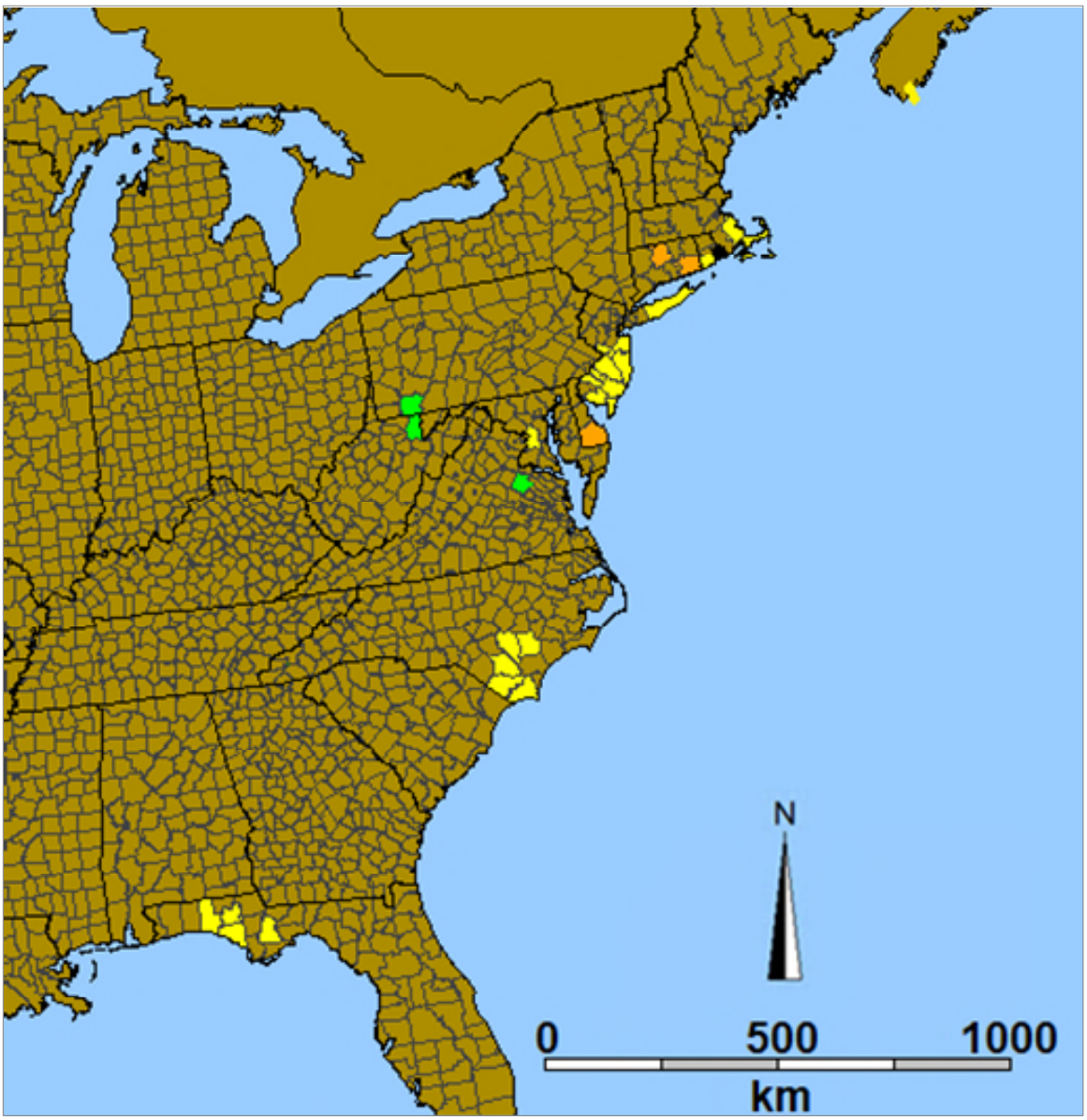


Figure 7. Global range of Thread-leaved Sundew, modified from Kartesz (2015). In the United States a whole county is shaded if at least one record is known. Orange = extirpated from the state (Connecticut and Delaware), Green = Introduced (Pennsylvania, West Virginia, Virginia).

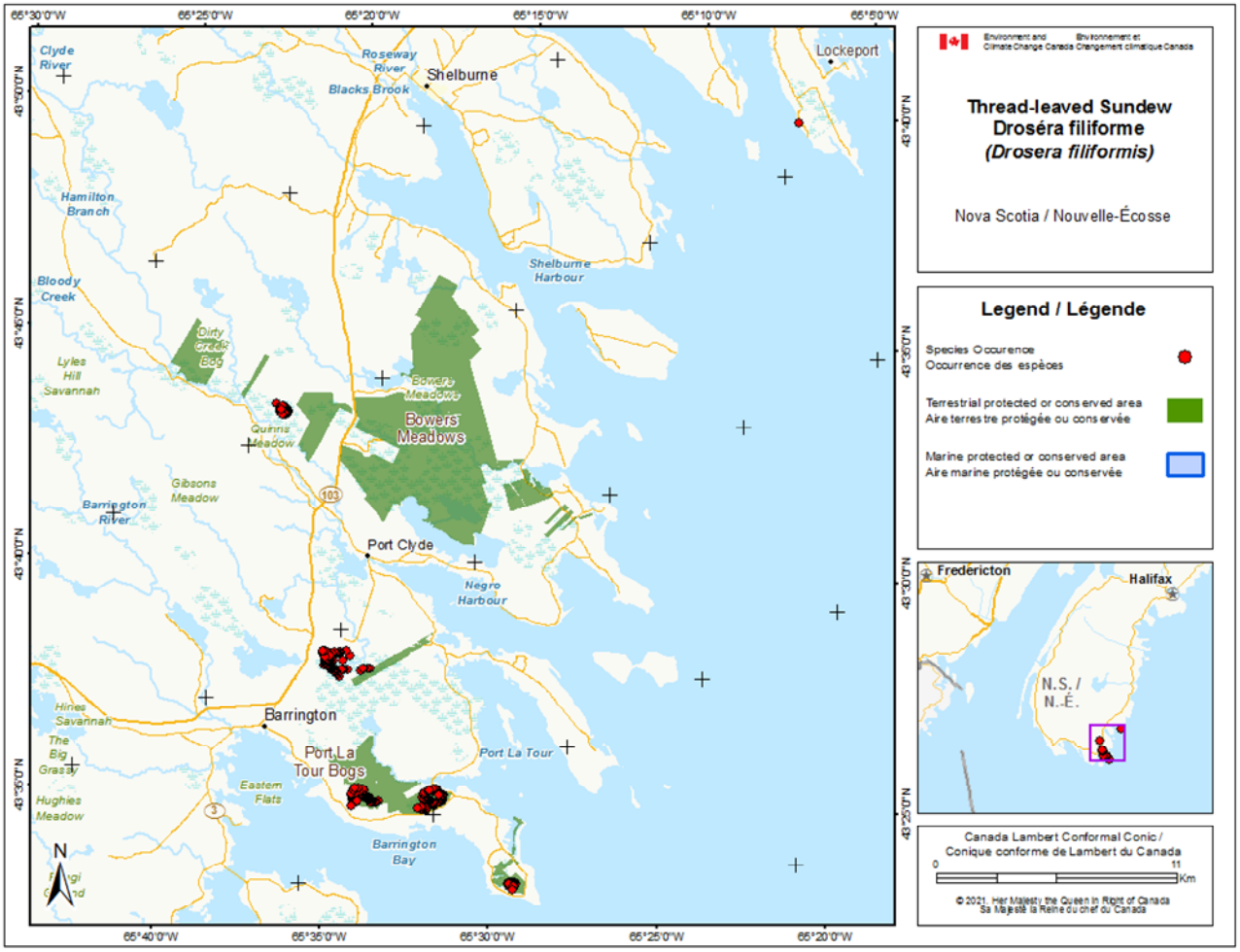


Figure 8. Canadian occurrences of Thread-leaved Sundew (red dots).

Eastern Baccharis (Threatened)

Eastern Baccharis is native to eastern North and Central America and the northern Caribbean. The majority of its range is along the Gulf of Mexico and United States' Atlantic coast from Veracruz, Mexico to northern Massachusetts but it also occurs inland to Oklahoma, Arkansas and Tennessee, with some inland occurrences representing colonization beyond its historic natural range (Figure 9). The species becomes more restricted to the coast in the northern end of its continuous distribution, from Virginia to Massachusetts. Eastern Baccharis has established as an introduction in Australia, New Zealand, England, Spain, France, Belgium, The Netherlands (where no longer considered extant), Italy and the Republic of Georgia, and it is considered a problematic or potentially problematic invasive species in most of those countries, especially Australia and Spain (Fried et al. 2016).

Canadian occurrences are restricted to a 13 km wide x 12 km long coastal region of extreme southwestern Nova Scotia east of Yarmouth, with a single individual a further 12 km southeast at West Pubnico (Figure 10). The total Canadian population is

estimated at 2,850 mature individuals. Within its small range, Eastern Baccharis is highly concentrated in a few sites on the Tusket River Estuary and Lobster Bay. A 300 m x 250 m area on Morris Island, Lobster Bay and a 400 m x 100 m area near Bird Point on the Tusket River Estuary each support over 1,000 individuals and together make up more than 70% of the known population (Blaney and Mazerolle 2010 unpublished data, Mills 2007 unpublished data). This concentration makes the species susceptible to large, rapid population declines if development, storm events or other impacts were to affect key sites. The range of Eastern Baccharis in Canada is 75 km^2. Population trends in Canada are unknown. Small declines are likely occurring with shoreline development or alteration. Sea level rise and increased storm impacts associated with climate change may be a threat now or in the future, but current and future impacts are hard to predict because it is unclear how much newly suitable habitat might be created by sea level rise and whether the species will be able to colonize that habitat.

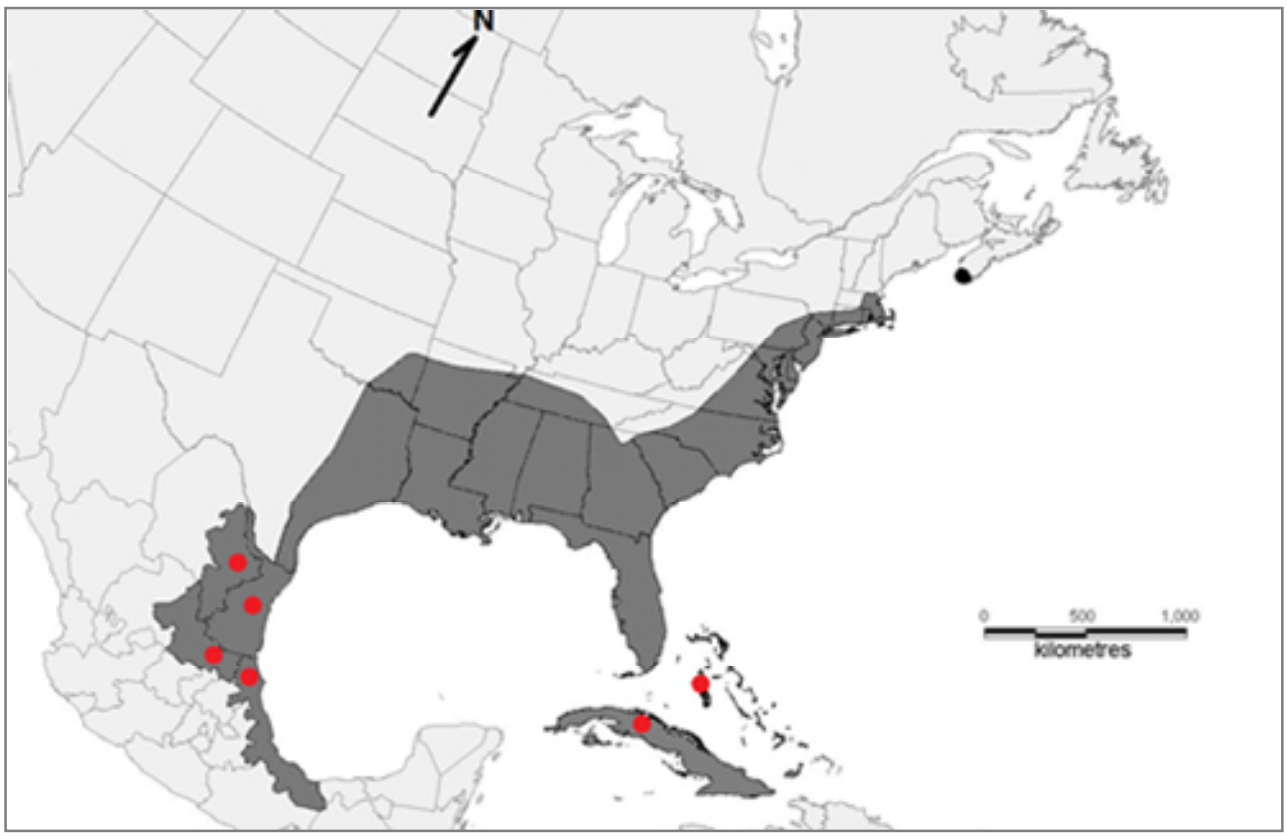


Figure 9. Native global range of Eastern Baccharis. Range outlined in the United States is based on county-level distribution data (Kartesz 2015). Shading within Mexican states and Caribbean countries (jurisdictions indicated by red dots) represents presence only rather than precise distribution.

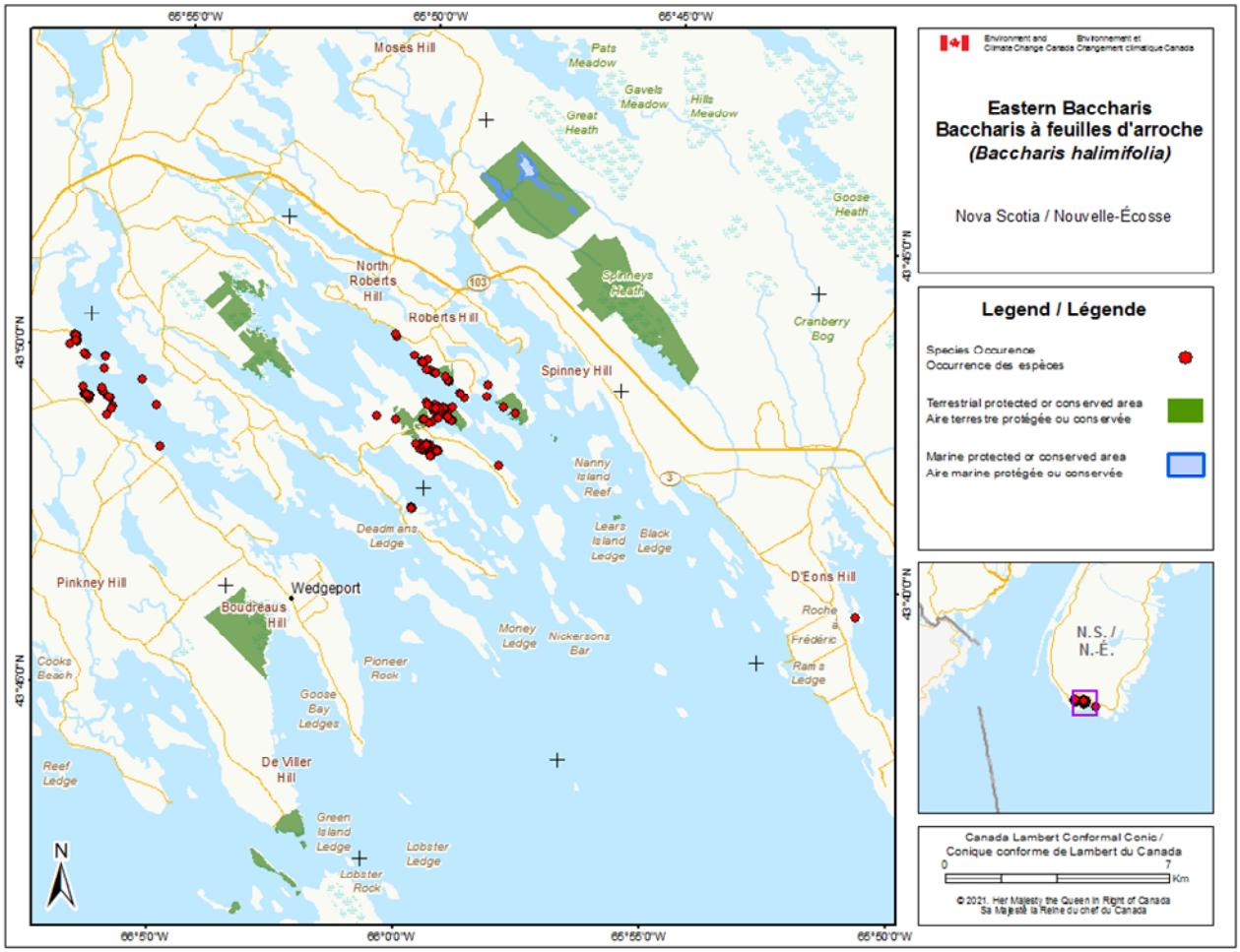


Figure 10. Canadian occurrences of Eastern Baccharis (red dots).

Sweet Pepperbush (Threatened)

Sweet Pepperbush occurs from Texas and Florida, north to Maine, with a disjunct population in southwestern Nova Scotia (Figure 11). It is documented spreading from cultivation in Belgium, The Netherlands and England (COSEWIC 2014). In Nova Scotia, this species is known from four subpopulations on the shores of six lakes: Belliveau Lake in Digby County, Louis and Canoe Lakes in Yarmouth County, and a single connected subpopulation on Mill, Mudflat, and Pretty Mary Lakes in Annapolis County (Figure 12). In contrast to other lakeshore ACPF species, it occurs in areas that are protected from waves and ice scour and is found in low catchment area lakes (Hill et al. 2000). Populations are large on Belliveau Lake (16,000 stems estimated) and at the Mill-Mudflat-Pretty Mary Lake subpopulation (27,700 stems estimated), though total number of genetic individuals is much lower because almost all observed reproduction is vegetative. Louis Lake is estimated to have 1,700 stems and Canoe Lake supports a single pepperbush plant that had 4 stems in 2011. The population trend is unknown. The range of Sweet Pepperbush in Canada is 1,984 km^2. There is no indication of substantial decline, but small losses associated with localized shoreline development

(including infilling for cottages (B. Toms, personal communication, 2021) may be occurring and lake eutrophication from pig farm development could be a future issue at Belliveau Lake.

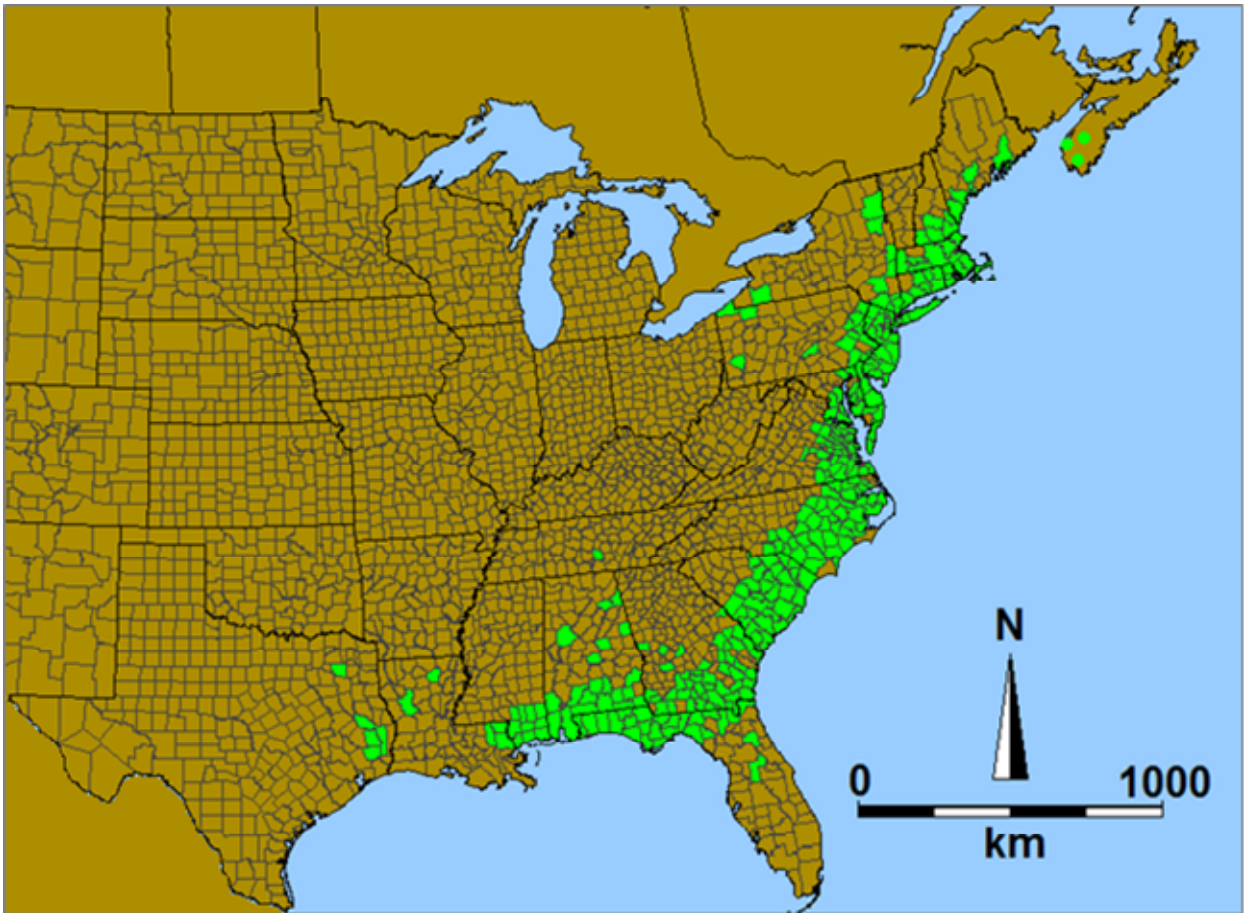


Figure 11. Global range of Sweet Pepperbush, modified from Kartesz (2015). In the United States a whole county is shaded if at least one record is known.

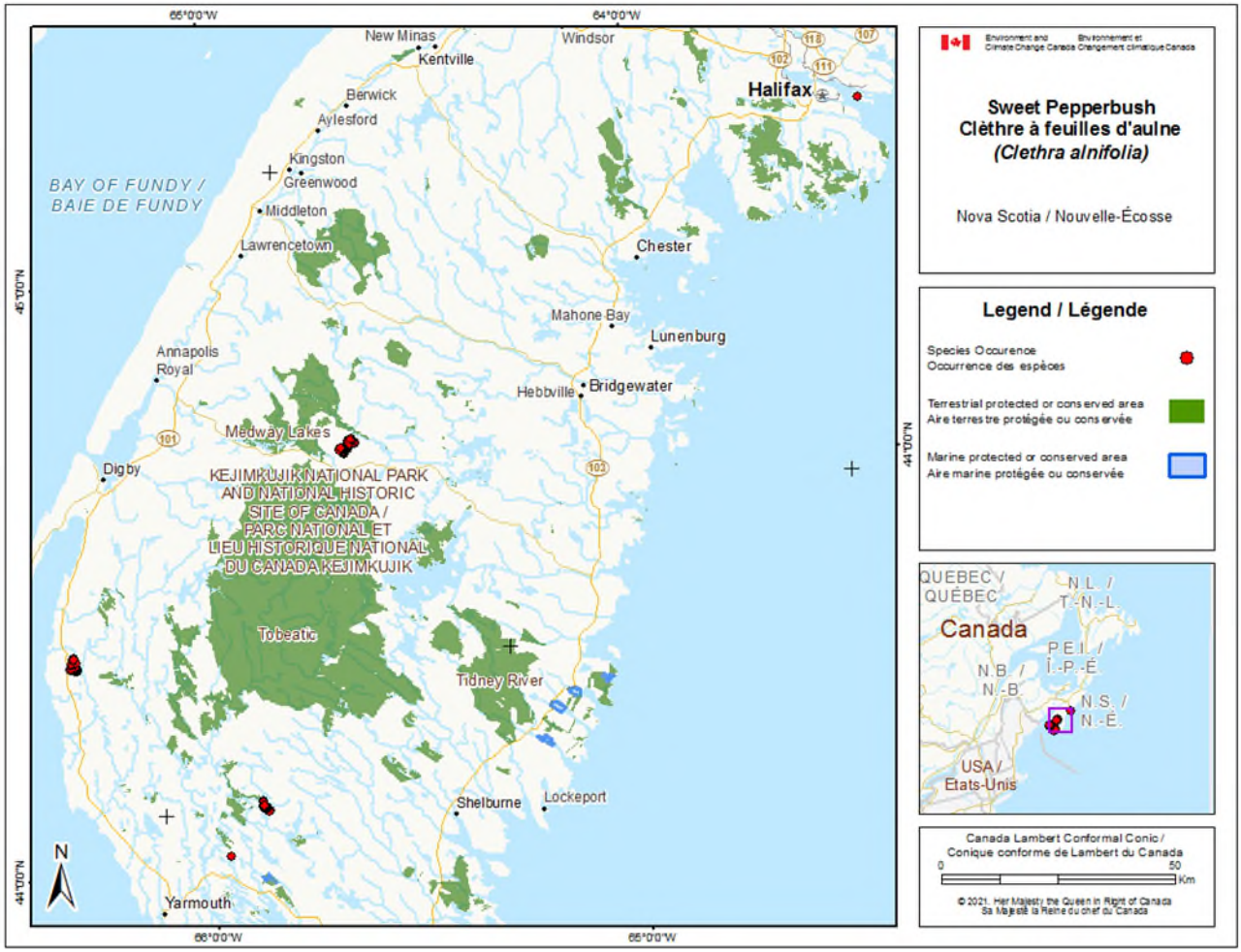


Figure 12. Canadian occurrences of Sweet Pepperbush (red dots). Cultivated Sweet Pepperbush records: Marcel Lake and McNabs Island.

Eastern Lilaeopsis (Special Concern)

Eastern Lilaeopsis occurs along the Atlantic coast from Nova Scotia to Florida, and west to eastern Texas along the Gulf of Mexico coast (Figure 13). In Canada, Eastern Lilaeopsis occurs in six Nova Scotia river estuaries. Five are in southwestern Nova Scotia: the Tusket and Annis Rivers (including Pleasant Lake) in Yarmouth County, LaHave River in Lunenburg County, Medway River in Queens County and Roseway River in Shelburne County. It also occurs in northern mainland Nova Scotia on the River Philip in Cumberland County, along the Northumberland Strait (Figure 14). The number of individuals is large as it is abundant at all known locations. The population trend is unknown, but there is no indication of substantial decline.

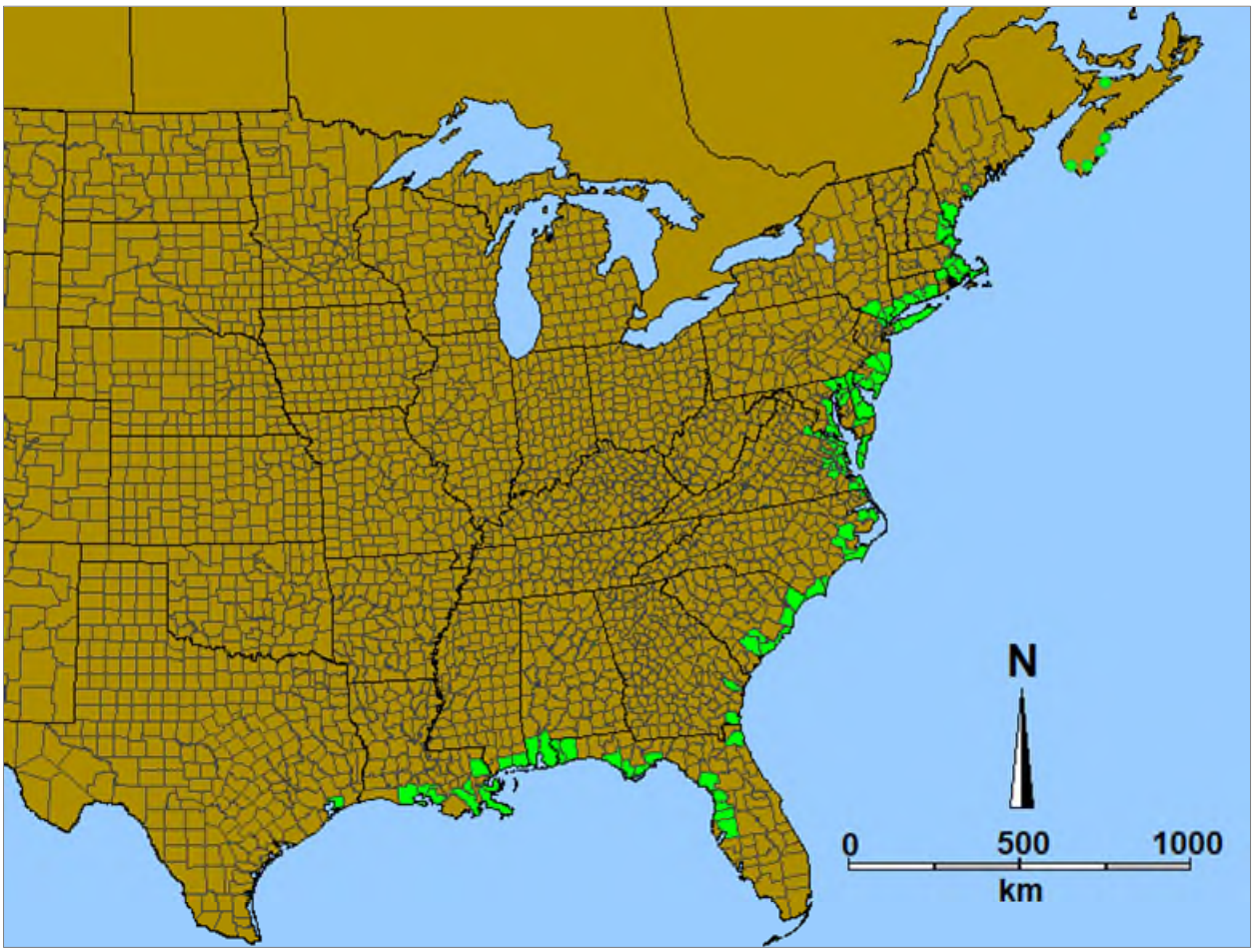


Figure 13. Global range of Eastern Lilaeopsis, modified from Kartesz (2015). In the United States a whole county is shaded if at least one record is known.

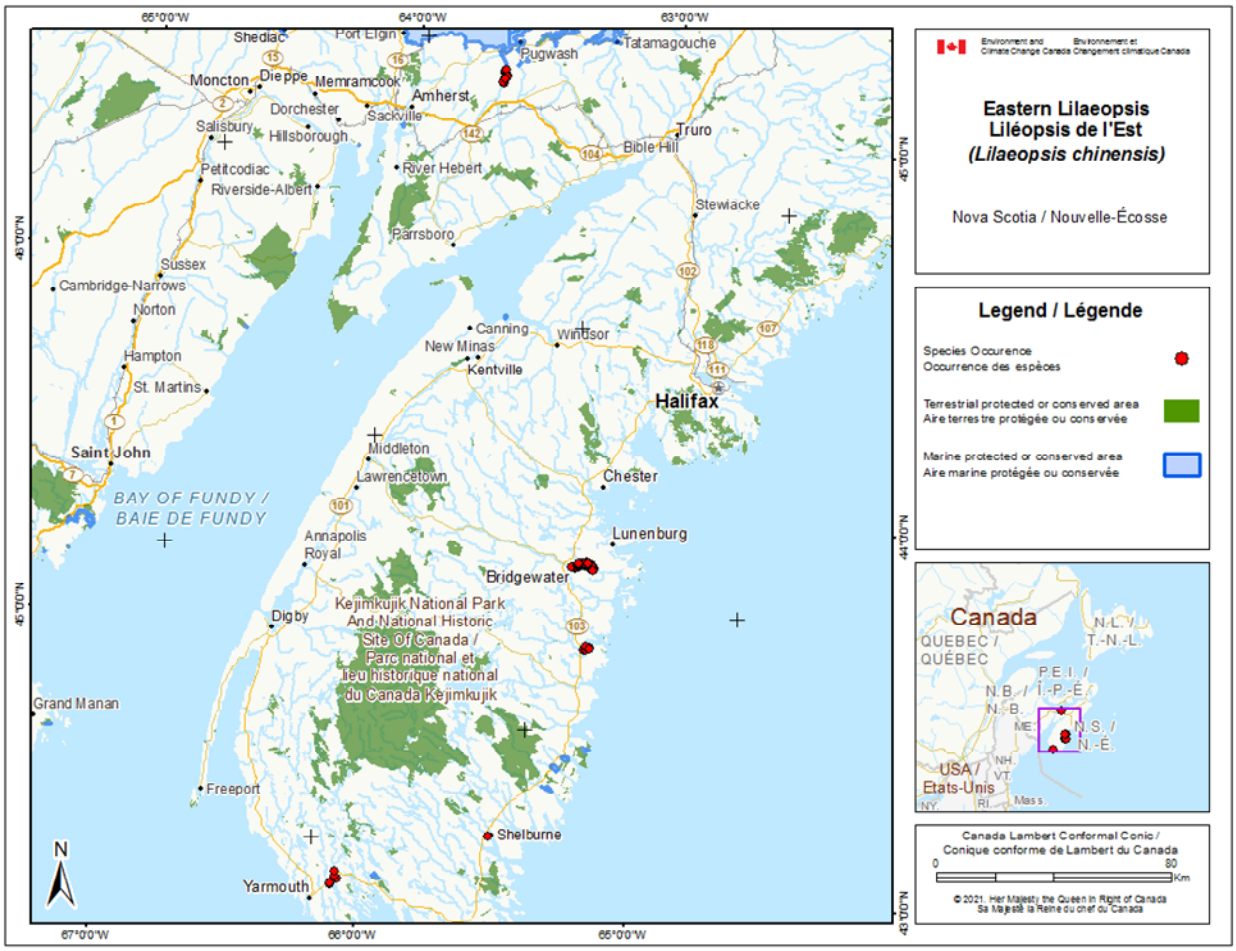


Figure 14. Canadian occurrences of Eastern Lilaeopsis (red dots).

Goldencrest (Special Concern)

In the US, Goldencrest occurs from New Jersey south to Florida and Louisana (Figure 15). The Canadian population in Nova Scotia is highly disjunct, but surprisingly widespread in the province (Figure 16). It occurs on the shorelines of eight lakes: Beartrap, Hog, Ponhook, Little Ponhook, Molega and Shingle lakes on the Medway River system (Queens and Lunenburg counties), Seven Mile Lake on the LaHave River system and Fancy Lake on the Petite Riviere system (Lunenburg County). It is also found in four bogs: Dunraven Bog (Sable River, Queens County), and Moores Lake Bog and Tiddville Bog (Little River system, Digby County) and Demones Run Bog (LaHave River system, Lunenburg County). An extensive subpopulation along the Little River on Digby Neck was extirpated in the early 1900s due to diatomaceous earth mining and damming of the river that flowed through the wetland habitat, and a small subpopulation on Brier Island was lost after 1985 because of bog drainage and subsequent nutrient enrichment by nesting gulls. A third subpopulation recorded from Sandy Cove, Digby County in 1949 has never been relocated. The range of Goldencrest in Canada is 3,330 km^2. The total number of rosettes is high, with many thousands at some sites, especially in the extensive occurrence around the shorelines of Ponhook Lake and

Shingle Lake. The population trend is unknown. There is no indication of substantial decline, but local losses are likely occurring on lakeshore sites because of substantial shoreline development in Queens and Lunenburg counties.

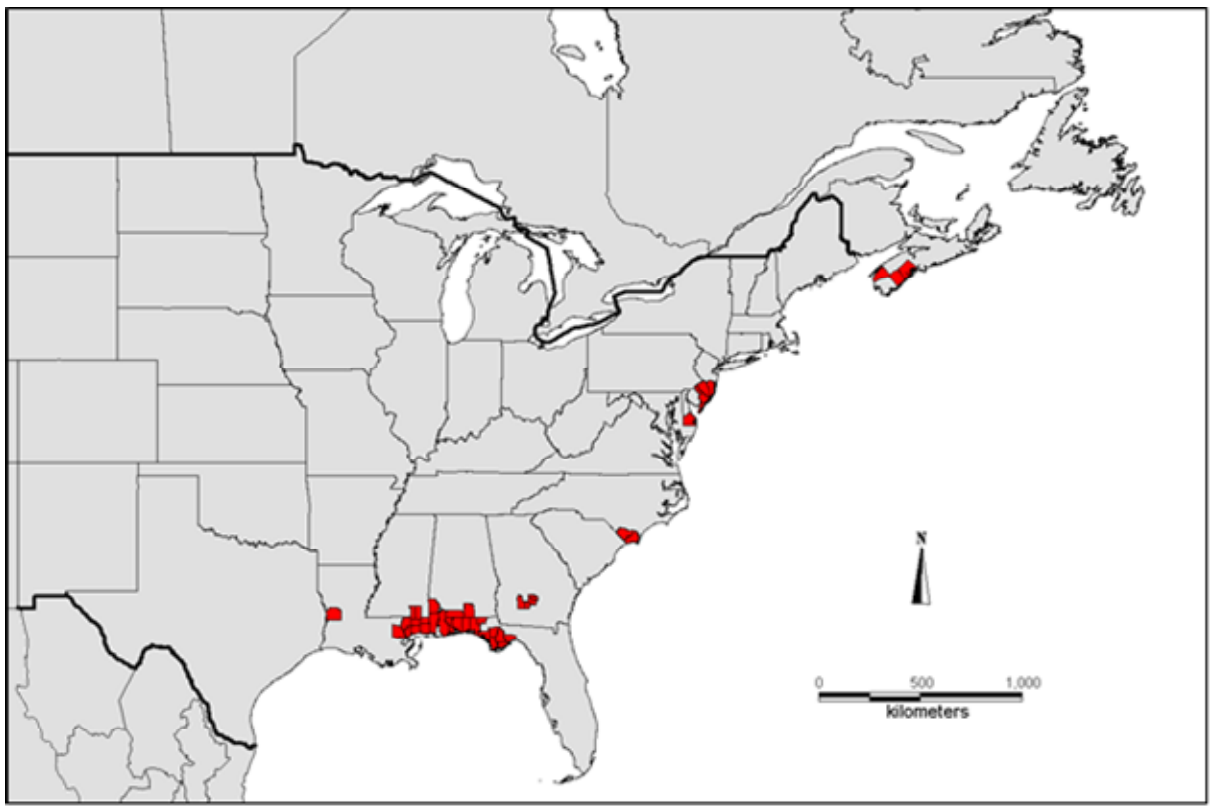


Figure 15. Global range of Goldencrest by county (entire county highlighted if one record exists; modified from Kartesz 2015).

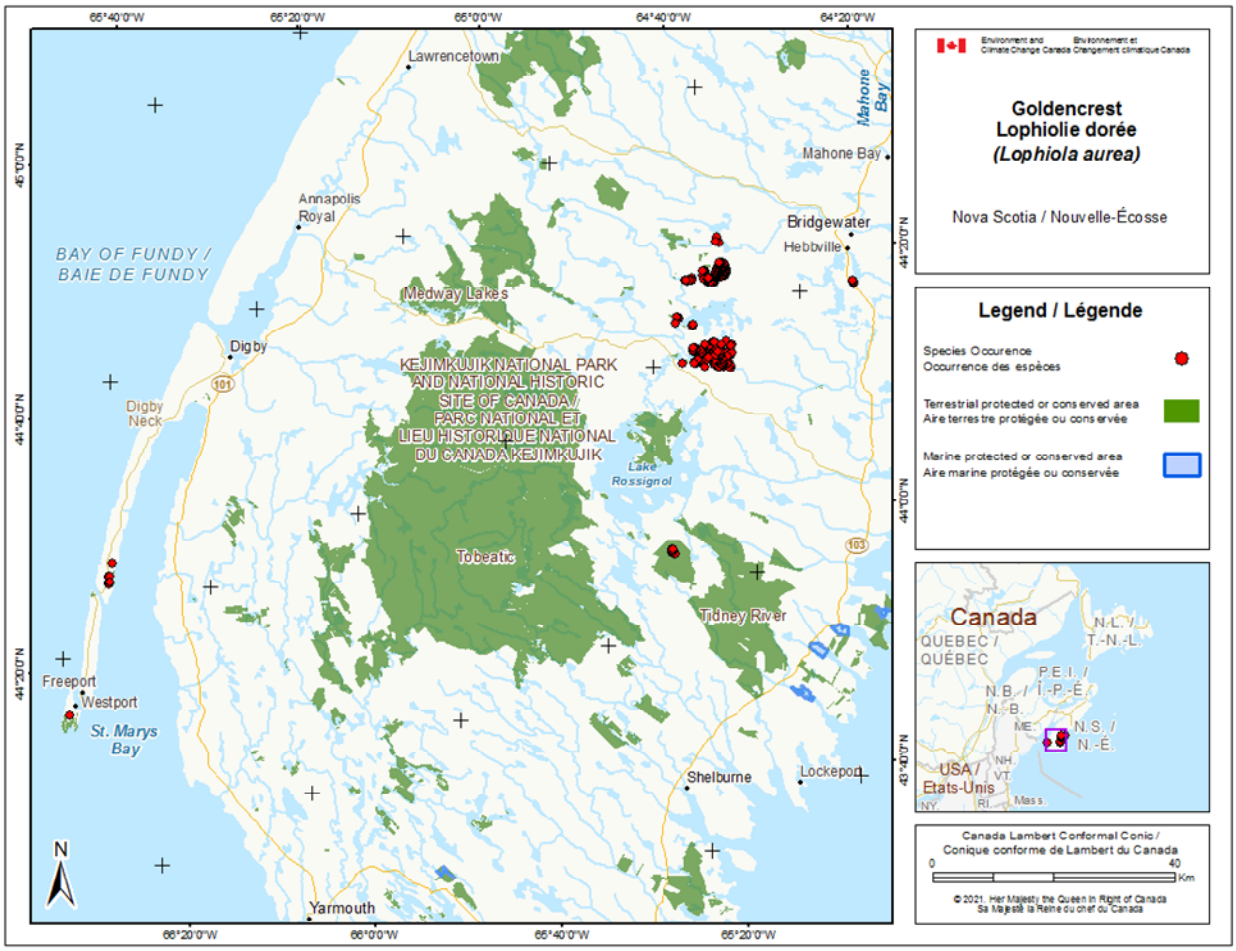


Figure 16. Canadian occurrences of Goldencrest (red dots).

Long's Bulrush (Special Concern)

In the US, Long's Bulrush is restricted to a limited range from New Jersey to Maine, relatively near to the Atlantic coast (Figure 17). In Canada, it is known from 39 occurrences in peatlands and lakeshores in southern Nova Scotia from Wilsons Lake in southern Yarmouth County to Smith Lake and Demones Run in central Lunenburg County (Figure 18). Knowledge of the occurrences of Long's Bulrush in Nova Scotia is less complete than is the case with most other listed ACPF. A systematic survey of randomly selected habitat in 2015 demonstrated that there is a 95% probability of at least 12 undiscovered occurrences in Nova Scotia with the number of undiscovered occurrences likely exceeding 34. The range of Long's Bulrush in Canada is 4,862 km^2. The known Canadian population is estimated at 718,000 rosettes and 2,700 clones but the actual population clearly exceeds those values. Population trends are unknown, but there is no indication of substantial decline. Habitat decline associated with the absence of fire and increased cover of the invasive Glossy Buckthorn could cause population declines over the long term.

Figure 17. Global distribution of Long's Bulrush (black dots).

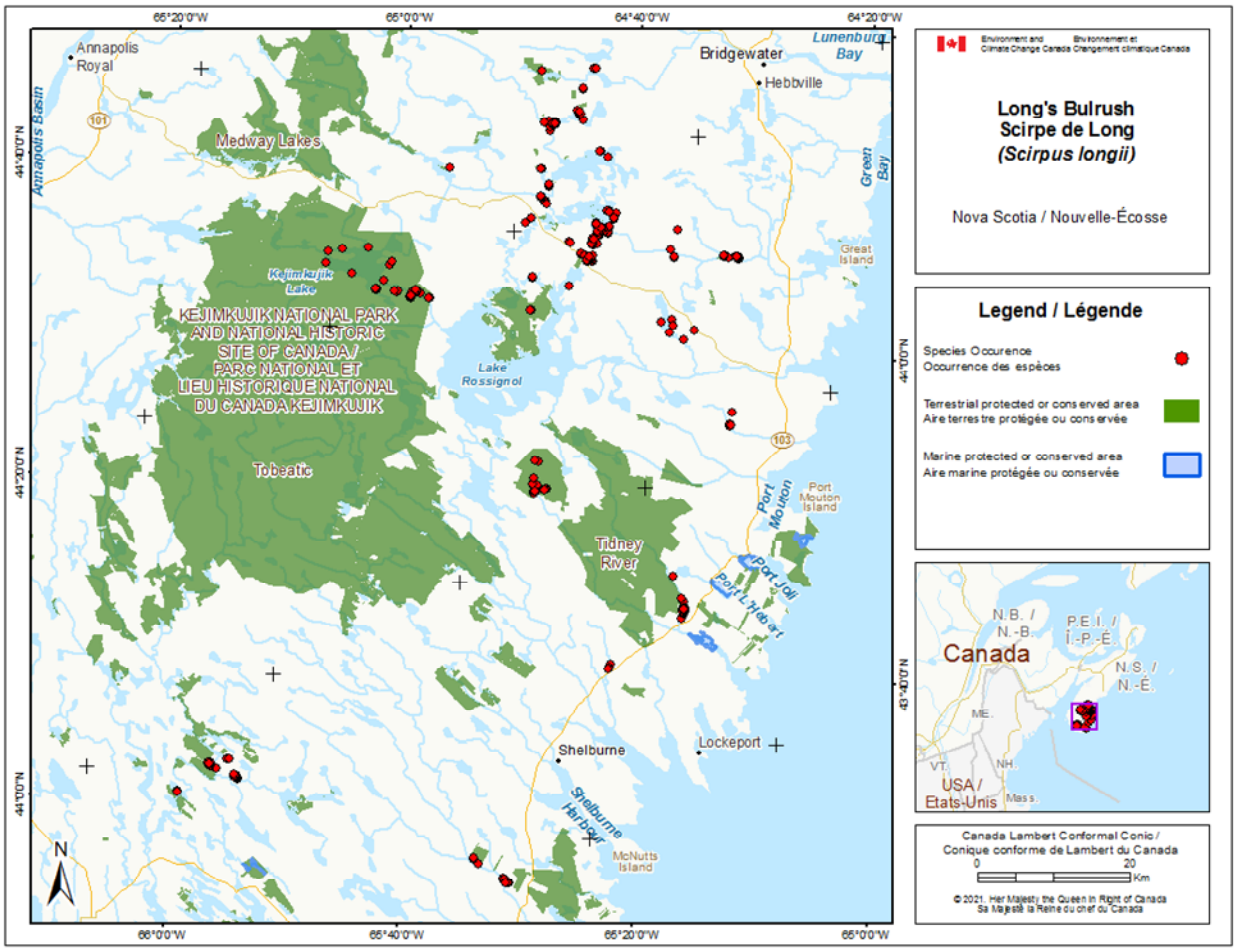


Figure 18. Canadian occurrences of Long's Bulrush (red dots).

New Jersey Rush (Special Concern)

In the United States New Jersey Rush occurs in three disjunct regions: southern New Jersey; west of Chesapeake Bay in Maryland and northeastern Virginia; and western North Carolina (Figure 19). In Canada, it is restricted to a highly disjunct population in southeastern Cape Breton Island, from Lower L'Ardoise to Gabarus Lake and inland west to Loch Lomond and Silver Mine (Figure 20). This distribution is unique among listed ACPF in Nova Scotia, which are otherwise almost entirely restricted to the southwestern part of the province. New Jersey Rush is known from 31 bogs and fens in Cape Breton and Richmond counties. The range of New Jersey Rush in Canada is 523 km^2 (S. Blaney, unpublished data). Its population was estimated in the last status report (COSEWIC 2004b) at 5,000 to 10,000 mature individuals but the population is likely significantly higher because many new sites have since been found and additional new sites will likely be found with further surveys. The population trend is unknown, though there is no indication of substantial declines.

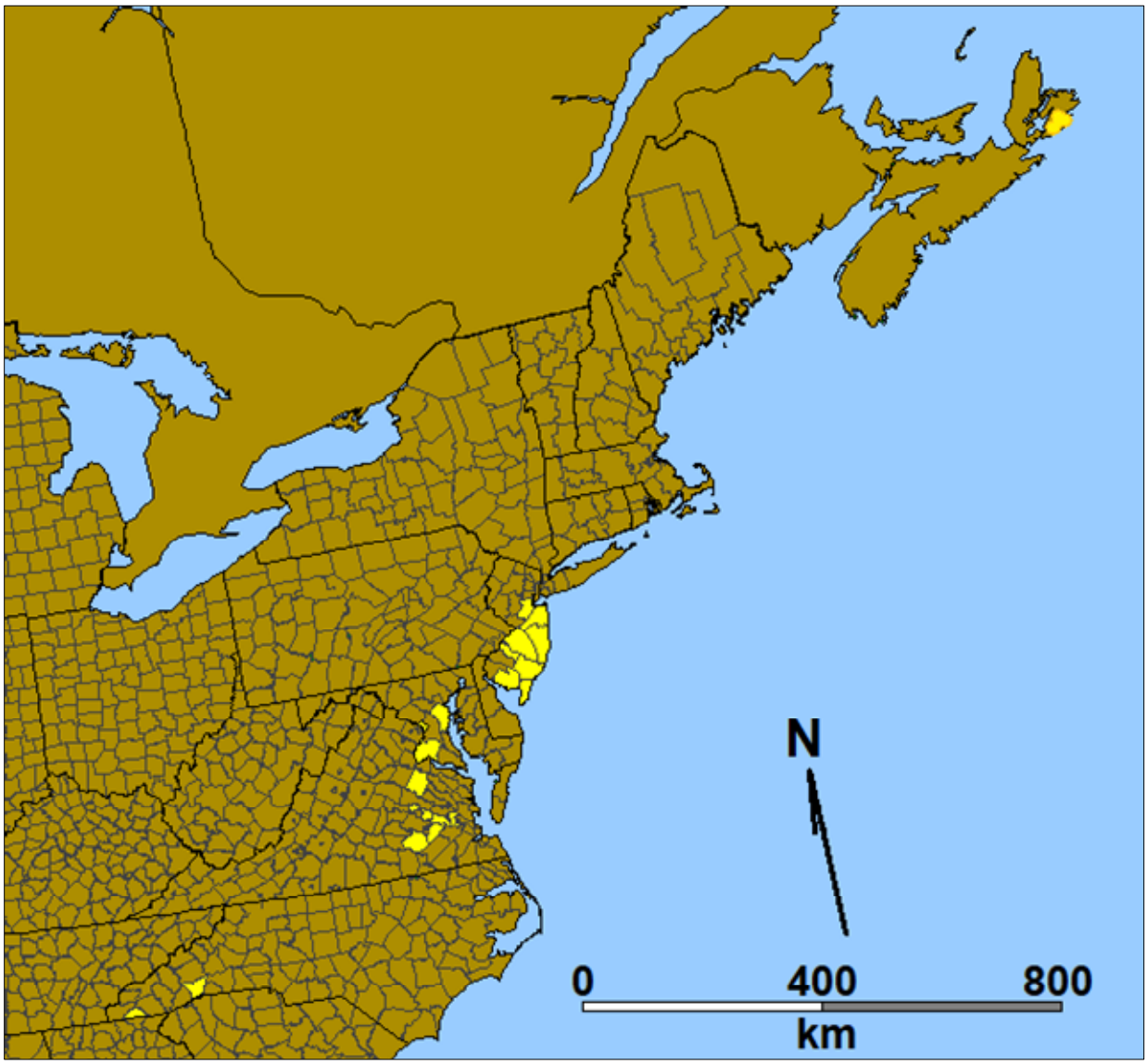


Figure 19. Global range of New Jersey Rush, modified from Kartesz (2015). In the United States a whole county is shaded if at least one record is known.

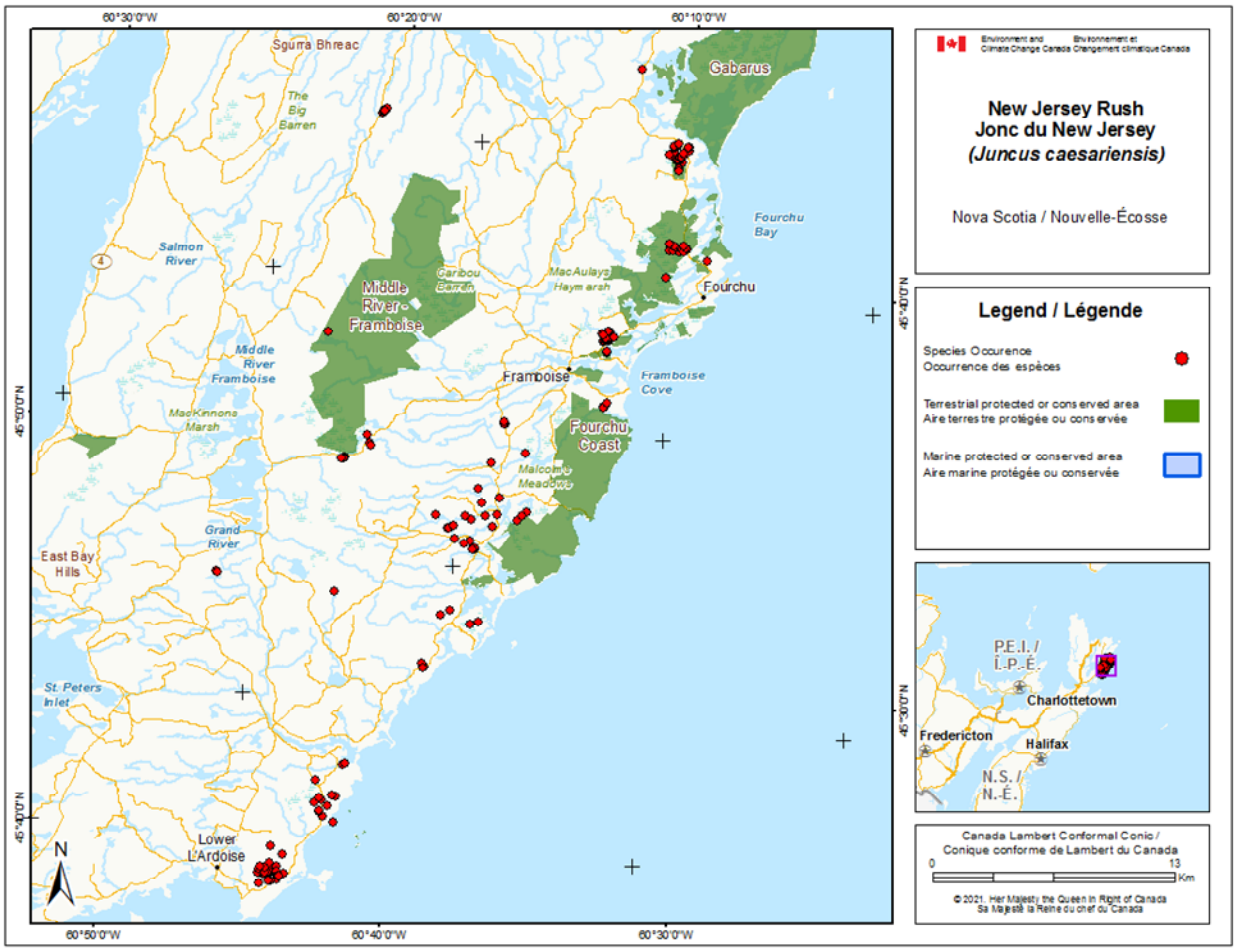


Figure 20. Canadian occurrences of New Jersey Rush (red dots).

Redroot (Special Concern)

Redroot occurs from Nova Scotia and Massachusetts, south along the coast to Florida, and Louisiana (Figure 21). It is also found in Cuba. In Nova Scotia, it is restricted to a small area on the Medway River system in Queens County where it is present on the shores of seven connected lakes: Ponhook, Little Ponhook, Molega, Cameron, Hog, First Christopher, and Beartrap Lakes in Queens County. Small subpopulations also occur on the shore of the Medway River 9 km downstream and 18 km downstream of Ponhook Lake and on the Wildcat River between Molega and Ponhook Lakes (Figure 22). Redroot is not widespread on these rivers but some additional occurrences could exist as they have been incompletely surveyed. The range of Redroot in Canada is 212 km^2 (S. Blaney, unpublished data). In 2007, the estimated total population was 575,000 to 650,000 rosettes (only 1,000 to 1,100 flowering). Comprehensive population surveys were completed 2008 to 2013 but no analysis to estimate total population has been attempted. Population trends cannot be directly assessed. Substantial declines are not suspected but small losses have likely been occurring for many years as a result of ongoing cottage and residential development.

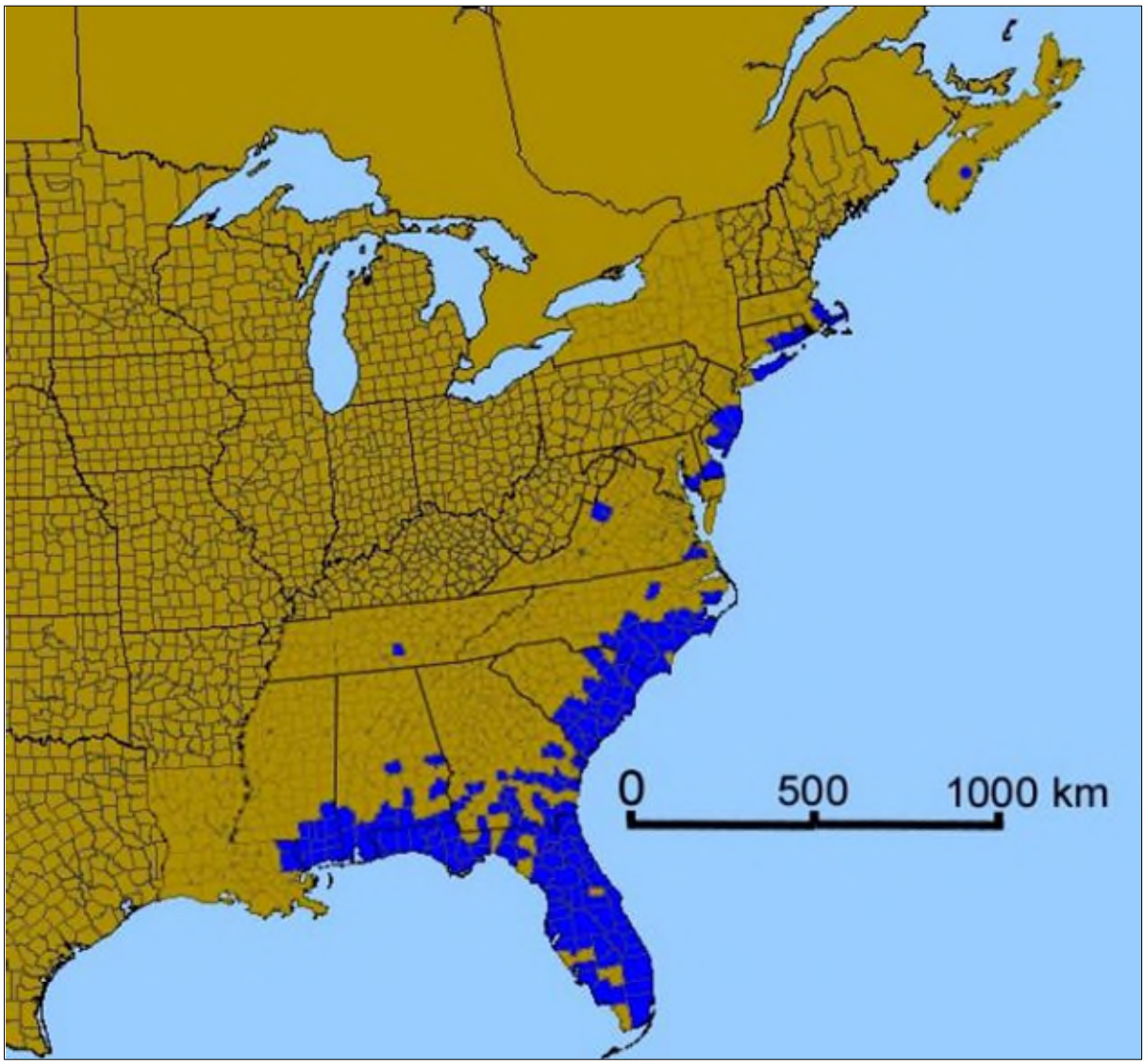


Figure 21. North American range of Redroot by county (dark shading) for the United States (modified from Kartesz 2015), with Canadian range indicated by a dot. The species also occurs in Cuba.

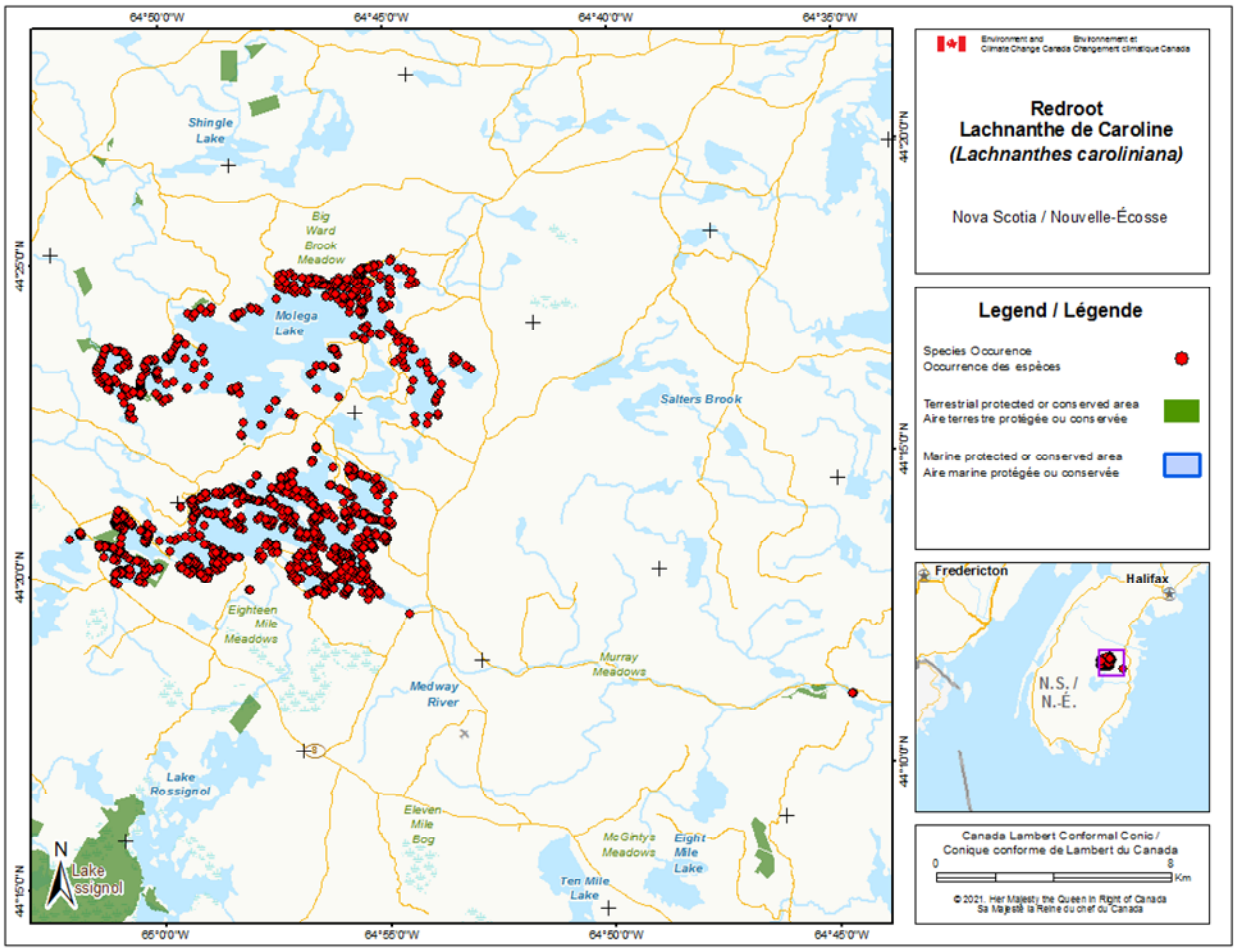


Figure 22. Canadian occurrences of Redroot (red dots).

Tubercled Spike-rush (Special Concern)

Tubercled Spike-rush occurs in the eastern United States from eastern Texas north to southern Maine with most of its range occurring within the Atlantic Coastal Plain and Gulf Coastal Plain (Figure 23). In Nova Scotia it occurs on the shores of eight lakes and one river: Harper, Gold, Western, and Barrington Lakes in Shelburne County, Great Pubnico Lake, Mill Lake, Nonias Lake and the Quinan River in Yarmouth County and Little Ten Mile Lake in Queens County (Figure 24). Four of these sites have been discovered in the past decade, suggesting additional undiscovered subpopulations may occur. The range of Tubercled Spike-rush in Canada is 2,178 km^2 (S. Blaney, unpublished data). Total population is in the hundreds of thousands of clumps, with large populations on Barrington Lake, Great Pubnico Lake and Harpers Lake, and much smaller populations elsewhere. The species' detectability varies from year to year with water levels and the population of mature plants may vary substantially as well. Long-term population trends are unknown. The Barrington Lake subpopulation may be susceptible to habitat loss caused by off-highway vehicle (OHV) use, but there is no indication of major declines elsewhere.

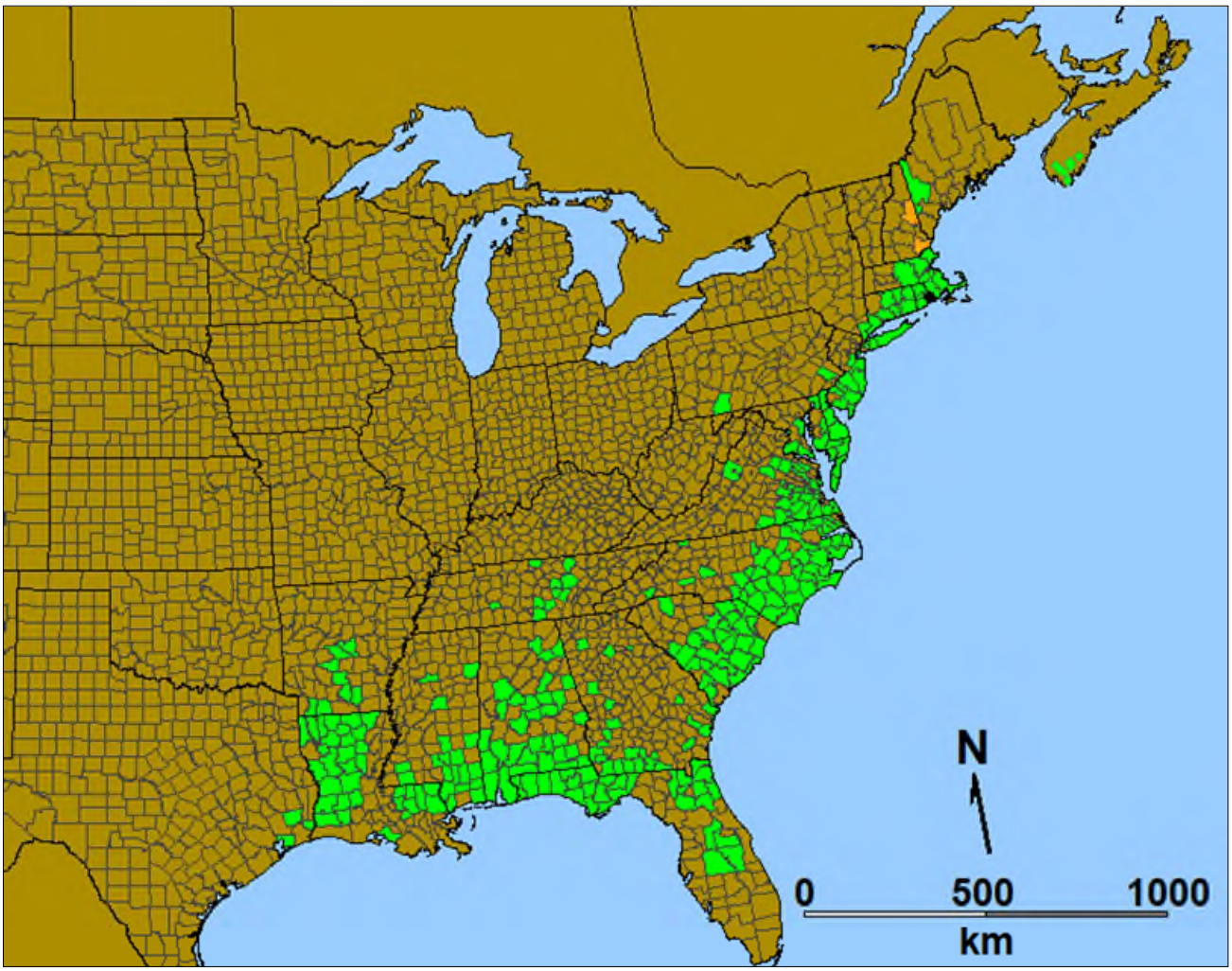


Figure 23. Global range of Tubercled Spikerush, modified from Kartesz (2015). In the United States a whole county is shaded if at least one record is known. Orange shading (New Hampshire) indicates the species is considered historic statewide.

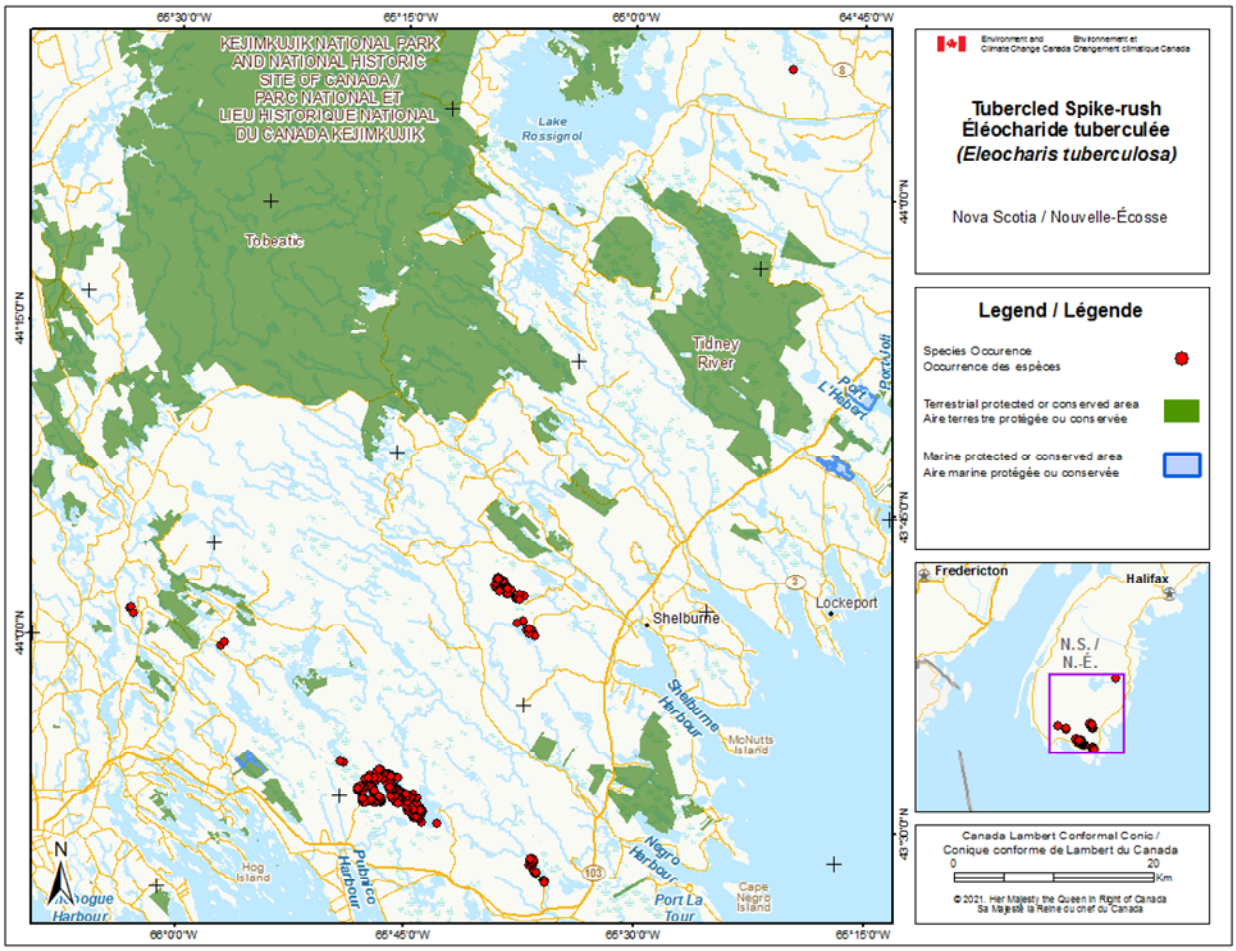


Figure 24. Canadian occurrences of Tubercled Spikerush (red dots).

Water Pennywort (Special Concern)

Water Pennywort is a tropical species found from central South America, northward through Central America and the Caribbean, and into the United States in southern California and along the Gulf and Atlantic Coastal Plains north to Massachusetts, with scattered eastern occurrences further inland, especially around the southern Great Lakes (Figure 25). It is also widely introduced in southern Asia and in New Zealand.

The disjunct Nova Scotia occurrence represents the northern limit of Water Pennywort's range. It is found at three lakes in southwestern Nova Scotia: Kejimkujik Lake, located in Kejimkujik National Park and National Historic Site, Queens County, and Wilsons and Springhaven Duck lakes in Yarmouth County (Figure 26). Springhaven Duck Lake is less than 1 km south of Wilsons Lake but is in the Kiack Brook rather than the Tusket River watershed. Wilsons and Springhaven Duck lakes are approximately 70 km southwest of Kejimkujik Lake. The range of Water Pennywort in Canada is 469 km^2.

Populations are likely stable as known patches have been persistent at Wilsons and Kejimkujik lakes for decades after their original documentation. Occurrences have been

carefully monitored in Kejimkujik through annual stem counts since 2004, showing population stability or possible increase within broad fluctuations caused by variable water levels.

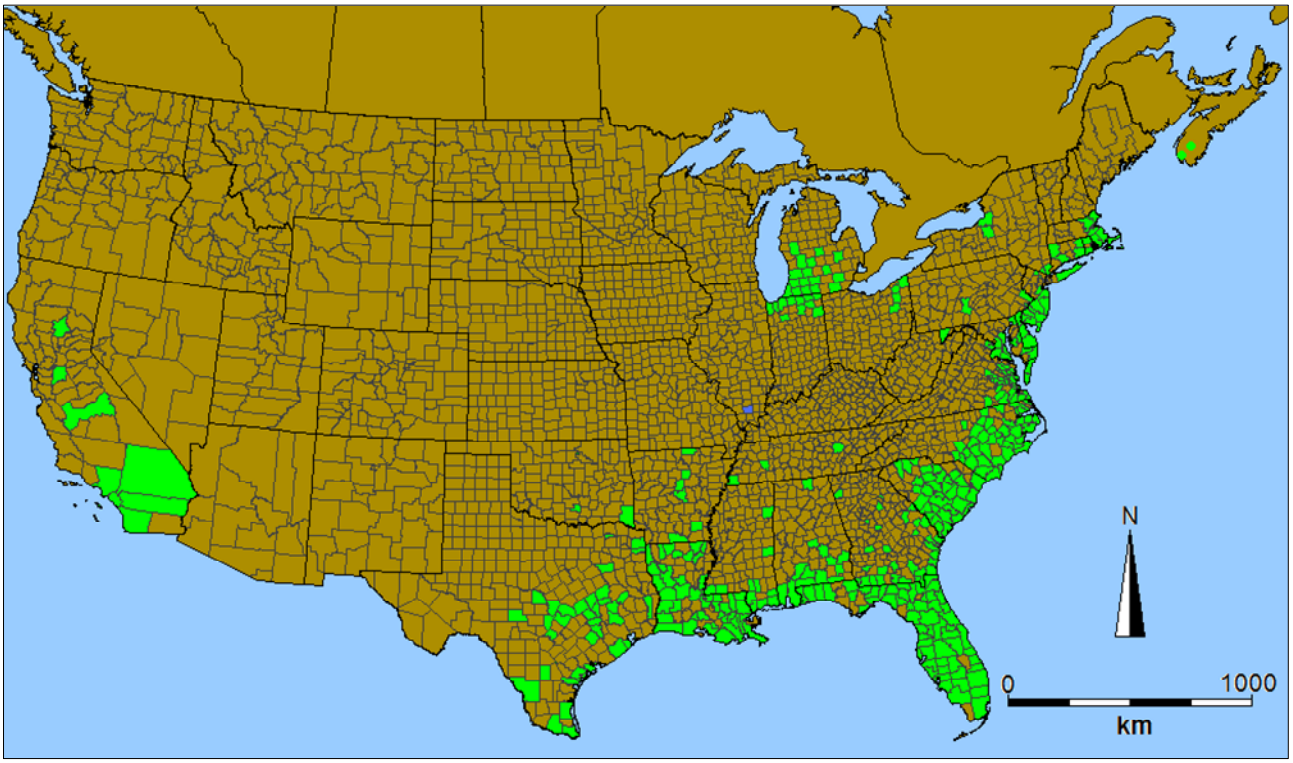


Figure 25. United States and Canadian range (green shading) of Water Pennywort, modified from Kartesz (2015). In the United States a whole county is shaded if at least one record is known. Water Pennywort is also native throughout Central America and the Caribbean and in the northern half of South America, and is introduced in Illinois (blue shading), New Zealand and southeast Asia.

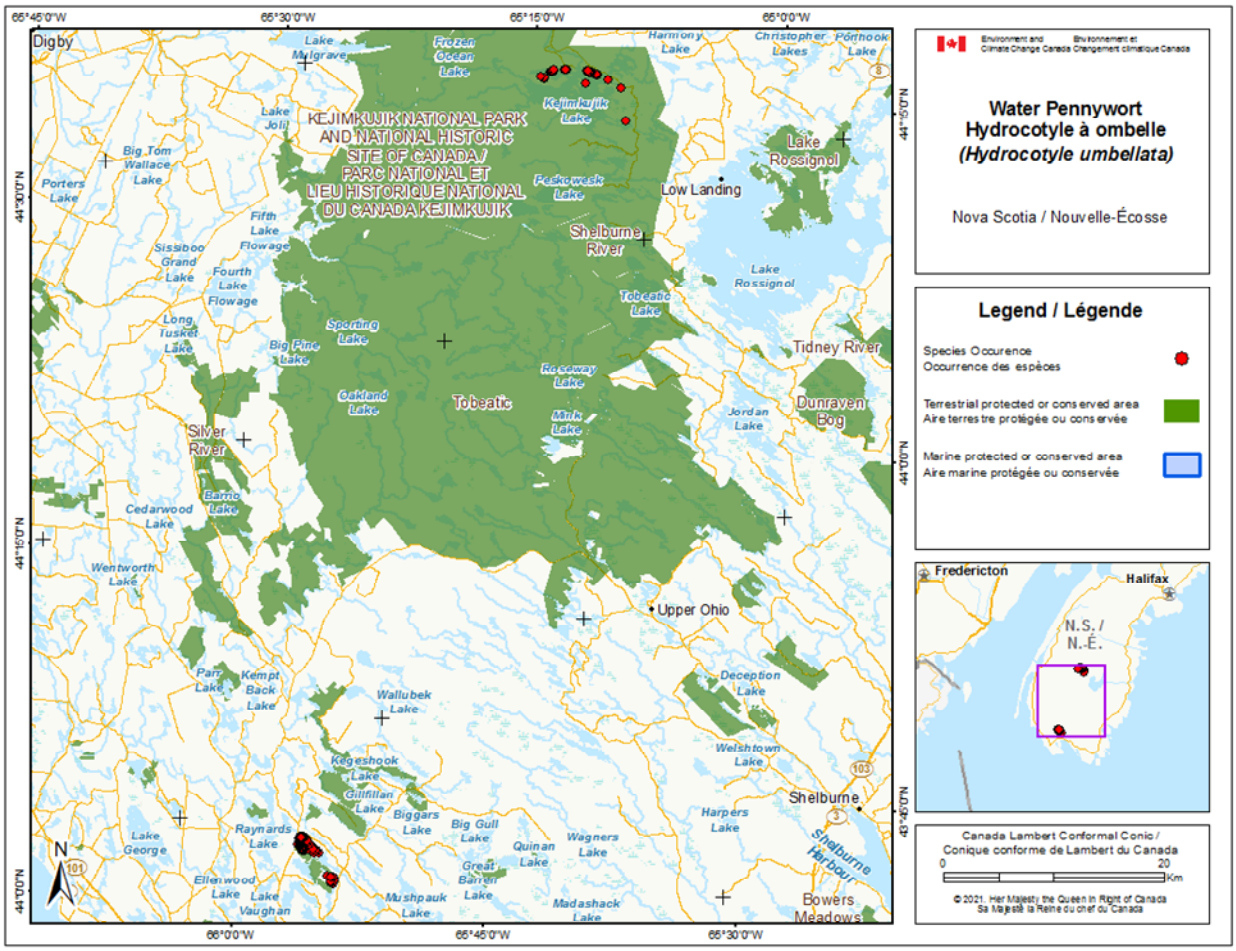


Figure 26. Canadian occurrences of Water Pennywort (red dots).

3.3 Needs of the ACPF

Pink Coreopsis (Endangered)

Known or inferred Pink Coreopsis needs include:

- Infertile, gently sloping cobble, gravel, peat, or sandy lake shorelines: occurs both on summer-exposed substrates and as an emergent in shallow water (to a depth of about 15 cm at low water periods);
- Natural stresses and disturbances from periodic water level fluctuations, wave action and/or ice scour: prevents establishment of more aggressive plants and maintains an open habitat (COSEWIC 2012b);
- High winter water levels: provide insulation from freezing;
- Generalist pollinating insects: for pollination (Siqueira 2003; COSEWIC 2012a).

Plymouth Gentian (Endangered)

Known or inferred Plymouth Gentian needs include:

- Broad, infertile, gently sloping lakeshores and occasionally river shores, on cobble, gravel, peat, or sand, often in areas with glacial deposits of red till (COSEWIC 2012c; Keddy 1984; Keddy 1985a);
- Periodic water level fluctuations: excludes more aggressive, competitively superior native shrubs and plants (COSEWIC 2012c);
- Lakes having large upstream catchment areas: increased water fluctuation and ice scour in these lakes, reduces shoreline fertility and creates broader zones of suitable habitat through summer drawdown (Holt et al. 1995; Keddy 1983; 1984; 1985);
- High winter water levels: provide insulation from freezing (Hazel 2004);
- Syrphid flies and solitary bees (Perry 1971; Trant 2005): for pollination;
- Seed banking: allows long-term persistence, especially for surviving extended high water periods (Orrell Elliston 2006);
- Peat lenses kept together by Twig-rush (Hill et al. 2006): may be necessary for seedling establishment.

Tall Beakrush (Endangered)

Known or inferred Tall Beakrush needs include:

- Shallow acidic open lakeshores that are fully exposed, or nearly so, during summer low water levels;
- Acidic, nutrient-poor conditions;
- Disturbance from fluctuating water levels, ice scour and wave action (Keddy 1985b; Keddy and Wisheu 1989; Hill and Keddy 1992; Wisheu and Keddy 1994; Hill et al. 1998): maintains communities;
- Gravelly substrates, often with a thin layer of peaty organic soil on top, but some plants are on deeper peat or on shallow organic soil within cracks in exposed bedrock;
- High winter water levels: provide insulation from freezing;
- Wind: for pollination;
- Drier periods: may be required for germination (noted in a closely related species) (COSEWIC 2014b).

Thread-leaved Sundew (Endangered)

Known or inferred Thread-leaved Sundew needs include:

- Infertile, acidic, open raised bogs (large peatlands with deep peat, raised in the centre) dominated by peat mosses, heath shrubs, short sedges and grasses;
- Open conditions: the species is typically found in wetter hollows where competition from other vegetation is reduced because of especially strong nutrient limitation;
- Insects: carnivory provides supplementation of nutrients (especially nitrogen);

- Moderate winter temperatures: all Canadian occurrences are in the southernmost part of Nova Scotia and are no more than 6 km from tidal waters. Winter temperatures are strongly moderated in this zone and the species could be limited by cooler climates;
- Insects: for pollination (Zinck 1991).

Eastern Baccharis (Threatened)

Known or inferred Eastern Baccharis needs include:

- Ocean-moderated climate: temperatures considerably milder than the coast of Maine at the same latitudes (USDA 1990; Agriculture and Agrifood Canada 2000). The small islands and points on which Eastern Baccharis occurs are surrounded by water that generally remains open through the winter and this likely further moderates winter temperatures;
- Transition zone from saltmarsh to coastal forest (partially shaded sites on the margins of well-developed salt marshes or on upper beaches, usually fronted by saltmarsh): soil salinity is lower and vegetation cover is predominantly grasses/ grass-like plants and low shrubs;
- Open and semi-open coastal habitats in estuaries or bays not subject to daily flooding: offers protection from onshore wind and waves. The species' tolerance of salinity is likely important in enabling it to avoid competition from shrubs and trees that may be superior competitors in less saline habitats.

Limitations of Eastern Baccharis include:

- Competition from taller woody plants: appears to be a significant limitation because Canadian Eastern Baccharis are restricted to areas where tree cover does not exceed 60% (Blaney and Mazerolle pers. obs. 2006-2010). Studies elsewhere indicate that both fruit production and seed germination are considerably reduced under dense shade (Westman et al. 1975). At Morris Island, a few mature plants lowest in the saltmarsh were visibly unhealthy, with some dead, perhaps indicating effects of ongoing sea level rise (Blaney and Mazerolle pers. obs. 2006-2010);
- Establishing from seed: the apparently low seedling recruitment and rarity of small individuals observed in Canadian populations suggest that establishment from seed may be a natural limiting factor, perhaps because of low winter survival of seedlings (COSEWIC 2011);
- Frequency and duration of flooding, exposure to wave action: studies have verified tolerance of a range of soil and groundwater salinity levels (Westman et al. 1975), but have shown intolerance to prolonged high-salinity conditions (Tolliver et al. 1997);
- Limitation by wave action is suggested by the species' restriction to a sheltered estuary system and the fact that Eastern Baccharis occurrences within the estuary are mostly within highly sheltered bays or behind wide saltmarshes that offer further protection from heavy wave action. The life stages at which the above limitations are important, and the relative importance of limitations caused

by physiological effects of soil saturation and salinity vs. those caused by physical damage from waves are unknown.

Sweet Pepperbush (Threatened)

Known or inferred Sweet Pepperbush needs include:

- Unshaded lakeshores and lakeshore forest margins (Taschereau 1986; COSEWIC 2014a);
- Permanently moist to saturated substrate;
- Gravelly, sandy, peat and muck soils, sometimes within the zone of shoreline boulders pushed up by ice;
- Shrubby and semi-forested stream margins and to a limited extent under Red Maple-dominated swamp forest canopy within about 20 m of shorelines (Hill pers. comm. 2012);
- Insects (especially bees): for pollination.

Limitations of Sweet Pepperbush include:

- Flowering: appears limited under dense forest canopy in Nova Scotia (Hill pers. comm. 2012);
- Reproduction by seed: occasional seedlings have been observed (Hill et al. 2000; at Louis Lake), but despite an abundance of pollinator visits evident during the mid-summer to early fall flowering period at all sites, ovules are infrequently maturing to seed. Sweet Pepperbush exhibits strong, but not complete self-incompatibility (Hemingson 1986; Reed et al. 2002; Reed 2006). Limited seed production and a consequent inability to disperse from lake to lake could explain the absence of Sweet Pepperbush from hundreds of apparently suitable lakes in southern Nova Scotia, including many near large subpopulations.

Eastern Lilaeopsis (Special Concern)

Known or inferred Eastern Lilaeopsis needs include:

- intertidal zone along the shorelines of estuaries, submerged under up to 2 m of water for part of each day (Keddy 1987a);
- gentle, muddy slopes, and occasionally on gentle slopes of fine gravel (Environment Canada 2000, Roland and Zinck 1998);
- Saltwater Cordgrass (*Spartina alterniflora)*-dominated intertidal river shore: providing significant shade to the low Eastern Lilaeopsis plants.

Goldencrest (Special Concern)

Known or inferred Goldencrest needs include:

- Open, low-gradient, gravel and cobble lakeshores (often associated with stands of Twig-rush); or
- Sheltered peatlands and floating peat mats along lake margins (bay bogs); or
- Nutrient-poor graminoid-dominated fens within large peatlands not associated with lakes (COSEWIC 2012a);

- Seasonal flooding, ice and wave action: total biomass and competition from other plants is reduced;
- Infertile substrates: total biomass and competition from other plants is reduced;
- High winter water levels: provide insulation from freezing;
- Fluctuating water conditions: allow for flowering and seedling establishment when water levels are low (Keddy 1987b). Abundant flowering has been observed at some sites (Newell and Proulx 1998; Blaney and Mazerolle pers. obs. 2006-2010).

Limitations of Goldencrest include:

- Small fraction of populations are reproductive plants: especially on lakeshore sites where entire stands may be strictly vegetative in a given year (Blaney and Mazerolle pers. obs. 2007-2010).

Long's Bulrush (Special Concern)

Known or inferred Long's Bulrush needs include:

- Acidic peatlands: competition from shrubs is minimal due to waterlogged conditions or ice scour, low pH and limited nutrient availability (Hill 1992; COSEWIC 2017);
- Waterlogged areas: shrub growth is suppressed (Hill and Johansson 1992);
- Timely disturbance: flowering (except for Lac de l'Ecole) appears to be dependent on disturbance like OHVs, damage, fire, muskrat grazing, and road building (Schuyler and Stasz 1985, Hill 1992);
- Seed banking: allows long-term persistence, especially for surviving extended high water periods;

Limitations of Long's Bulrush include:

- Flowering: occurs infrequently throughout its range and at all Canadian populations except for Lac de l'Ecole, which flowers annually (possibly associated with genes obtained through hybridization with Wooly Bulrush). The main form of reproduction is vegetative through underground rhizomes;
- Hybridization when flowering: Long's Bulrush can hybridize with the weedy and common Wooly Bulrush (*Scirpus cyperinus)*. Hybridization is frequent in at least two Nova Scotia populations (MacKay et al. 2010). Wooly Bulrush has probably increased over historic levels in the vicinity of Long's Bulrush because it can utilize disturbed areas such as logging road ditches;
- Plant and litter cover: limit germination and establishment unless reduced (e.g., by grazing and fire) (Schuyler and Stasz 1985; Rawinksi 2001).
- Long's Bulrush flowers primarily in response to fire disturbance or physical damage throughout its range (not just in Nova Scotia).

New Jersey Rush (Special Concern)

Known or inferred New Jersey Rush needs include:

- Edges of small bays or coves within bogs and fens, and in small peaty openings in coniferous woods (COSEWIC 2004b);
- Open conditions: cannot compete with dense woody species. It is found in wet areas but does not tolerate prolonged standing water conditions (COSEWIC 2004b);
- Moderate disturbance (as found along animal trails through peatlands): tends to enhance growth by removing competing vegetation and providing germination microsites (COSEWIC 2004b).

Limitations of New Jersey Rush include:

- The species is sensitive to hydrological changes and is negatively affected by site drainage or flooding (COSEWIC 2004b);
- Seed production: not been observed in Nova Scotia (COSEWIC 2004b), but it has not been studied intensively and must occur to some degree given the extent of the species' occurrence.

Redroot (Special Concern)

Known or inferred Redroot needs include:

- Shorelines of lakes (and locally along rivers);
- Peat, sand, gravel and rocky substrates (Keddy 1994; COSEWIC 2009) that are exposed or nearly exposed at low summer water levels: abundance is highest on cobble beaches of peat or gravel that face to the southwest (windward), often in shoreline stands of Twigrush (Keddy 1994, Wisheu et al. 1994);
- Nutrient-poor substrates due to the removal of organic matter by wave action and ice-scour (Hill and Keddy 1992, Wisheu and Keddy 1994, Wisheu et al. 1994) and to the acidic parent material from which the soils are derived;
- Wave action and ice-scour: limit woody plants and robust herbs (Hill and Keddy 1992);
- Summer low water followed by increasing water levels in to the fall (based on experiments which indicated these are ideal conditions for establishment Gerritsen and Greening 1989);
- Seed banking: allows long-term persistence, especially for surviving extended high water periods;
- High winter water levels: provide insulation from freezing.

Limitations of Redroot include:

- Rarity of flowering individuals (Keddy 1994): limits dispersal ability.

Tubercled Spike-rush (Special Concern)

Known or inferred Tubercled Spike-rush needs include:

- Open, sandy or stony lakeshores and gravel bars, on the fringes of peat layers, and on the edges of peaty wetlands bordering lakes (Roland and Zinck 1998);
- Sometimes associated with North American Beaver (*Castor canadensis*)-caused disturbance (Newell and Zinck 1999);
- High winter water levels: provide insulation from freezing.

Limitations of Tubercled Spike-rush:

- An absence of occurrences growing with woody species, suggests it is incapable of persisting once shrubs have established;
- After colonization of newly formed peat mats, gradually being replaced by more aggressive sedges and rushes and eventually heath shrubs when the peat persists (COSEWIC 2010);
- Rhizomes are short and ascending (Bruhl and Smith 2002), suggesting that vegetative reproduction may be limited to expansion of the tight clumps.

Water Pennywort (Special Concern)

Known or inferred Water Pennywort needs include:

- Acidic, nutrient-poor gravelly lakeshores within the zone flooded in winter and exposed in summer, and in permanently inundated lakeshore zones with depth at low water to about 1 m (COSEWIC 2014c); or
- Peaty lakeshore and a gravelly, disturbed streamside;
- Low water conditions exposing the plants: required for flowering (Roland and Zinck 1998);
- High winter water levels: provide insulation from freezing;
- Low nutrient conditions, seasonal flooding, wave action and ice scour: limit more competitive, higher biomass species (Keddy and Wisheu 1989; Wisheu and Keddy 1989; Sweeney and Ogilvie 1993; Morris et al. 2002);
- Lakes with large upstream catchment areas: increased water fluctuation and ice scour reduces shoreline fertility and creates broader zones of suitable habitat (Keddy 1983, 1984, 1985; Holt et al. 1995);
- Ice movement: likely a significant cause of fragmentation (and hence dispersal) in Canada (COSEWIC 2014c).

Limitations of Water Pennywort:

- Climate and/or poor dispersal may be limiting the species in Nova Scotia;
- Flowers appear non-functional as seed production has never been documented in Nova Scotia, possibly as a consequence of very low genetic diversity (Vasseur et al. 2002).

4. Threats

4.1 Threat Assessment

Direct threats to ACPF and their habitats are addressed in Tables 2 and 3.
The threat assessment for the species is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system. Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational) (Salafsky et al. 2008). Limiting factors are not considered during this assessment process. For the purposes of threat assessment, only present and future threats are considered. Historical threats, indirect or cumulative effects of the threats, or any other relevant information that would help understand the nature of the threats are presented in the Description of Threats section.

Threat calculator assessments were completed as part of the COSEWIC assessment process for Tall Beakrush (Endangered), Eastern Baccharis (Threatened) (Appendix C) and Long's Bulrush (Special Concern) (Appendix D).

Preliminary threat calculator assessments, not yet reviewed through the standard COSEWIC process, are outlined in Tables 2 and 3 for all other listed ACPF species at risk and available in Appendices C and D.

Table 2. Threat Impacts (i.e., the degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest) summarised from Threat Calculator Assessments of ACPF species at risk assessed as Endangered or Threatened. A full Threat Calculator Assessment is available for Tall Beakrush and Eastern Baccharis (Appendix C). Assessments for other species here are preliminary and have not undergone standard COSEWIC review (Appendix C). Underlined text indicates threats that were not recognized in the species' COSEWIC report.

Threat	Pink Coreopsis	Plymouth Gentian	Tall Beakrush	Thread-leaved Sundew	Eastern Baccharis	Sweet Pepperbush
1. Residential & commercial development	Medium–Low	Medium–Low	High–Low	–	Medium–Low	Low
1.1 Housing & urban areas	Medium–Low	Medium–Low	High–Low	–	Medium–Low	Low
1.2 Commercial & industrial areas	Negligible	–	Negligible	–	Low	Negligible
1.3. Tourism & recreation areas	Negligible	–	Negligible	–	Negligible	Negligible
2. Agriculture & aquaculture	–	Negligible	–	–	–	–
2.3 Livestock farming & ranching	–	Negligible	–	–	–	–
3. Energy production & mining	–	–	–	High–Low	–	–
3.2 Mining & quarrying	–	–	–	High–Low	–	–
5. Biological resource use	–	–	–	–	Negligible	–
5.2 Gathering terrestrial plants	–	–	–	–	Negligible	–
6. Human intrusions & disturbance	Low	Low	–	Low	Low	–
6.1 Recreational activities (OHV use)	Low	Low	–	Low	Low	–
7. Natural system modifications	Unknown	Unknown	Not calculated (possibly in the long term)	–	–	Medium–Low
7.2 Dams & water management/use	Unknown	Unknown	Not calculated (possibly in the long term)	–	–	Medium–Low
8. Invasive & other problematic species & genes	Negligible	Low	Not calculated (possibly in the long term)	–	–	Low
8.1 Invasive non-native/alien species/diseases	Not calculated (possibly in the long term)	Low	Not calculated (possibly in the long term)	–	–	Low

Threat	Pink Coreopsis	Plymouth Gentian	Tall Beakrush	Thread-leaved Sundew	Eastern Baccharis	Sweet Pepperbush
8.2 Problematic native species	Negligible	–	–	–	–	–
9. Pollution	Low	Low	Not calculated (possibly in the long term)	–	–	Unknown
9.1 Household sewage & urban waste water	Negligible	–	Not calculated (possibly in the long term)	–	–	Unknown
9.3 Agricultural & forestry effluents	Low	Low	Not calculated (possibly in the long term)	–	–	–
11. Climate change & severe weather	Low	–	–	–	Unknown	–
11.1 Habitat shifting & alteration	Low	–	–	–	Unknown	–
11.4 Storms & flooding	Low	–	–	–	Unknown	–

Table 3. Threat Impacts (the degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest) summarised from Threat Calculator Assessments of ACPF species at risk assessed as Special Concern. A full Threat Calculator Assessment is available for Long's Bulrush (Appendix D). Assessments for other species here are preliminary and have not undergone standard COSEWIC review (Appendix D). Underlined text indicates threats that were not recognized in the species' COSEWIC report.

Threat	Eastern Lilaeopsis	Goldencrest	Long's Bulrush	New Jersey Rush	Redroot	Tubercled Spikerush	Water Pennywort
1. Residential & commercial development	Low	Medium–Low	Negligible	Low	Medium–Low	Low	Medium–Low
1.1 Housing & urban areas	Low	Medium–Low	Negligible	Low	Medium–Low	Low	Medium–Low
1.2 Commercial & industrial areas	Low	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
1.3 Tourism & recreation areas	Negligible	Medium–Low	Negligible	Negligible	Negligible	Negligible	Negligible

Threat	Eastern Lilaeopsis	Goldencrest	Long's Bulrush	New Jersey Rush	Redroot	Tubercled Spikerush	Water Pennywort
3. Energy production & mining	–	Not Calculated (possibly in the long term)	Not Calculated (possibly in the long term)	–	–	–	–
3.2 Mining & quarrying	–	Not Calculated (possibly in the long term)	Not Calculated (possibly in the long term)	–	–	–	–
4. Transportation & service corridors	Not calculated (past effect)	–	Low	Low	–	–	–
4.1 Roads & railroads	Not calculated (past effect)	–	Low	Low	–	–	–
5. Biological resource use	–	–	–	Unknown	–	–	–
5.3 Logging & wood harvesting	–	–	–	Unknown	–	–	–
6. Human intrusions & disturbance	–	Negligible	Negligible	Negligible	Low	Low	Low
6.1 Recreational activities (OHV use)	–	Negligible	Negligible	Negligible	Low	Low	Low
7. Natural system modifications	Negligible	Negligible	Unknown	–	Medium–Low	–	Low
7.1 Fire & fire suppression	–	–	Unknown	–	–	–	–
7.2 Dams & water management/use	–	Negligible	Not Calculated (past effect)	–	Medium–Low	–	Low
7.3 Other ecosystem modifications	Negligible	–	–	–	–	–	–

Threat	Eastern Lilaeopsis	Goldencrest	Long's Bulrush	New Jersey Rush	Redroot	Tubercled Spikerush	Water Pennywort
8. Invasive & other problematic species & genes	–	Not Calculated (possibly in the long term)	Low	–	–	–	Not Calculated (possibly in the long term)
8.1 Invasive non-native/alien species/diseases	–	Not Calculated (possibly in the long term)	Low	–	–	–	Not Calculated (possibly in the long term)
8.2 Problematic native species/diseases	–	–	Unknown	–	–	–	–
9. Pollution	–	Not Calculated (possibly in the long term)	–	–	Not Calculated (possibly in the long term)	Not Calculated (possibly in the long term)	Unknown
9.1 Household sewage & urban waste water	–	–	–	–	–	–	–
9.3 Agricultural & forestry effluents	–	Not Calculated (possibly in the long term)	–	–	Not Calculated (possibly in the long term)	Not Calculated (possibly in the long term)	Unknown
11. Climate change & severe weather	Unknown	–	–	–	–	–	–
11.1 Habitat shifting & alteration	Unknown	–	–	–	–	–	–

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4.2 Description of Threats

1. Residential and commercial development

Shoreline development is the most serious threat to ACPF species at risk in Nova Scotia. Most development is for recreational properties (private cottages and camps) and falls under IUCN Threat Category 1.3 - Tourism and recreation areas. Some shoreline development is for permanent dwellings (Housing & Urban Areas – 1.1); and very locally some is Commercial & Industrial Development (1.2; i.e. the fish processing plant on Salmon Lake). Shoreline development and intensification is an ongoing threat for all lakeshore species on private land at most occupied lakes and is also a threat for Eastern Baccharis coastal areas. The threat of shoreline development is especially intense on Belliveau, Kegeshook, Bennetts and Third Lakes (B. Toms, personal communication, 2021). Impacts are highly variable depending on level of shoreline alteration and use, from negligible to extreme. Bogs (New Jersey Rush, Thread-leaved Sundew, Long's Bulrush, bog occurrences of Goldencrest) and the tidal zone occupied by Eastern Lilaeopsis offer limited development potential and much lower direct housing/cottage threat, though new access roads through wetlands to shoreline development sites might cause impacts.

Shoreline development may alter ACPF habitat by infilling or hardening of shorelines, dumping of sand or gravel, removal of boulders and rocks for beaches or boat launches, construction of docks, dredging of boat slips and manicuring or removal of shoreline vegetation. Most commonly, cottagers use a portion of their shorefront intensively for docks, boat launches, patios or swimming areas that impact or destroy that part of local species at risk sub-populations, but the remaining shorefront is used less intensively in ways that may allow persistence of plants. In most cases there are also relatively undisturbed portions of shoreline between adjacent cottages. However, on densely-occupied lakes with small lakeshore frontages, development of the lakeshore is instensified (e.g., Wilsons Lake, parts of Molega, Ponhook, Shingle Lakes, Third, Pearl, Belliveau, Kegeshook, Little Ponhook (B. Toms, personal communication, 2021). Impacts of shoreline alteration are not limited to newly constructed cottages. Existing development sites may continue to add “improvements” over time that increase impacts on shoreline plants and habitat.

2. Agriculture & aquaculture

Cattle farming is limited within the regions occupied by ACPF species at risk, and typically does not overlap with occupied habitat. In 2019, cattle grazing down to the Tusket River shore was observed within a small (<1000 plants) sub-population of Plymouth Gentian upstream from Wilsons Lake around Tinkhams Island. Cattle grazing has also been documented at Travis Lake above Pearl Lake (B. Toms, personal communication, 2021). Impacts on plants could occur through direct grazing, trampling, increased competition from native plant species caused by enrichment from manure (see 9. Pollution), and increased presence of exotic species moved by cattle and enabled by manure enrichment. A small subpopulation of Goldencrest on Brier Island was lost after 1985 because of bog drainage (for a failed agriculture endeavour) and subsequent nutrient enrichment by nesting gulls.

3. Energy production & mining

No peat mining is currently proposed for bog-associated ACPF species at risk sites. Past proposals for Swaine's Road Bog (rejected and no longer active) were the threat responsible for the Endangered status of Thread-leaved Sundew. Peat resources are significant at many bogs occupied by Thread-leaved Sundew, Goldencrest and Long's Bulrush and other peat mining proposals could surface in the future, especially at sites accessible from main roads. Peat mining removes occupied substrate and can substantially alter hydrology of adjacent unmined peat and thus would represent a significant threat to persistence of ACPF were it to occur in occupied peatlands.

The Barren Meadow Brook system of linear peatlands and narrow rocky ridges supports multiple Long's Bulrush occurrences and one large Goldencrest occurrence and is within an area that has been actively investigated for gold mining in the past decade, probably to be done via surface mining if ultimately approved. This area is within the Pu'tlaqne'katik Wilderness Area though the legal protection of about 200 hectares along Route 325 (between Shingle Lake and Seven Mile Lake) will only come into effect if overlapping mineral rights expire and no new rights are issued (NS Environment 2020. Issues related to mining rights are one of the considerations that have prevented final approval of Nature Reserve status. Similar claims could affect other peatland occurrences of these two species. Surface mining proposals that would directly affect lakeshores may be less likely to be approved because of cottage use and public sentiment.

Diatomaceous earth mining eliminated a large population of Goldencrest on Digby Neck at some point between the 1920s and 1950s (COSEWIC 2012a). It is no longer an active threat as far as is known.

4. Transportation & service corridors

Roads are not known to be a major threat to any ACPF species at risk. In most cases, occupied sites are sufficiently removed from existing roads that road maintenance activities are unlikely to cause impacts. New road construction to the shoreline is occurring on heavily developed lakes (cottages) and would damage or eliminate portions of occupied habitat but is unlikely to extend across a large portion of occupied habitat at any one lake. Road construction through occupied peatland, saltmarsh or swamp habitats could affect site hydrology and have broader impacts.

Specific road impacts on ACPF have been noted where Highway 8 bisects the Eighteen Mile Brook occurrence of Long's Bulrush. Road construction there may be affecting site hydrology and contributing to drier conditions that promote succession toward treed habitat unsuitable for Long's Bulrush. Road construction or maintenance was also noted as a threat to Eastern Lilaeopsis in the Tusket area in the most recent status report (COSEWIC 2004a), but no further details were given.

5. Biological resource use

Minor cutting of Eastern Baccharis stems for camouflaging duck hunting blinds was observed in 2010 (COSEWIC 2011). This has not been monitored further but is unlikely to be a significant threat as the species can resprout vigorously following cutting. Users presumably have no knowledge of the species' significance and could readily be encouraged to use other common species in the same area.

Impacts on shoreline ACPF from forestry have been theorized to be possible via changes in local hydrology or nutrient status (Environment Canada and Parks Canada Agency 2016; COSEWIC 2004b). There is no specific documentation of forestry-related indirect impacts on ACPF in Nova Scotia, and current unofficial Special Management Practices for forest harvest around ACPF lakes provide a buffer of 100 m (see *Actions Already Completed or Underway* [6.1]) on Crown Lands, which likely minimizes potential impacts. However, clear cutting (Belliveau Lake 2013-2014) and select harvesting (Wilson Lake 2012) have been documented within metres of occupied lakes (B. Toms personal communication, 2021).

6. Human interactions & disturbance

Almost all OHV use that affects ACPF species at risk is in contravention of provincial regulations on OHV use in wetlands and shorelines, but enforcement of the regulations is limited and difficult.

OHV impacts are most serious for Tubercled Spikerush at Barrington Lake, where OHVs break up and ultimately remove ideal substrate (a thin layer of peat over hard packed lakeshore sediments). This habitat recovers slowly. Heavy OHV activity and obvious plant damage is regularly observed in some wide, low gradient shorelines with large populations of Plymouth Gentian, Pink Coreopsis, Water Pennywort, Redroot and potentially Long's Bulrush and Goldencrest. Long term effects for these species are unclear.

Bogs are frequently heavily affected by proliferating OHV trails. Damage to long-lived, slow-reproducing Long's Bulrush and Goldencrest could be locally significant in bogs, though this is not well documented. Individual plants of Thread-leaved Sundew and New Jersey Rush can also be damaged or killed by OHV use. These two species, however, are considered to be less threatened by OHV impacts because they reproduce more extensively and quickly from seed and are known to experience increased seedling recruitment in response to moderate levels of OHV disturbance to bog peat.

OHV roads/trails create edges which encourage the encroachment of non-native and invasive vegetation (and OHVs act as carriers of seeds into sensitive habitats) (Ouren et. al. 2007)

7. Natural system modifications

The artificial regulation of water levels through dam construction can directly eliminate coastal plain shoreline species through flooding. It can also alter community

composition as loss of natural fluctuations simplifies shorelines and allows shrubs and other competitive, high biomass species to displace less competitive ACPF species (Keddy and Wisheu 1989; Wisheu and Keddy 1994; Nilsson and Jansson 1995; Hill et al. 1998; Merritt and Cooper 2000). For lakeshore ACPF, low winter water levels on reservoirs are likely also a crucial factor, because significant winter flooding may be required to insulate rosettes against freezing (see *Habitat Requirements*).

The hydroelectric dam at Tusket Falls was completed in 1929 and eliminated Plymouth Gentian and Pink Coreopsis occurrences on Lake Vaughan and Gavels Lake. These species may also have been on other affected lakes. The dam eliminated what was likely continuous Plymouth Gentian occurrence between Wilson Lake and Lake Fanning, genetically isolating the latter sub-population. Pink Coreopsis is more tolerant of extended submergence and still occurs on the dam-controlled Raynards Lake, but that population is likely reduced and less productive than it would be under natural conditions because of inadequate summer drawdown.

Dams on the Mersey River system created Lake Rossignol and several other reservoirs and include three power generating dams on the lower river. These likely eliminated occurrences of Long's Bulrush and potentially other ACPF species at risk. Nova Scotia Power owns much of the Carrigan Lake shoreline because of potential future use as a reservoir to feed the Mersey River dams. Raising the operating level would affect most of the Canadian population of Tall Beakrush.

Molega Lake has also been regulated by a small weir at its outlet that may have reduced populations of Tall Beakrush, Goldencrest, Redroot and Long's. The dam was constructed in 1880 to assist river driving of logs and to regulate flow for a mill downstream at Charleston and it held 1.7 m of water. It was inconsistently maintained up until about 1965 but has not been maintained since. The remains of the dam still hold water about 25 cm above the level downstream at Hog Lake

Two other small, non-hydroelectric dams owned by private individuals are present on Mill Lake (supports Sweet Pepperbush) and Springwater Duck Lake (supports Water Pennywort). Mill Lake is controlled by a dam that raises its water level about 1.5 m. This dam has likely been present for at least 70 years and may have reduced Sweet Pepperbush from pre-dam levels. The species is absent from the most significantly affected area within about 500 m of the dam and is less common on Mill Lake than the adjacent Pretty Mary or Mudflat lakes. The largest potential threat related to this dam is that it will give way and result in conditions less suitable for existing pepperbush while exposing unoccupied potential habitat that could be rapidly taken over by invasive Glossy Buckthorn. The outlet to Sloans Lake has recently been channelized and hardscaped. It is unclear how this might affect Pink Coreopsis is unclear. Water levels at Springhaven Duck lake are affected by a roughly 1 m high earth dam (COSEWIC 2014c). The extent to which this dam influences Water Pennywort is unclear, but occurrence of Water Pennywort in shoreline and deeper water sites at the lake suggests ability to cope with future dam-related water level changes. Long's Bulrush is fire-adapted, flowering and establishing seedlings largely after fire. More frequent past

fires would explain its widespread distribution in southern NS despite complete inability to disperse across watershed boundaries in its typical vegetative form. A few occurrences are visibly affected by shading from encroaching Red Maples or other species (Problematic native species, 8.2), but this is not a current issue at many occurrences. The extent to which fire frequency is currently reduced below historic levels and the level of threat that poses for Long's Bulrush is unclear.

8. Invasive & other problematic species & genes

The strongly acidic and nutrient-poor soils at ACPF sites limit the number and extent of invasive plant species occurrence. The most significant invasive plant species for ACPF is the shrub Glossy Buckthorn (*Frangula alnus*), which is noted as a threat for Tall Beakrush, Sweet Pepperbush, Goldencrest and Long's Bulrush. Glossy Buckthorn is likely to become a larger threat in the future as the species expands through bird dispersal and existing stands become denser. There is good potential for managing impacts of Glossy Buckthorn at ACPF species at risk sites through manual removal, though this becomes prohibitively expensive the more sites need management.

The other invasive species known in proximity to ACPF species at risk is Reed Canary Grass (*Phalaris arundinacea*) near Plymouth Gentian occurrences on Lake Fanning, where the Reed Canary Grass is likely responding to eutrophication caused by mink farm effluent. No direct effects of Reed Canary Grass on Plymouth Gentian were visible during the last site visit in 2011 and current status is unknown. The Raynards Lake Pink Coreopsis occurrence downstream from Lake Fanning is also subject to mink farm eutrophication and would be another site to investigate for impacts of Reed Canary Grass.

For Long's Bulrush, hybridization with Woolgrass Bulrush (*Scirpus cyperinus*) is documented at several sites but the severity of the threat posed by hybridization is unclear. Woolgrass Bulrush is common and widespread and would be within potential wind pollination distance at all Long's Bulrush sites. Hybridization is considered a threat for Long's Bulrush rather than a natural limiting factor because Woolgrass Bulrush numbers may have increased in response to creation of logging road ditches and other human disturbances.

For lakeshore ACPF, competition from more robust native species is generally a limiting factor, not a threat, except where the competing species are promoted by human actions (see Agricultural Effluents and Fire Suppression).

9. Pollution

Eutrophication can act directly on lakeshore ACPF by causing algal blooms that can condense and be deposited directly on top of shoreline plants (COSEWIC 2012b; 2012c). It can also lead to enhanced competitive performance of common native species (see Problematic native species, 8.2) and invasive species (see Invasive Species 8.1, Reed Canary Grass) that could exclude rare ACPF. Eutrophication of ACPF habitat has thus far been associated primarily with mink farming.

New mink farm development could occur anywhere near ACPF species at risk lakes, but there has been a well-documented problem with mink farm effluent in the Carleton River system since at least 2007 (COSEWIC 2012b; 2012c). This affects two ACPF species at risk occurrences: 1) the Lake Fanning sub-population of Plymouth Gentian, which is potentially in decline because of increased competition with native species (especially Golden Hedge-Hyssop) and the invasive Reed Canary Grass; and 2) the Raynards Lake sub-population of Pink Coreopsis, which is likely already limited by unfavourable water level management for hydroelectricity production. Further monitoring of the status of these sub-populations is required.

Reports of significant unexplained nutrient level increases on the Tusket River system cited in the COSEWIC reports for Pink Coreopsis and Plymouth Gentian (COSEWIC 2012b, 2012c) were largely responsible for the listing of those species as Endangered. Significant nutrient changes are well documented on Kegeshook Lake due to residential development (B. Toms, personal communication, 2021).

Eutrophication effects have also been noted near Sweet Pepperbush on Belliveau Lake. At that site, a several hectare stand of Broadleaf Cattail (*Typha latifolia*), a native species not typically abundant on nutrient-poor southern Nova Scotia lakes, has developed at the inflow of a stream draining sewage ponds from an inactive hog farm 600 m upslope from the lake. Effects are unclear but as a robust tall shrub, Sweet Pepperbush is likely to be more resistant to eutrophication effects than smaller lakeshore herbs.

There has been no indication of substantial increases in nutrient levels in most ACPF lakes as a result of household sewage or waste water (the exception is Kegeshook Lake noted above), however cumulative impacts may ultimately be significant on large lakes, such as Ponhook and Molega, where there are hundreds of cottages and continued water quality monitoring at ACPF lakes with extensive human use is needed.

11. Climate change & severe weather

Eastern Baccharis and Eastern Lilaeopsis will be affected by rising sea levels in the future. Where landforms, patterns of sediment deposition and absence of human development permit, coastal shoreline zones will move inland with sea level rise associated with global climate change. Coastal species are generally well adapted to manage incremental habitat shifts, and the ruderal nature of Eastern Baccharis suggests good capability to establish in new sites. The extent which Eastern Baccharis and Eastern Lilaeopsis might be negatively affected by shifting habitats is unclear. Any effects would be most readily addressed by habitat conservation just inland from current occurrences, in combination with ex-situ seed banking as a precautionary measure.

Another newly recognized threat to Nova Scotia's ACPF from climate change-related habitat shifting is saltwater intrusion into the freshwater Pleasant Lake where a small population of Pink Coreopsis occurs. The lake is just above typical high tide levels at the mouth of the Carleton River and already supports a few salt-tolerant species, including Eastern Lilaeopsis. A relatively small rise in sea level could easily increase salinity

above tolerable levels for Pink Coreopsis, which is known exclusively from freshwater habitats elsewhere in its range.

5. Population and Distribution Objectives (for Endangered and Threatened species)/ Management Objectives (for species of Special Concern)

The population and distribution objectives for the ACPF listed as Endangered and Threatened and the Management objectives for the ACPF listed as Special Concern are outlined in Table 4.

Table 4. Population and distribution objectives for the listed ACPF species at risk.

Species Common Name	**Population and Distribution Objectives**
Pink Coreopsis Plymouth Gentian	• Increase redundancy by re-establishing two populations in suitable areas within the species' natural range (mitigating extirpations because of historical anthropogenic flooding).
Tall Beakrush Thread-leaved Sundew Eastern Baccharis Sweet Pepperbush	• Maintain a stable population within the species' range in Canada (i.e., extent of occurrence as of 2019), including any new sites that may be found in the future.
Species Common Name	**Management Objectives**
Eastern Lilaeopsis Goldencrest Long's Bulrush New Jersey Rush Redroot Tubercled Spikerush Water Pennywort	• Maintain a stable population within the species' range in Canada (i.e., extent of occurrence as of 2019), including any new sites that may be found in the future.

Meeting these objectives will involve conserving suitable habitat to prevent further decline in extent and quality of habitat and to allow for colonization of presently unoccupied habitat. Additionally, for Pink Coreopsis and Plymouth Gentian, meeting these objectives involves re-establishing populations which may require restoring habitat in areas of former habitat destroyed by human activity, to the extent possible.

The listed ACPF are intrinsically rare in Canada and naturally precarious due to their small ranges and specific and narrow habitat niches. Because of this, the approaches and measures outlined in this document may not result in de-listing of the species. The best long-term scenario would be to ensure survival, persistence and independence of the species in their natural habitat at levels sufficient to support resilience to perturbation by stochastic demographic or environmental effects. Specifically, this would involve addressing vulnerability to human-caused threats and mitigating or restoring any loss of suitable habitat to the extent possible to maintain redundancy in the population.

6. Broad Strategies and General Approaches to Meet Objectives

6.1 Actions Already Completed or Currently Underway

Actions already completed or currently underway are summarized in Table 5.

Table 5. Actions Already Completed or Currently Underway for ACPF species at risk, following the Conservation Measures Partnership Conservation Actions Classification framework v 2.0 (CMP 2016). Actions already completed are listed as bullet points.

1. Land / Water Management (Actions directly managing or restoring sites, ecosystems and the wider environment)
1.1 Site / Area Stewardship (Enhancing viability / mitigating stresses for sites and/or ecosystem targets, especially on a smaller scale)
• The Southwest Nova Scotia Habitat Conservation Strategy was completed for ECCC in 2013 (Mersey Tobeatic Research Institute (MTRI) 2013).
• The Protected Areas Division of NS Environment has also completed extensive work on prioritizing areas and particular parcels of land for conservation.
• The Nature Conservancy of Canada (NCC) and Te Nova Scotia Nature Trust (NSNT) have completed similar prioritization efforts for parcels within their focal areas around Lobster Bay and Port Joli (NCC) and the Ponhook – Molega lakes area (NSNT).
• Some management of Glossy Buckthorn is occurring in Kejimkujik National Park and National Historic Site. Though not in areas known to be occupied by SAR, this should reduce the rate of spread of the species into occupied Long's Bulrush sites in Kejimkujik National Park and National Historic Site.
1.2 Ecosystem & Natural Process (Re)Creation (Restoring missing or severely degraded ecosystems and ecosystem functions and processes, especially on a large scale)
• Some discussions have taken place with NS Power on water level management in the Tusket River drainage system that would be more favourable for ACPF lakeshore species on reservoirs, though no substantial changes to water level management have yet been undertaken.
• The Stewardship Centre for British Columbia and Natural Resources Canada launched a project in 2020 to assess the potential of extending the Green Shores® program (based in British Columbia) to Atlantic Canada. The Green Shores® program actively promotes the maintenance and/or (re)creation of natural shorelines (Freshwater lakeshores and Marine shores) and provides guidance, tools and a certification system to minimize impacts of shoreline development and/or restore shorelines at previously developed sites.
2. Species Management (Actions directly managing or restoring specific species or taxonomic groups)
2.1 Species Stewardship (Enhancing viability of / mitigating stresses to specific taxa within their current range)
• Extensive survey work to find new ACPF species at risk populations has been undertaken (220 lakes visited by botanists prior to 2000, ~270 lakes (~190 newly visited) since 2000, a large proportion of these comprehensively surveyed).

• From 2010 to 2016, MTRI led shoreline inventories to comprehensively document species' distribution (stored at Atlantic Canada Conservation Data Centre (AC CDC)) and habitat distributions (stored with MTRI) on lakes known to support ACPF species at risk. This included geo-tagged photographic documentation of baseline shore condition that can be compared to new conditions in actions against unauthorized shoreline alterations.
• Since 1999, AC CDC has maintained a comprehensive GIS database of ACPF species at risk occurrence records, which serves as the database of record for all management activities. This is a critical role in species' status assessment, recovery planning and action, site management, threat mitigation and development permitting.
2.3 Ex-Situ Conservation (Protecting specific taxa in artificial settings with the aim of ultimately restoring them to their natural settings)
• The Acadia Seed Bank and the Harriet Irving Botanical Garden at the K.C. Irving Environmental Science Centre, Acadia University, are well equipped for long-term storage of seeds and live plants of ACPF species at risk. Specific activities have been undertaken for a few SAR, particularly tissue culture of Thread-leaved Sundew.
3. Awareness Raising (Actions making people aware of key issues and/or feeling desired emotions, leading to behavior change)
3.1 Outreach & Communications (Promoting desired awareness and/or emotions and subsequent behavior change by providing information to target audiences through appropriate channels)
• MTRI has produced outstanding printed guides to ACPF and their stewardship (Crowley and Beals 2011; Crowley 2015) and maintains the well-used ACPF website.
• Various ACPF efforts of NSNT, NCC, MTRI have been featured in print, radio and television media reports.
• Parks Canada maintains ongoing interpretation of ACPF for park visitors at Kejimkujik National Park and National Historic Site.
• The Nova Scotia Department of Lands and Forestry (NS DLF) works with other divisions within the department to increase awareness of all Species at Risk, including ACPF, within the department and with all Nova Scotians.
5. Livelihood, Economic & Moral Incentives (Actions using livelihood, other economic and moral incentives to directly influence attitudes and behaviors)
5.3 Market-Based Incentives (Using market mechanisms to change behaviors and attitudes)
• ECCC's Ecological Gifts Program offers significant tax benefits to landowners who donate land or a partial interest in land to a qualified recipient. Recipients ensure that the land's biodiversity and environmental heritage are conserved in perpetuity. The program has contributed to the conservation of several protected areas supporting ACPF species at risk.
6. Conservation Designation & Planning (Actions directly protecting sites and/or species)
6.1 Protected Area Designation &/or Acquisition (Legally or formally establishing or expanding public or private parks, reserves, and other protected areas roughly equivalent to IUCN Categories I-IV)
• Extensive designation of protected areas has taken place since 1998, bringing the provincial proportion of protected areas up to 12.7% and the proportion within the southern Nova Scotia region supporting most ACPF up to about 37%. 11 of the 13 ACPF species at risk have sizable numbers of individuals within protected areas. Only Tall Beakrush and Eastern Lilaeopsis currently have no individuals known to be in protected areas.
• NSNT, NCC, the Tusket River Environmental Protection Association (TREPA) contribute to a large network of conservation lands benefiting ACPF.

6.2 Easements & Resource Rights (Legally or formally establishing protection of some specific aspect of the natural resources on public or private lands)
• At least 45 voluntary conservation easements have been arranged with ACPF landowners by NSNT, in which landowners pledge to practice appropriate habitat management and to notify NSNT if they intend to sell their property.
6.4 Conservation Planning (Planning for management of sites, species, or thematic conservation projects)
• Kejimkujik National Park and National Historic Site Staff planned for the management of Long's Bulrush and Water Pennywort in The Multi-species Action Plan for Kejimkujik National Park and National Historic Site of Canada (Parks Canada Agency 2017) and have completed actions within this action plan (1. Complete the Atlantic Coastal Plain Flora (ACPF) Atlas on Kejimkujik Lake to complete population mapping on lakes listed as High Priority in the Recovery Strategy; 2. Seasonally protect Water Pennywort in the Jeremy's Bay campground using signs and barriers)
7. Legal & Policy Frameworks (Actions developing and influencing legislation, policies and voluntary standards affecting conservation)
7.1 Laws, Regulations & Codes (Creating, amending, or influencing laws, regulations and codes at all levels)
• Provincial Nova Scotia Endangered Species Act proclaimed in 1999.
7.2 Policies & Guidelines (Creating, amending, or influencing policies and guidelines at all levels)
• Special management practices (100 m buffer from the shoreline) for forestry in the vicinity of ACPF lakes have been developed and informally implemented by NS DLF, but have not yet been finalized and published.
• Some effort has been made toward outreach and engagement on ACPF species at risk to municipal governments responsible for development permitting, resulting in consideration for ACPF species at risk within the municipal plan for Queens County.
9. Education & Training (Actions enhancing the knowledge and skills of specific individuals)
9.1 Formal Education (Enhancing knowledge and skills of students in a formal degree program)
• Academic investigation of ACPF ecology has been ongoing since the 1980s, led by Paul Keddy, Irene Wisheu, Nick Hill, Tom Herman, Liette Vasseur, Ed Reekie, Sara Good, Ron MacKay, Karen Harper and their students and collaborators, resulting in numerous B.Sc. and M.Sc. graduates familiar with ACPF species at risk issues.
9.2 Training & Individual Capacity Development (Enhancing knowledge, skills and information exchange for practitioners, stakeholders, and other relevant individuals in structured settings outside of degree programs)
• Outreach and training programs by NSNT and MTRI for lakeshore landowners and other interested citizens have produced many ACPF monitors and champions.
10. Institutional Development (Actions creating the institutions needed to support conservation work)
10.2 External Organizational Development & Support (Creating or providing non-financial support & capacity building for conservation organizations)
• Environment and Climate Change Canada has led the establishment of the Kespukwitk Conservation Collaborative in order to increase capacity for conservation in southwest Nova Scotia.

10.3 Alliance & Partnership Development (Forming and facilitating partnerships, alliances, and networks of organizations)
• Kespukwitk Conservation Collaborative was founded in 2017-2018 to enhance collaboration in and capacity for conservation efforts of all species at risk across the southern Nova Scotia region occupied by most ACPF
10.4 Financing Conservation (Raising and providing funds for conservation work)
• A wide range of federal and provincial funds, private foundation support and funds from small donors have contributed to the efforts of MTRI, AC CDC, NSNT, NCC, university researchers and others in conserving ACPF species at risk.

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6.2 Strategic Direction for Recovery and Measures to be Taken

Table 6. Recovery Planning Table (Endangered and Threatened ACPF), Conservation Measures (Special Concern ACPF) and implementation schedule following the Conservation Measures Partnership Conservation Actions Classification framework v 2.0 (CMP 2016).

Broad Strategy and Approach	#	Measure	Priority[a]	Threat, limitation or Concerns Addressed	Timeline
2. Species Management					
2.1 Species Stewardship	1	Assist ACPF in-situ via reproduction management	Low	All threats in Tables 2 and 3	as necessary
2.3 Ex-Situ Conservation	2	Provide ex-situ protection to ACPF via gene banking (seeds, tissue) to protect against catastrophic loss and ensure ACPF			2026
	3	Ensure ACPF are returned to appropriate habitats to meet population and distribution objectives			as necessary
	4	Provide ex-situ protection to ACPF via captive breeding over generations and ensure ACPF are returned to appropriate habitats to meet population and distribution objectives			2026
3. Awareness Raising					
3.1 Outreach & Communications	5	Raise awareness of listed ACPF (e.g., species' needs, occurrences, direct threats) with relevant government agencies, landowners and managers, recreational users (boaters, shoreline users) via reported media, social media, ads & marketing, displays, signs, person-to person engagement, and experiential learning	High	All threats in Tables 2 and 3	2021-2026
4. Law Enforcement & Prosecution					
4.1 Detection & Arrest	6	Reduce or deter illegal behaviour through compliance promotion: verify compliance with laws via surveillance, patrolling, carrying out investigations, establishing/maintaining informer networks, and/or intercepting arrest.	High	All anthropogenic threats in Tables 2 and 3	ongoing

Broad Strategy and Approach	#	Measure	Priority[a]	Threat, limitation or Concerns Addressed	Timeline
5. Livelihood, Economic & Moral Incentives					
5.2 Better Products & Management Practices	7	Change behaviours by developing better products & practices (e.g., simplify processes for permitting and/or licensing among multiple government agencies)	Medium	All anthropogenic threats in Tables 2 and 3	2026
6. Conservation Designation & Planning					
6.1 Protected Area Designation &/or Acquisition	8	Establish or demarcate protected areas (e.g., purchase, donations, identify core habitat, Provincial Parks, Nature Reserves, Wilderness Areas)	High	All anthropogenic threats in Tables 2 and 3	ongoing
6.2 Easements & Resource Rights	9	Promote Conservation Easements			ongoing
6.4 Conservation Planning	10	Plan for managing sites with ACPF (e.g., plan conservation activities at occupied sites, determine target audiences, specific approaches for each audience)			2026
7. Legal & Policy Frameworks					
7.1 Laws, Regulations & Codes	11	Create, amend, or influence environment-related provincial and/or municipal laws and/or regulations (SMPs, Codes of Practice)	High	All anthropogenic threats in Tables 2 and 3	as necessary
7.2 Policies & Guidelines	12	Create, amend, or influence environment-related provincial and/or municipal policies and/or guidelines			as necessary
8. Research & Monitoring					
8.1 Basic Research & Status Monitoring	13	Conduct research on ACPF (basic species biology: e.g., pollination and seed production, seed viability, seedling recruitment, seed banking, dispersal and limitations and genetic diversity)	High	Knowledge gaps	2026
	14	Conduct research on High and Medium human-caused threats to ACPF (Residential & commercial development and Dams & water management/use; especially the effects of altered water regimes at sites impacted by hydroelectric dams)			

Broad Strategy and Approach	#	Measure	Priority[a]	Threat, limitation or Concerns Addressed	Timeline
	15	Develop and implement protocols and methods (including detailed study design) to monitor ACPF and priority threats to the species (e.g., cottage development (sub-divisions, septic systems), shoreline alterations (wharves), infilling, road construction, OHVs, mink farming, peat mining, and cranberry farming)			
8.2 Evaluation, Effectiveness Measures & Learning	16	Collect information about the effectiveness of specific projects (e.g., protection approaches including informal agreements, outreach and communications, effectiveness of monitoring protocols for identifying threats, assess habitat restoration methods, propagation techniques)	High	Knowledge gaps	2026
9. Education & Training					
9.2 Training & Individual Capacity Development	17	Provide conservation capacity development through hands-on coaching & technical assistance and developing training materials (e.g., monitoring protocols, field sheets)	High	Capacity building	ongoing
10. Institutional Development					
10.3 Alliances & Partnership Development	18	Create and maintain partnerships focused on coordinating conservation implementation, knowledge generation & sharing (e.g., with Indigenous communities, U.S. species experts and recovery practitioners, volunteers, local clubs and large landowners and through Recovery Action Forums)	Low	Capacity building	ongoing

[a] "Priority" reflects the degree to which the broad strategy contributes directly to the recovery of the species or is an essential precursor to an approach that contributes to the recovery of the species.

6.2.1 Monitoring

Guides and protocols already exist for ACPF:

- ACPF Shoreline Inventory Protocol (Blaney 2010)
- [Draft] Volunteer Monitoring Guide (MTRI 2012)
- [Draft] ACPF Volunteer Water Quality Monitoring Protocol (2014)

Updating and revising these protocol/guides and developing a comprehensive monitoring plan with protocols for all ACPF is a recovery measure set out in the recovery planning table, conservation measures and implementation schedule (Table 6: 8.1 #15).

6.3 Narrative to Support the Recovery and Conservation Measures

Ex-situ conservation of genetic diversity (seed storage, conservation planting and tissue culture) that can enable potential future re-introduction efforts is a prudent precautionary action contributing to the long-term conservation of all ACPF species at risk.

Caution is most strongly warranted for species with especially small Canadian populations and distributions (e.g., Tall Beakrush and Eastern Baccharis) and for smaller and more isolated sub-populations of the more abundant and widely distributed SAR. Of these, Eastern Baccharis is especially facing major changes to its habitat because of sea level rise and increased storm frequency and severity associated with climate change. These changes are not preventable through local action and the extent to which the species will be able to move landward is uncertain. The Canadian population occupies a very small elevational range in a limited area of occurrence such that most or all plants could be quickly and uniformly affected by sea level rise. Maintaining genetic diversity ex-situ, coupled with research into population genetics and feasibility of re-introduction, is thus especially important for Eastern Baccharis.

Most human impacts on ACPF species at risk from shoreline development and OHV use are unintentional and result from an absence of knowledge of the existence or significance of ACPF, or from a lack of information on where ACPF occur. The effects of shoreline development on ACPF can often be readily mitigated without substantial impacts on landowner activities. Increasing public understanding and appreciation of ACPF and the roles individuals can play in conservation of ACPF habitat are thus extremely important measures for reducing threats. Behavioural change and resultant reduction in threats can be accomplished through the continuation and expansion of stewardship and education initiatives that are targeted broadly, and more specifically to key groups such as provincial and municipal permitting authorities, landowners, OHV and lake associations and school groups local to particular ACPF species at risk occurrences. Outreach efforts can include signs, online and printed materials, media appearances, meetings and educational talks and walks. Increasing availability of information on exactly where ACPF species at risk occur could also greatly improve conservation outcomes by reducing accidental impacts and the unintentional overlooking of species at risk occurrences in permitting processes. Detailed online

distribution maps for each ACPF species at risk should be available to all, especially to those who might undertake potentially harmful activities like shoreline alterations, and to those in governments charged with permitting such activities and enforcing existing laws and regulations around them.

Where threatening activities contravene provincial regulations, as with unauthorized shoreline alterations, OHV use on shores and major releases of farm effluent, more effective detection, enforcement and deterrence are needed to produce behavioural change and reduce threats. This can be accomplished through public education on relevant laws and regulations and on how to report violations, through consistent habitat monitoring that targets sites most likely to be impacted, and through improved information availability on species at risk occurrences that reduces the possibility of an "I didn't know" defence. Where enforcement is especially difficult under current staffing levels and directives, efforts to amend provincial or municipal laws, regulations, policies and guidelines may be needed.

Effective conservation actions depend upon good data management and data availability. Existing databases of distribution and population information and habitat and threat information should be maintained and enhanced to ensure that all are comprehensive, well documented, and readily accessible.

Direct conservation action can only be initiated when species at risk occurrences are documented. Targeted searches for undiscovered occurrences should continue so that previously undocumented occurrences can be conserved and so that conservation actions can be prioritized based on species' actual status. Among the Special Concern species, Long's Bulrush has an experimentally determined 95% probability of at least 16 undiscovered occurrences in Nova Scotia and the number of undiscovered occurrences likely exceeds 34 (COSEWIC 2017). The next most promising species for undiscovered occurrences are New Jersey Rush (numerous occurrences and fairly extensive unsearched habitat) and Tubercled Spikerush (multiple recent discoveries, easily overlooked). Eastern Lilaeopsis, Goldencrest, Redroot and Water Pennywort all have distributions reaching 100 km or more northeastward from southernmost mainland Nova Scotia, suggesting that although occupancy of apparently suitable habitat is very infrequent, additional occurrences could occur. Distribution of primarily lakeshore species on rivers should be investigated further, especially for Plymouth Gentian on the Tusket River, Redroot on the Medway River and Tubercled Spikerush on the Quinan River, where scattered occurrences have been documented.

Establishment of permanent protected areas and easements effectively mitigates the most important threat to lakeshore and estuarine ACPF species at risk – shoreline development. As noted in *Actions Already Completed or Currently Underway (6.1)*, impressive progress has been made over the last 20 years in protecting ACPF species at risk through provincial protected areas and conservation NGO ownership. Additional protected areas that support species at risk represent a further conservation benefit and should be promoted, but needs are greater for certain species and areas. Tall Beakrush would especially benefit from inclusion in additional protected areas because no

occurrences are currently protected and shoreline development is the most immediate threat. Other important targets for inclusion in new protected areas include larger occurrences of Sweet Pepperbush (on Belliveau, Mill, Mudflat and Pretty Mary lakes) and Tubercled Spikerush (especially on Great Pubnico and Barrington lakes), the shorelines of Ponhook – Molega and associated lakes (Redroot, Goldencrest and Long's Bulrush are especially frequent, ownership is largely private and development pressure is very heavy), and occurrences of Eastern Baccharis with broad zones of low gradient coastal swamp or forest that will allow future landward migration.

Where formal protected areas are not feasible, other actions are required. A comprehensive plan for conserving and managing all ACPF species at risk occurrences should be developed, promoting the stewardship and education initiatives outlined above. Conservation plans might also include the designation of core habitat protection under the NS ESA and restoration actions for extirpated populations. The cost-effectiveness and conservation-effectiveness of all actions undertaken should be analysed with the intention of adapting future actions as needed.

Regular monitoring of populations and site conditions and threats is crucial to detect new impacts and inform management actions. Comprehensive shoreline surveys (2016) provide strong baseline values for species' distribution and populations and threats/ impacts. A regular and standardized monitoring and reporting protocol should be developed to allow rapid detection of changes in these factors. This should include assessment of the cumulative impacts of multiple mink farms, shoreline alterations and septic systems. Monitoring all occurrences is a labour-intensive undertaking, so efforts to train and include volunteer monitors should be continued and expanded to maximize areas covered.

Effectiveness of conservation actions may be limited because of knowledge gaps relative to species' population genetics or ecology. Where important questions remain, conservation-focused research should be undertaken to further understanding of:

- genetic diversity across Nova Scotia occurrences and between Nova Scotia and United States occurrences
- basic species biology - pollination and seed production, seed viability and seedling recruitment, seed banking, dispersal and dispersal limitations

Conservation success will be maximized where the efforts of all interested parties are well-coordinated and integrated in partnerships and alliances. The ACPF Recovery Team should continue to foster communication and collaboration among team members and with other interested parties, including international ACPF experts. Collaboration and coordination with other regional Species at Risk Teams can be facilitated through the Kespukwitk Conservation Collaborative, which (among other goals) aims to increase financial support for species at risk conservation actions. Another key area where partnership can be improved is in bringing Mi'kmaq participation and Traditional Ecological Knowledge into all aspects of ACPF conservation and recovery.

7. Critical Habitat

Section 41(1)(c) of SARA requires that the recovery strategy include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction.

Critical habitat is fully identified in this document for the Endangered and Threatened species to the extent possible, based on best available information. Additional critical habitat may be added in the future if new information supports the inclusion of areas beyond what is currently identified.

7.1 Identification of the Species' Critical Habitat

Critical Habitat for Pink Coreopsis, Plymouth Gentian, Tall Beakrush, Thread-leaved Sundew, Eastern Baccharis and Sweet Pepperbush is identified as all areas with suitable habitat within the yellow polygons in Figures 27 – 48 (Appendix E). Suitable habitat relates to areas possessing a specific set of biophysical attributes required for ACPF's life processes as summarised in Table 7.

Areas within the polygons that clearly do not contain the biophysical attributes (e.g., existing bridges, roads, trails, cleared or otherwise developed areas) are not identified as critical habitat under SARA.

Critical habitat does not apply to species of Special Concern and is therefore not identified for Eastern Lilaeopsis, Goldencrest, Long's Bulrush, New Jersey Rush, Redroot, Tubercled Spike-rush or Water Pennywort.

Table 7. The area and associated biophysical attributes necessary for Pink Coreopsis, Plymouth Gentian, Tall Beakrush, Thread-leaved Sundew, Eastern Baccharis and Sweet Pepperbush. All life stages are represented (reproductive plant, seeds and seedling) as are all life processes (sexual reproduction: flowering, pollination, seed maturation, seed release, germination; vegetative growth and asexual reproduction and overwintering in dormancy)

Species	Area or Type of Site[a]	Biophysical Attributes[b]
Pink Coreoposis, Plymouth Gentian, Tall Beakrush	Lakeshore or river shore	Open, low gradient, low nutrient shoreline: • Substrate of cobble, gravel, peat, or sand; • Low biomass; competition from robust shrubs or herbs reduced as a result of water level fluctuations and ice scour; • Flooded in winter (to insulate plants against freezing); • Generally exposed during summer low water (to promote growth & reproduction) but may be submerged during high water events.
Sweet Pepperbush	Upper lake or stream shore and adjacent swamp	Shoreline at transition zone between open shoreline maintained by ice scour and water level fluctuation, and tall shrub and forested habitats occurring above the open lakeshore: • Permanently moist to saturated substrate – often bouldery; • Absence of heavy ice scour; • Limited tree cover.
Thread-leaved Sundew	Open peatland (e.g., bog or fen)	Large domed or plateau peatland: • Deep, acidic peat substrate; • Very limited tree cover; • Reduced competition from peatland shrubs, often as a result of locally wetter conditions in depressions.
Eastern Baccharis	Estuaries and coastal habitats (i.e., sheltered bays and estuaries near the transition from saltmarsh or beach to uplands or freshwater swamp)	Open or semi-open coastal habitats: • Protected from open ocean waves; • Subject to occasional saltwater inundation that reduces competition from less salt-tolerant species; • Limited competition from other shrubs; and • less than 60% tree cover.

[a]Area or type of site - The area or type of site where the listed species naturally occurs or depends on in order to carry out its life processes.

[b]Biophysical attributes: measureable properties or characteristics of the area or type of site. In essence, biophysical attributes provide the greatest level of information about the area or type of site required to support the life process requirements of the species.

7.1.1 Information and methods used to identify critical habitat

ACPF data were received from the AC CDC and MTRI. Records since 1995 were included in the data set used to create the yellow polygons in Figures 27 - 48 (Appendix E).

Lake/River-Associated Species (Pink Coreopsis, Plymouth Gentian, Tall Beakrush, Sweet Pepperbush)

Critical Habitat under SARA is identified as any shoreline on a waterbody (lake or river) with suitable habitat (Table 7) for Pink Coreopsis, Plymouth Gentian, Tall Beakrush or Sweet Pepperbush. The yellow polygons were created from two datasets:

1. A radius of 1,000 m was drawn around each record (1995-2019) of Pink Coreopsis, Plymouth Gentian, Tall Beakrush or Sweet Pepperbush from the AC CDC dataset. A 30 m riparian zone extending landward of the banks of the occupied shorelines within this 1,000 m radius was drawn. Also, a 30 m riparian zone was drawn on all rivers and streams flowing towards or away from occupied shorelines within the 1,000 m radius (even if the river or stream segment itself was unoccupied). This habitat ensures connectivity of populations is identified because intact riparian zones along waterbodies play a role in water filtration.

   Of note: a) Pink Coreopsis can occur in fairly deep water zones that are rarely exposed to the air and would not necessarily be recognized as “shoreline habitat”; b) ACPF lakeshore species occurrence may move over time as new habitat is opened up by ice scour, or as habitat is lost through growth of more robust shrubs and herbs; and c) there is some spatial imprecision (typically under 10 m) associated with points obtained from an average handheld GPS unit, as almost all ACPF occurrence records would be.

2. Shorelines within the range of ACPF (but lacking records) were inventoried for occupancy and biophysical attributes (Table 7) by MTRI (2010-2015 and 2019). A suitability score of 1-4 was assigned for all unoccupied shorelines searched determined from substrate and slope biophysical attributes. A 30 m riparian zone extending landward of the banks of the waterbody was drawn on all segments of the waterbody shoreline provided by MTRI with a score greater than two. This suitable, though presently unoccupied, habitat ensures connectivity of populations and is identified because intact riparian zones along these waterbodies play a role in water filtration.

Thread-leaved Sundew

Any peatland with suitable habitat (Table 7) having at least one Thread-leaved Sundew plant is identified as critical habitat under SARA. Unforested peatland habitat of occupied bogs was delineated by overlaying AC CDC points with the Forest Inventory polygons from the Nova Scotia Forest Inventory layer to create the yellow polygons for this species. Fine scale hydrological differences (wetter depressions with reduced competition) are critical for Thread-leaved Sundew. Hydrology of the whole peatland is

sensitive to any significant removal of peat that changes the overall contour, as would occur after peat mining (Van Seters and Price 2001; Price et al. 2003).

Eastern Baccharis

Any site with suitable habitat (Table 7) having at least one Eastern Baccharis plant is identified as critical habitat under SARA. To ensure future establishment of new plants along the shoreline and to allow for future establishment in habitat becoming newly suitable (due to landward migration of shorelines), a 500 m radius around each Eastern Baccharis plant restricted to that portion landward of the mean low water mark is identified as critical habitat.

Survey Completeness on Lakeshores - Pink Coreopsis, Plymouth Gentian, Tall Beakrush, Sweet Pepperbush

Botanical fieldwork focused on documenting occurrence of rare ACPF on southwest Nova Scotia lakeshores has been very extensive. There have been botanist visits to at least 402 out of 1,450 named lakes in southern Nova Scotia, with comprehensive shoreline surveys completed on well over 100 lakes since 2000 (see COSEWIC 2019). All lakes known to support ACPF species at risk (Endangered, Threatened and Special Concern) were comprehensively surveyed between 2008 and 2013 (Kejimkujik Lake was completed in 2016), with the occurrence of species at risk documented comprehensively at a scale of roughly 10 m. Comprehensive mapping of the habitat characteristics of the shorelines was also completed for ACPF species at risk lakes (MTRI 2016; AC CDC 2019). Surveys for new occurrences of ACPF species at risk have focused especially on lakes most promising for rare shoreline ACPF herbs (larger lakes associated with that are lower in their watersheds, and lakes close to known ACPF sites). No high potential lakes for Pink Coreopsis and Plymouth Gentian remain unsurveyed. Tall Beakrush and Sweet Pepperbush occur in less specialized lakeshore habitats and/or are found outside the lower Tusket River area, so potential for eventually locating additional populations of those species appears higher.

Survey Completeness in Peatlands - Thread-leaved Sundew

Following its discovery in Canada in 1977, targeted surveys for Thread-leaved Sundew were undertaken in 20 apparently suitable raised bogs (COSEWIC 2001), mostly in the 1990s. Additional targeted surveys for new occurrences and on-the-ground delimitation of known occurrences were also undertaken by AC CDC in 2013 and MTRI in 2016. No new occurrences were found since 1999, despite these targeted survey efforts. Many other peatlands across the ACPF zone of southwestern Nova Scotia have also had general botanical surveys undertaken since 2000, mostly by AC CDC (AC CDC 2019; COSEWIC 2017), without finding the sundew. There is, however, still good potential for undiscovered occurrences to be found as there is unsearched suitable habitat within 20 km of known sites, and extensive unsearched potentially suitable habitat further away from the coast and further northeast.

Survey Completeness in Estuaries - Eastern Baccharis

The potential range of Eastern Baccharis was thoroughly surveyed for the species by the AC CDC and NS Natural Resources (now NS DLF) between 2006 and 2015 (COSEWIC 2011), and the species is readily locatable from a distance when in seed. Potential for discovery of additional sub-populations thus seems relatively low.

7.2 Schedule of Studies to Identify Critical Habitat

The 2010 Recovery Strategy included a schedule of studies necessary for the identification of Critical Habitat for the ACPF species then listed as Endangered or Threatened. The studies identified in 2010 were completed.

The information currently available is sufficient to fully identify critical habitat under SARA for the Endangered and Threatened species in this document; therefore, a schedule of studies is not required.

7.3 Activities Likely to Result in the Destruction of Critical Habitat

Understanding what constitutes destruction of critical habitat is necessary for the protection and management of critical habitat. Destruction is determined on a case by case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function for the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time. Activities described in Table 8 include those likely to cause destruction of critical habitat for the species; however, destructive activities are not limited to those listed.

1867 **Table 8.** Activities Likely to Result in the Destruction of Critical Habitat for ACPF, separated by species
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Activities Likely to Result in the Destruction of Critical Habitat for Eastern Baccharis		
Description of Activity	**Description of Effect**	**Details of Effect**
Coastal development in critical habitat or in closely associated areas (e.g., construction of homes, vacation homes, and associated infrastructure such as boardwalks and trails)	• Natural landward migration of shorelines processes (e.g., overwash and sediment migration) are impeded by development • Habitat may become too flooded or too dry, beyond natural regimes, due to alterations of elevations • Habitat and/or the function of a site may be physically destroyed or altered	• Related IUCN-CMP Threat: 1.3 Tourism & Recreation Areas, 1.1 Housing & Urban Areas (e.g., construction of cottages or homes), 1.2 Commercial & Industrial Areas • This activity would likely result in the destruction of critical habitat if it occurred within the bounds of, or very near, critical habitat. • This activity could cause destruction all times of the year.
Shoreline stabilization (also known as armouring or “hard” stabilization)	• Natural processes by which coastal habitats respond to storms may be impeded while foreshore erosion is accelerated • Non-native vegetation species may be introduced; Natural transport of coastal sediments may be restricted leading to erosion of shorelines elsewhere • Natural transport of coastal sediments may be restricted leading to erosion of shorelines elsewhere	• Related IUCN-CMP Threat: 1.1 Housing & Urban Areas • Non-native vegetation species may alter the availability of light and water in the habitat, such that it is no longer suitable for ACPF species. • This activity would likely result in the destruction of critical habitat if it occurred within the bounds of critical habitat. • Outside of critical habitat, this activity may likely result in the destruction of adjacent critical habitat if natural processes by which coastal habitats respond to storms are impeded. • This activity could cause destruction all times of the year.
Use of OHVs in saltmarsh habitats	• Deep ruts may be left, soil may be compacted which may alter drainage patterns • Habitat may become too flooded or too dry, beyond natural regimes, due to ruts and/or soil compaction • Habitat and/or the function of a site may be physically destroyed or altered	• Related IUCN-CMP Threat 6.1 Recreational activities (OHVs) • This activity would likely result in the destruction of critical habitat if it occurred within the bounds of, or very near, critical habitat. • This activity could cause destruction all times of the year.

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Activities Likely to Result in the Destruction of Critical Habitat for Pink Coreopsis, Plymouth Gentian, Tall Beakrush, and Sweet Pepperbush		
Description of Activity	**Description of Effect**	**Details of Effect**
Shoreline development in critical habitat or in closely associated areas (e.g., construction of homes, vacation homes, and associated infrastructure such as boat docks, launches, wharves, breakwaters, boardwalks and trails)	• Non-native vegetation species may be introduced • Natural transport of coastal sediments may be restricted leading to erosion of shorelines elsewhere • Habitat may become too flooded or too dry, beyond natural regimes, due to alterations of elevations • Habitat and/or the function of a site may be physically destroyed or altered	• Related IUCN-CMP Threat: 1.1 Housing & Urban Areas • Non-native vegetation species may alter the availability of light and water in the habitat, such that it is no longer suitable for ACPF species. • This activity would likely result in the destruction of critical habitat if it occurred within the bounds of critical habitat. • Outside of critical habitat, this activity may likely result in the destruction of adjacent critical habitat if natural processes by which coastal habitats respond to storms are impeded. • This activity could cause destruction all times of the year.
Building Roads	• Non-native vegetation species may be introduced Habitat may become too flooded or too dry, beyond natural regimes, due to alterations of elevations • Soil may be compacted which may alter drainage patterns and hydrological regimes • Sediments or other nutrients may be introduced into waterways	• Related IUCN-CMP Threat 4.1 Roads & Railroads • Non-native vegetation species may alter the availability of light and water in the habitat, such that it is no longer suitable for ACPF species. • This activity would likely result in the destruction of critical habitat if it occurred within the bounds of, or very near, critical habitat. • This activity could cause destruction all times of the year.
Use of OHVs	• Deep ruts may be left, soil may be compacted which may alter drainage patterns • Habitat may become too flooded or too dry, beyond natural regimes, due to ruts and/or soil compaction • Habitat and/or the function of a site may be physically destroyed or altered	• Related IUCN-CMP Threat 6.1 Recreational activities (OHVs) • This activity would likely result in the destruction of critical habitat if it occurred within the bounds of, or very near, critical habitat. • This activity could cause destruction all times of the year.

Dams and water management (hydroelectric dams)	• Habitat may be changed beyond natural regimes (e.g., stabilized water levels) • Habitat and/or the function of a site may be physically destroyed or altered	• Related IUCN-CMP Threat 7.2 Dams & water Management/Use • This activity would likely result in the destruction of critical habitat if it occurred within the bounds of, or very near, critical habitat. • This activity could cause destruction all times of the year.
Pollution (sewage, run-off, agricultural & forestry effluents)	• Substrate may be provisioned with additional nutrients which may be unsuitable for ACPF growth • Higher nutrient levels may allow other vegetation (native & non-native) to flourish and competitively exclude ACPF • Sediments or other nutrients may be introduced into the waterway	• Related IUCN-CMP Threat 9.1 Domestic & Urban Waste Water (e.g., sewage, run-off including sediments, fertilizers, pesticides, road salt) and 9.3 Agricultural & Forestry Effluents (e.g., nutrient loads incl. fertilizer run-off, manure; soil erosion; sedimentation) • This activity would likely result in the destruction of critical habitat if it occurred within the bounds of, or very near, critical habitat. • This activity could cause destruction all times of the year.

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Activities Likely to Result in the Destruction of Critical Habitat for Thread-Leaved Sundew		
Description of Activity	**Description of Effect**	**Details of Effect**
Shoreline development in critical habitat or in closely associated areas (e.g., construction of homes, vacation homes, and associated infrastructure such as boardwalks and trails)	• Non-native vegetation species may be introduced • Habitat may become too flooded or too dry, beyond natural regimes, due to alterations of elevations • Habitat and/or the function of a site may be physically destroyed or altered	• Related IUCN-CMP Threat: 1.1 Housing & Urban Areas (e.g., construction of cottages or homes) • This activity would likely result in the destruction of critical habitat if it occurred within the bounds of, or very near, critical habitat. • This activity could cause destruction all times of the year.
Hard rock mining	• Habitat and/or the function of a site may be physically destroyed (e.g., converted, removed) or otherwise altered • Habitat may be changed beyond natural regimes (e.g., flooded), due to alterations of elevations • Toxic runoff water may affect vegetation	• Related IUCN-CMP Threat: 3.2 Mining & quarrying • This activity would likely result in the destruction of critical habitat if it occurred within the bounds of, or very near, critical habitat. • This activity could cause destruction all times of the year.

Cranberry growing and Peat Mining	• Habitat and/or the function of a site may be physically destroyed (e.g., converted, removed) or otherwise altered • Habitat may be changed beyond natural regimes (e.g., flooded), due to alterations of elevations • Non-native vegetation species may be introduced	• Related IUCN-CMP Threat 2.1 Annual & Perennial Non-Timber Crops and Related IUCN-CMP Threat: 3.2 Mining & Quarrying (peat extraction) • This activity would likely result in the destruction of critical habitat if it occurred within the bounds of, or very near, critical habitat. • This activity could cause destruction all times of the year.
Building Roads	• Non-native vegetation species may be introduced • Habitat may become too flooded or too dry, beyond natural regimes, due to alterations of elevations • Soil may be compacted which may alter drainage patterns and hydrological regimes • Sediments or other nutrients may be introduced into the waterway	• Related IUCN-CMP Threat 4.1 Roads & Railroads • This activity would likely result in the destruction of critical habitat if it occurred within the bounds of, or very near, critical habitat. • This activity could cause destruction all times of the year.
Use of OHVs	• Deep ruts may be left, soil may be compacted which may alter drainage patterns • Habitat may become too flooded or too dry, beyond natural regimes, due to ruts and/or soil compaction • Habitat and/or the function of a site may be physically destroyed or altered	• Related IUCN-CMP Threat 6.1 Recreational activities (OHVs) • This activity would likely result in the destruction of critical habitat if it occurred within the bounds of, or very near, critical habitat. • This activity could cause destruction all times of the year.
Pollution (sewage, run-off, agricultural & forestry effluents)	• Substrate may be provisioned with additional nutrients which may be unsuitable for ACPF growth • Non-native and native vegetation may be introduced and may flourish due to higher nutrient loads which may result in competitive exclusion of ACPF • Sediments or other nutrients may be introduced into the waterway	• Related IUCN-CMP Threat 9.1 Domestic & Urban Waste Water (e.g., sewage, run-off including sediments, fertilizers, pesticides, road salt) and 9.3 Agricultural & Forestry Effluents (e.g., nutrient loads including fertilizer run-off, manure; soil erosion; sedimentation) • This activity would likely result in the destruction of critical habitat if it occurred within the bounds of, or very near, critical habitat. • This activity could cause destruction all times of the year.

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7.4 Proposed Measures to Protect Critical Habitat

The information below outlines the measures proposed to be taken to protect critical habitat for the Endangered and Threatened SARA-listed species addressed in this recovery document.

7.4.1 Measures proposed to protect critical habitat on federal lands

As required under SARA, a description of the portions of critical habitat found in federally protected areas[5] are published in the Canada Gazette Part 1 (Gazette Statement). This critical habitat will then be protected under subsection 58(1) of SARA. Gazette statements are available on the Species at Risk Public Registry.

Also required under SARA (subsection 58(5)), if it is determined critical habitat for the Endangered and Threatened species also occurs on federal lands that are not federally protected areas, the competent minister shall, after consulting with every other competent minister, make an order for any portion of critical habitat that is not legally protected by provisions in or measures under SARA or any other Act of Parliament. If the minister does not make the order, the minister shall include in the Registry a statement setting out how the critical habitat or portions of it are legally protected. Environment and Climate Change Canada will continue to work with relevant federal departments to ensure that critical habitat on other federal lands is protected.

No critical habitat for ACPF species is known to occur on federally protected areas or other federal lands.

7.4.2 Measures proposed to protect critical habitat on non-federal lands

With regard to the portions of critical habitat on non-federal lands, Environment and Climate Change Canada will assess the protection currently in place. This involves first working with the Government of Nova Scotia to determine which provincial laws and legal instruments are in place to prevent destruction of critical habitat. If there are gaps in the protection of critical habitat, provisions or measures in place under SARA or other federal legislation will be reviewed to determine whether they prevent destruction of critical habitat. The laws and legal agreements in place that protect critical habitat will be monitored for efficacy at least every five years. Conservation measures, including stewardship initiatives, that contribute to preventing critical habitat destruction will also be considered and monitored.

[5] These federally protected areas are: a national park of Canada named and described in Schedule 1 to the *Canada National Parks Act*, The Rouge National Park established by the *Rouge National Urban Park Act*, a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Birds Convention Act, 1994* or a national wildlife area under the *Canada Wildlife Act* see ss. 58(2) of SARA.

If it is determined that any portions of critical habitat are not protected, and steps are being taken to protect those portions, those steps will be communicated via the Species at Risk Public Registry through the reports referred to in section 63 of SARA.

8. Evaluation of Socio-economic Costs and Benefits

SARA requires that an action plan include an evaluation of the socio economic costs of the action plan and the benefits to be derived from its implementation (SARA 49(1)(e), 2002). This evaluation addresses only the incremental socio-economic costs of implementing this action plan from a national perspective as well as the social and environmental benefits that would occur if the action plan were implemented in its entirety, recognizing that not all aspects of its implementation are under the jurisdiction of the federal government. It does not address cumulative costs of species recovery in general nor does it attempt a cost-benefit analysis. Its intent is to inform the public and to guide decision making on implementation of the action plan by partners.

The protection and recovery of species at risk can result in both benefits and costs. The Act recognizes that “wildlife, in all its forms, has value in and of itself and is valued by Canadians for aesthetic, cultural, spiritual, recreational, educational, historical, economic, medical, ecological and scientific reasons” (SARA 2002). Self-sustaining and healthy ecosystems with their various elements in place, including species at risk, contribute positively to the livelihoods and the quality of life of all Canadians. A review of the literature confirms that Canadians value the preservation and conservation of species in and of themselves. Actions taken to preserve a species, such as habitat protection and restoration, are also valued. In addition, the more an action contributes to the recovery of a species, the higher the value the public places on such actions (Loomis and White 1996; DFO 2008). Furthermore, the conservation of species at risk is an important component of the Government of Canada’s commitment to conserving biological diversity under the International Convention on Biological Diversity. The Government of Canada has also made a commitment to protect and recover species at risk through the Accord for the Protection of Species at Risk. The specific costs and benefits associated with this action plan are described below.

8.1 Policy Baseline

The Province Nova Scotia has access to many legislative, regulatory and management tools for the conservation and stewardship of ACPF and their critical habitat. For example,

- Endangered Species Act: requires recovery planning which must identify areas of habitat to be considered for designation as core habitat. Once core habitat has been designated, the Minister may create regulations controlling, restricting or prohibiting access to, or activities in, the habitat.

- Conservation Easements Act: may include prohibitions against activities likely to result in the destruction of critical habitat. However, the scope of this Act is limited and there is a lack of clarity regarding offences and penalties.
- Forests Act: maintains or enhances wildlife and wildlife habitats and water quality. The intent and purpose of this Act is to ensure that wildlife, wildlife habitats and the long-term diversity and stability of the forest ecosystems, water supply watersheds and other significant resources are maintained or enhanced.
- Parks Act: preserves unique, rare, representative, or otherwise significant elements of the natural environment and historic resources of Nova Scotia and prevents the willful destruction of park property (including trees and other natural resources). In addition, the Minister may take such measures, as the Minister deems necessary to protect flora and fauna within a provincial park.
- Special Places Protection Act: preserves ecological sites containing rare or endangered species in their natural habitats, enables designation of land as ecological sites. The Minister may develop a management plan for an ecological site and the Minister may issue ecological research permits.
- Wilderness Areas Protection Act: provides for the establishment, management, protection and use of wilderness areas; maintains and restores the integrity of natural processes and biodiversity; and protects representative examples of natural landscapes and ecosystems.
- Environment Act: protects the environment including biological diversity, requires many activities to undergo an approval process that may incorporate consideration of habitat, and requires environmental assessments for designated undertakings. The Minister can reject an undertaking or place conditions on an undertaking including conditions to protect habitat.
- Crown Lands Act: enables the Minister to set aside special areas on Crown lands for habitat protection and requires the Minister to integrate appropriate protective measures in forest-management planning for Crown lands to respect wildlife habitats.

8.2 Socio-economic Profile and Baseline

Many recovery measures are undertaken with the assistance of federal or provincial species at risk funding programs, in-kind contributions by recovery biologists, or research by universities.

8.3 Socio-economic Costs of Implementing this Action Plan

Implementation of the recovery measures identified in Table 6 may generate direct costs as well as societal costs. These costs are reported in this section only if they result in incremental expenditures or constraints in land uses (including foregoing or modifying current and future activities; e.g., harvesting, mineral resource exploration/development) compared to measures already in place (see ongoing measures in Table 6).

For ACPF, the direct and societal costs are expected to be low (i.e., between $0 and $5 million) over the short term (five years). Costs would only be incurred locally as the species occupies a limited geographic area in Nova Scotia and are expected to be minimal. These anticipated costs include salary, volunteer time, travel, materials, equipment and other related costs. Indirect costs are those resulting from implementing the action plan, which may have an impact on various stakeholders. Impacts to stakeholders include foregoing or modifying current and future activities.

8.4 Benefits of Implementing this Action Plan

Nearly half (46%) of respondents to the 2012 Canadian Nature Survey (Federal, Provincial and Territorial Governments of Canada 2014) reported taking some form of direct action to assist in the recovery of species at risk. Care for the environment is consistently ranked as one of Canada's top priorities in public opinion polls (Environment Canada 2009). A recent opinion poll found that three quarters of Canadian respondents feel that preserving natural areas and the variety of native plant and animal life in Canada is important to them (Ipsos Reid Opinion Poll 2011).

Wetland ecosystems provide a number of goods and services that can be categorized as provisional goods, regulating services, habitat/support, cultural services and supporting services (Millennium Assessment Report, 2003 and TEEB, 2010). Wetlands provide a wide range of socio-economic benefits including flood control, filtering contaminants, carbon sequestration, coastal protection, regulating drinking water supply, supporting plant life, and supporting recreational activities. According to a Genuine Progress Index (GPI) Atlantic study on the province's water resource values, Nova Scotia's wetlands provide an estimated $7.9 billion worth of benefits in ecosystem services to Nova Scotians annually and wetland loss to development in Nova Scotia has resulted in an estimated $2.3 billion cost annually in terms of lost ecological services such as water purification, recharging drinking waters and enhancing fishery productivity (Nova Scotia Wetland Conservation Policy, 2009).

All ACPF species will benefit from protection as a result of this action plan, as will several associated plant species, and species from other taxa (e.g. pollinator insects, fish species and aquatic insects). Other species at risk that will benefit from protection include: Eastern Ribbonsnake, Blanding's Turtle, and Atlantic Whitefish. The measures outlined in this action plan offer a cost effective way of maximizing conservation and will benefit the broader ecological community.

By focusing on increasing protection measures, as well as improved outreach, education and stewardship, it is expected that the recovery approaches outlined in the action plan will benefit the larger ecological community as well. Achieving the goal of this action plan will have a positive impact for Canadians.

8.5 Distributional Impacts

Although ACPF occur on private properties, landowners are not expected to bear the brunt of the responsibility for the species' recovery. Non-governmental organizations are active in Nova Scotia where the species occurs, and an approach of this action plan is to foster cooperative relationships with landowners and others to conserve critical habitat.

Indirect incremental costs resulting from the impacts of implementing some recovery measures may be absorbed by industry through increased operating costs.

9. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives for Pink Coreopsis, Plymouth Gentian, Tall Beakrush, Thread-leaved Sundew, Eastern Baccharis, Sweet Pepperbush, Eastern Lilaeopsis, Goldencrest, Long's Bulrush, New Jersey Rush, Redroot, Tubercled Spikerush and Water Pennywort.

- Pink Coreopsis and Plymouth Gentian are restored at historical sites (where extirpated because of anthropogenic flooding and where feasible);
- There is no observed, estimated, inferred, or suspected reduction in the population size of any listed ACPF; and
- The range (extent of occurrence) of each species in Canada is maintained or increased.

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Appendix A: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*[6]. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[7] (FSDS) goals and targets.

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

The implementation of this recovery document will clearly benefit the environment by promoting the recovery of ACPF Species at Risk. The potential for this document to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this document will clearly benefit the environment and will not entail any significant adverse effects. The reader should refer to the following sections of the document in particular: Section 3 which contains a description of the species' habitat and biological needs as well as Section 6 which includes the recovery planning table.

Implementation also directly contributes to the goals and targets of the Federal Sustainability Development Strategy for Canada. Specifically, it contributes to Goal 5: Wildlife Conservation – Maintain or restore populations of wildlife to healthy levels, and to Goal 6: Ecosystem/Habitat Conservation and Protection: Maintain productive and resilient ecosystems with the capacity to recover and adapt.

[6] www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html
[7] www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1

Appendix B: Nova Scotia's ACPF Species and their Status

updated October 31, 2019

[1] COSEWIC / SARA Status: E = Endangered, T = Threatened, SC = Special Concern, NAR = Not At Risk, U = Under Assessment

[2] NS ESA Status: E = Endangered, T = Threatened, V = Vulnerable, U = Under Assessment

Scientific Name (VASCAN 2019, synonyms in brackets)	Common Name	Global Rank	COSEWIC[1]	SARA[1]	NS ESA[2]	National Rank	NS S-Rank	# prov	Canadian Distribution outside NS	Notes	NB Status
Lyonia ligustrina	Maleberry	G5	E	-	-	N1	S1	1			absent
Coreopsis rosea	Pink Coreopsis	G3	E	E	E	N1	S1	1			absent
Sabatia kennedyana	Plymouth Gentian	G3	E	T	E	N1	S1	1			absent
Rhynchospora macrostachya	Tall Beakrush	G4	E	E	E	N1	S1	1			absent
Drosera filiformis	Thread-leaved Sundew	G4G5	E	E	E	N1	S1	1			absent
Baccharis halimifolia	Eastern Baccharis	G5	T	T	T	N1	S1	1			absent
Clethra alnifolia	Sweet Pepperbush	G5	T	T	V	N1	S1	1			absent
Lilaeopsis chinensis	Eastern Lilaeopsis	G5	SC	SC	V	N2	S2	1			absent
Lophiola aurea	Golden Crest	G4	SC	SC	T	N2	S2	1			absent
Scirpus longii	Long's Bulrush	G2G3	SC	SC	V	N3	S3	1			absent
Juncus caesariensis	New Jersey Rush	G2	SC	SC	V	N2	S2	1			absent
Lachnanthes caroliniana (Lachnanthes caroliana)	Redroot	G4	SC	SC	T	N2	S2	1			absent
Eleocharis tuberculosa	Tubercled Spikerush	G5	SC	SC	T	N2	S2	1			absent
Hydrocotyle umbellata	Water Pennywort	G5	SC	SC	E	N1	S1	1			absent
Amelanchier nantucketensis	Nantucket Shadbush	G3Q	-	-	-	N1	S1	1			absent
Iris prismatica	Slender Blue Flag	G4G5	-	-	-	N1	S1	1		introduced record in ON	absent
Sisyrinchium fuscatum	Coastal Plain Blue-Eyed-Grass	G5?	-	-	-	N1	S1	1			absent

Scientific Name (VASCAN 2019, synonyms in brackets)	Common Name	Global Rank	COSEWIC[1]	SARA[1]	NS ESA[2]	National Rank	NS S-Rank	# prov	Canadian Distribution outside NS	Notes	NB Status
Trichostema dichotomum	Forked Bluecurls	G5	-	-	-	N1	S1	3	ON QC		absent
Torreyochloa pallida var. *pallida*	Pale Manna Grass	G5T5?	-	-	-	N2	S1	3	ON QC		reported unconfirmed
Crocanthemum canadense (Helianthemum canadense)	Rock-Rose; Long-branched Frostweed	#N/A	-	-	E	N3	S1	3	ON QC		absent
Schoenoplectus torreyi	Torrey's Bulrush	G5?	-	-	-	N4N5	S1	4	ON QC NB		S3
Toxicodendron vernix	Poison Sumac	G5	-	-	-	N4N5	S1	3	ON QC		absent
ssp. *richii* not recognized in VASCAN 2019 *(Suaeda maritima ssp. richii)*	Rich's Sea-Blite	G5T3	-	-	-	NNR	[S1]	1		questionable NL record	absent
var. *palustris* not recognized in VASCAN 2019 *(Proserpinaca palustris var. palustris)*	Marsh Mermaid-Weed	G5T5	-	-	-	NNR	[S1?]	3	ON, QC		reported unconfirmed
Panicum dichotomiflorum ssp. puritanorum (Panicum dichotomiflorum var. puritanorum)	Spreading Panic Grass	G5T4	-	-	-	N1N2	S1?	1			absent
Proserpinaca intermedia	Intermediate Mermaid-Weed	G4?Q	-	-	-	N1N2	S1S2	1			absent
Agalinis maritima	Saltmarsh False-Foxglove	G5	-	-	-	N2	S2	2	NB		SX
Carex longii	Long's Sedge	G5	-	-	-	N2	S2	2	ON	1 historic record in ON	absent

Scientific Name (VASCAN 2019, synonyms in brackets)	Common Name	Global Rank	COSEWIC[1]	SARA[1]	NS ESA[2]	National Rank	NS S-Rank	# prov	Canadian Distribution outside NS	Notes	NB Status
Eutrochium dubium (Eupatorium dubium)	Coastal Plain Joe-Pye-Weed	G5	-	-	-	N2	S2	1			absent
Platanthera flava var. flava	Southern Tubercled Orchid	G4T4?Q	-	-	-	N2	S2	1			reported unconfirmed
Spiranthes casei var. *novaescotiae*	Nova Scotian Case's Ladies'-Tresses	G4TNR	-	-	-	N2	S2	1			absent
Hudsonia ericoides	Pinebarren Golden Heather	G4	-	-	-	N2N3	S2	3	PE NL		absent
Najas gracillima	Thread-like Naiad	G5?	-	-	-	N2N3	S2	4	ON NB NL		S2
Utricularia resupinata	Inverted Bladderwort	G4	-	-	-	N4	S2	4	ON QC NB		S3?
Salix sericea	Silky Willow	G5	-	-	-	N5	S2	3	QC NB		S5
Iva frutescens (Iva frutescens ssp. oraria)	Marsh Elder	G5T5	-	-	-	N2N3	S2S3	1			absent
Potamogeton pulcher	Spotted Pondweed	G5	-	-	V	N2N3	S2S3	2	ON	1 historic record in ON	absent
Eleocharis flavescens var. olivacea (Eleocharis olivacea)	Yellow Spikerush	G5	-	-	-	N4	S2S3	4	ON QC NB		S1
Galium obtusum	Blunt-Leaved Bedstraw	G5	-	-	-	N4N5	S2S3	4	ON QC NB		S2?
Smilax rotundifolia	Round-leaved Greenbrier	G5	NAR	-	-	N3	S3	2	ON		absent
Alnus serrulata	Brookside Alder	G5	-	-	-	N3	S3	3	QC NB		S2
Bartonia virginica	Yellow Bartonia	G5	-	-	-	N3	S3	5	ON QC NB NL	very restricted in all other provinces	S1

Scientific Name (VASCAN 2019, synonyms in brackets)	Common Name	Global Rank	COSEWIC[1]	SARA[1]	NS ESA[2]	National Rank	NS S-Rank	# prov	Canadian Distribution outside NS	Notes	NB Status
Coleataenia longifolia (Panicum longifolium; Panicum rigidulum var. pubescens)	Redtop Panic Grass	G5T5?	-	-	-	N3	S3	1			absent
Juncus subcaudatus (Juncus subcaudatus var. planisepalus)	Woodland Rush	G5	-	-	-	N3	S3	2	NL		reported unconfirmed
Lorinseria areolata (Woodwardia areolata)	Dwarf Chain Fern	G5	-	-	-	N3	S3	1			absent
Proserpinaca pectinata	Comb-leaved Mermaid-Weed	G5	-	-	-	N3	S3	3	NB NL		S1
Schoenoplectus americanus	Olney's Bulrush	G5	-	-	-	N3	S3	2	BC	strongly ACP in E North America; also occurs on Pacific coast	reported unconfirmed
Dichanthelium clandestinum (Panicum clandestinum)	Deer-tongue Panic Grass	G5?	-	-	-	N3N4	S3	3	ON QC		absent
Eleocharis rostellata	Beaked Spikerush	G5	-	-	-	N3N4	S3	3	BC ON	strongly ACP in E North America; widely distributed W of Mississippi R	absent

Scientific Name (VASCAN 2019, synonyms in brackets)	Common Name	Global Rank	COSEWIC[1]	SARA[1]	NS ESA[2]	National Rank	NS S-Rank	# prov	Canadian Distribution outside NS	Notes	NB Status
Juncus marginatus	Grassleaf Rush	G5	-	-	-	N3N4	S3	3	ON QC		absent
Cephalanthus occidentalis	Buttonbush	G5	-	-	-	N5	S3	4	ON QC NB		S2
Decodon verticillatus	Swamp Loosestrife	G5	-	-	-	N5	S3	5	ON QC NB PE		S1
Neottia bifolia (Listera australis)	Southern Twayblade	G4		-		N3	S3	4	ON QC NB		S2
Agalinis neoscotica	Nova Scotia Agalinis	G2G3	-	-	-	N3N4	S3S4	2	NB		S2
Sisyrinchium atlanticum	Eastern Blue-Eyed-Grass	G5	-	-	-	N3N4	S3S4	1			absent
Solidago latissimifolia (Solidago elliottii)	Elliott's Goldenrod	G5	-	-	-	N3N4	S3S4	1			absent
Rhexia virginica	Virginia Meadow-Beauty	G5	-	-	-	N4N5	S3S4	2	ON		absent
Vaccinium corymbosum	Highbush Blueberry	G5	-	-	-	N4N5	S3S4	4	ON QC NB		S1
Symplocarpus foetidus	Skunk Cabbage	G5	-	-	-	N5	S3S4	4	ON QC NB		S2
Schizaea pusilla	Curly-grass Fern	G3G4		-		N3N4	S3S4	4	ON NB NL		S1
Carex atlantica ssp. *atlantica*	Atlantic Sedge	G5T4	-	-	-	N4	S4	4	ON QC NB		S1
Carex atlantica ssp. *capillacea*	Howe's Sedge	G5T5?	-	-	-	N4	S4	3	ON QC		reported unconfirmed
Carex bullata	Button Sedge	G5	-	-	-	N4	S4	1			absent
Corema conradii	Broom Crowberry	G4	-	-	-	N4	S4	4	QC NB PE	very restricted in all other provinces	S1
Cyperus dentatus	Toothed Flatsedge	G4	-	-	-	N4	S4	4	ON QC NB		S3
Dichanthelium spretum	Eaton's Panic Grass	G5	-	-	-	N4	S4	2	ON		absent

Scientific Name (VASCAN 2019, synonyms in brackets)	Common Name	Global Rank	COSEWIC[1]	SARA[1]	NS ESA[2]	National Rank	NS S-Rank	# prov	Canadian Distribution outside NS	Notes	NB Status
(Panicum spretum)											
Euthamia caroliniana (Euthamia galetorum)	Carolina Fragrant Goldenrod	G5	-	-	-	N4	S4	1			absent
Glyceria obtusa	Blunt Manna Grass	G5	-	-	-	N4	S4	2	NB		S1
Lycopodiella appressa	Southern Bog Clubmoss	G5	-	-	-	N4	S4	2	NL		reported unconfirmed
Symphyotrichum tradescantii	Tradescant's Aster	G4Q	-	-	-	N4	S4	4	QC NB NL		S4
Toxicodendron radicans var. radicans (Toxicodendron radicans ssp. radicans)	Eastern Poison-Ivy	G5	-	-	-	N4	S4	2	NB		S2?
Utricularia radiata	Small Swollen Bladderwort	G4	-	-	-	N4	S4	2	NB		S3
Utricularia subulata	Zigzag Bladderwort	G5	-	-	-	N4	S4	1			reported unconfirmed
Aronia arbutifolia (Photinia pyrifolia)	Red Chokeberry	G5	-	-	-	N4N5	S4	1		reports for ON, QC, NB, NL are all questionable	absent
Eleocharis robbinsii	Robbins' Spikerush	G4G5	-	-	-	N4N5	S4	4	ON QC NB		S4
Myriophyllum humile	Low Water-Milfoil	G5	-	-	-	N4N5	S4	3	QC NB		S2
Panicum virgatum (Panicum virgatum var. spissum)	Switch Grass	G5TNR	-	-	-	N4N5	S4	2	QC		absent
Persicaria robustior (Polygonum robustius)	Stout Smartweed	G4G5	-	-	-	N4N5	S4	2	QC		absent

Scientific Name (VASCAN 2019, synonyms in brackets)	Common Name	Global Rank	COSEWIC[1]	SARA[1]	NS ESA[2]	National Rank	NS S-Rank	# prov	Canadian Distribution outside NS	Notes	NB Status
Platanthera blephariglottis	White Fringed Orchid	G4G5	-	-	-	N4N5	S4	6	ON QC NB PE NL		S3
Rhynchospora capitellata	Blackish Beakrush	G5	-	-	-	N4N5	S4	4	ON QC NB		S3
Sisyrinchium angustifolium	Narrow-leaved Blue-Eyed-Grass	G5	-	-	-	N4N5	S4	4	ON QC NB		S1
Thelypteris simulata	Massachusetts Fern	G4G5	-	-	-	N4N5	S4	4	ON QC NL		S1S2
Xyris difformis	Lakeshore Yellow-eyed Grass	G5	-	-	-	N4N5	S4	3	ON NB		S1
Rosa palustris	Swamp Rose	G5	-	-	-	N5	S4	4	ON QC NB		S3
Bartonia paniculata ssp. *iodandra*	Branched Bartonia	G5	-	-	-	N4N5	S4S5	3	NB NL		S2S3
Gaylussacia bigeloviana (Gaylussacia dumosa var. bigeloviana)	Dwarf Huckleberry	G5	-	-	-	N5	S5	5	QC PE NB NL	Magdalens only in QC	S4
Gratiola lutea (Gratiola aurea)	Golden-Pert	G5	-	-	-	N5	S5	5	ON QC NB NL		S1
Hypericum virginicum (Triadenum virginicum)	Virginia Marsh St. John's-Wort	G5	-	-	-	N5	S5	4	ON QC NB		S1
Ilex glabra	Inkberry	G5	-	-	-	N5	S5	1			absent
Juncus militaris	Bayonet Rush	G4	-	-	-	N5	S5	4	ON NB NL		S4
Morella pensylvanica (Myrica pensylvanica)	Northern Bayberry	G5	-	-	-	N5	S5	6	ON QC NB PE NL		S5
Persicaria hydropiperoides (Polygonum hydropiperoides)	False Waterpepper	G5	-	-	-	N5	S5	5	BC ON QC NB		S4

Scientific Name (VASCAN 2019, synonyms in brackets)	Common Name	Global Rank	COSEWIC[1]	SARA[1]	NS ESA[2]	National Rank	NS S-Rank	# prov	Canadian Distribution outside NS	Notes	NB Status
Potamogeton confervoides	Algae-like Pondweed	G4	-	-	-	N5	S5	5	ON QC NB NL	both NF & LB	S4
Utricularia purpurea	Purple Bladderwort	G5	-	-	-	N5	S5	5	ON QC NB NL		S4
Viola lanceolata	Lance-leaved Violet	G5	-	-	-	N5	S5	7	BC ON QC NB PE NL		S4
Scirpus expansus	Woodland Bulrush	G4	-	-	-	N1	SH	2	ON		absent
Calamagrostis cinnoides (Calamagrostis coarctata)	Nuttall's Reed Grass	G5	-	-	-	NH	SH	1			absent
Dichanthelium meridionale (Panicum leucothrix)	Matting Panic Grass	G5	-	-	-	NU	SH	2	ON		absent
Elymus virginicus var. halophilus	Saltmarsh Virginia Wild Rye	G5T5	-	-	-	NNR	SNR	2	NB		SU

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Appendix C: Threat calculator assessments for Endangered and Threatened ACPF

Table 9. Threat calculator assessment for Pink Coreopsis.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Medium - Low	Restricted - Small	Serious - Slight	High
1.1	Housing & urban areas	Medium - Low	Restricted - Small	Serious - Slight	High
1.2	Commercial & industrial areas	Negligible	Negligible	Serious - Slight	High
1.3	Tourism & recreation areas	Negligible	Negligible	Serious - Slight	High
6	Human intrusions & disturbance	Low	Small	Serious - Slight	High
6.1	Recreational activities	Low	Small	Serious - Slight	High
7	Natural system modifications	Unknown	Small	Unknown	High
7.2	Dams & water management/use	Unknown	Small	Unknown	High
8	Invasive & other problematic species & genes	Negligible	Negligible	Extreme - Serious	High
8.1	Invasive non-native/alien species	Not Calculated			Low
8.2	Problematic native species	Negligible	Negligible	Extreme - Serious	High
9	Pollution	Low	Small	Extreme - Serious	High
9.1	Household sewage & urban waste water	Negligible	Negligible	Extreme - Serious	High
9.3	Agricultural & forestry effluents	Low	Small	Extreme - Serious	High
11	Climate change & severe weather	Low	Small	Extreme - Serious	Moderate - Low
11.1	Habitat shifting & alteration	Low	Small	Extreme - Serious	Moderate - Low

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

Table 10. Threat calculator assessment for Plymouth Gentian.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Medium - Low	Restricted - Small	Extreme - Moderate	High
1.1	Housing & urban areas	Medium - Low	Restricted - Small	Extreme - Moderate	High
2	Agriculture & aquaculture	Negligible	Negligible	Moderate - Slight	High
2.3	Livestock farming & ranching	Negligible	Negligible	Moderate - Slight	High
6	Human intrusions & disturbance	Low	Small	Moderate - Slight	High
6.1	Recreational activities	Low	Small	Moderate - Slight	High
7	Natural system modifications	Unknown	Small	Unknown	High
7.2	Dams & water management/use	Unknown	Small	Unknown	High
8	Invasive & other problematic species & genes	Low	Small	Extreme - Serious	High
8.1	Invasive non-native/alien species	Low	Small	Extreme - Serious	High
9	Pollution	Low	Small	Serious - Moderate	High
9.3	Agricultural & forestry effluents	Low	Small	Serious - Moderate	High

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

Table 11. Threat calculator assessment for Tall Beakrush.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	High - Low	Large - Small	Serious - Slight	High
1.1	Housing & urban areas	High - Low	Large - Small	Serious - Slight	High
1.2	Commercial & industrial areas	Negligible	Negligible	Serious - Slight	High
1.3	Tourism & recreation areas	Negligible	Negligible	Serious - Slight	High
7	Natural system modifications	Not Calculated			Low
7.2	Dams & water management/use	Not Calculated			Low
8	Invasive & other problematic species & genes	Not Calculated			Low
8.1	Invasive non-native/alien species	Not Calculated			Low
9	Pollution	Not Calculated			Low
9.1	Household sewage & urban waste water	Not Calculated			Low
9.3	Agricultural & forestry effluents	Not Calculated			Low

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

Table 12. Threat calculator assessment for Thread-leaf Sundew.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
3	Energy production & mining	High - Low	Large - Restricted	Extreme - Moderate	Moderate - Low
3.2	Mining & quarrying	High - Low	Large - Restricted	Extreme - Moderate	Moderate - Low
6	Human intrusions & disturbance	Low	Small	Slight	High
6.1	Recreational activities	Low	Small	Slight	High

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

Table 13. Threat calculator assessment for Eastern Baccharis.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Medium - Low	Restricted - Small	Serious - Slight	High
1.1	Housing & urban areas	Medium - Low	Restricted - Small	Serious - Slight	High
1.2	Commercial & industrial areas	Low	Small	Serious - Slight	High
1.3	Tourism & recreation areas	Negligible	Negligible	Serious - Slight	Moderate
5	Biological resource use	Negligible	Negligible	Negligible	High
5.2	Gathering terrestrial plants	Negligible	Negligible	Negligible	High
6	Human intrusions & disturbance	Low	Small	Slight	High
6.1	Recreational activities	Low	Small	Slight	High
11	Climate change & severe weather	Unknown	Pervasive	Unknown	High
11.1	Habitat shifting & alteration	Unknown	Pervasive	Unknown	High
11.4	Storms & flooding	Unknown	Pervasive	Unknown	High

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

Table 14. Threat calculator assessment for Sweet Pepperbush**.**

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Low	Small	Serious - Slight	High
1.1	Housing & urban areas	Low	Small	Serious - Slight	High
1.2	Commercial & industrial areas	Negligible	Negligible	Serious - Slight	High
1.3	Tourism & recreation areas	Negligible	Negligible	Serious - Slight	High
7	Natural system modifications	Medium - Low	Restricted	Serious - Moderate	Moderate - Low
7.2	Dams & water management/use	Medium - Low	Restricted	Serious - Moderate	Moderate - Low
8	Invasive & other problematic species & genes	Low	Large - Restricted	Slight	Moderate
8.1	Invasive non-native/alien species/diseases	Low	Large - Restricted	Slight	Moderate
8.2	Problematic native species/diseases	Unknown	Large - Restricted	Unknown	High - Moderate
9	Pollution	Unknown	Large - Restricted	Unknown	High - Moderate
9.1	Household sewage & urban waste water	Unknown	Large - Restricted	Unknown	High - Moderate

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

Appendix D: Threat calculator assessments for Special Concern ACPF

Table 15. Threat calculator assessment for Eastern Lilaeopsis.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Low	Small	Slight	High - Moderate
1.1	Housing & urban areas	Low	Small	Slight	High - Moderate
1.2	Commercial & industrial areas	Low	Small	Slight	High - Moderate
1.3	Tourism & recreation areas	Negligible	Negligible	Slight	High - Moderate
4	Transportation & service corridors	Not Calculated			
4.1	Roads & railroads	Not Calculated			Insignificant/Negligible
7	Natural system modifications	Negligible	Negligible		
7.3	Other ecosystem modifications	Negligible	Negligible	Extreme - Serious	Moderate
11	Climate change & severe weather	Unknown	Unknown	Unknown	Moderate - Low
11.1	Habitat shifting & alteration	Unknown	Unknown	Unknown	Moderate - Low

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

Table 16. Threat calculator assessment for Goldencrest.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Medium - Low	Restricted - Small	Serious - Moderate	High
1.1	Housing & urban areas	Medium - Low	Restricted - Small	Serious - Moderate	High
1.2	Commercial & industrial areas	Negligible	Negligible	Serious - Moderate	High
1.3	Tourism & recreation areas	Medium - Low	Restricted - Small	Serious - Moderate	High
3	Energy production & mining	Not Calculated			Low
3.2	Mining & quarrying	Not Calculated			Low
6	Human intrusions & disturbance	Negligible	Negligible	Moderate - Slight	High
6.1	Recreational activities	Negligible	Negligible	Moderate - Slight	High
7	Natural system modifications	Negligible	Negligible	Serious - Moderate	Moderate - Low
7.2	Dams & water management/use	Negligible	Negligible	Serious - Moderate	Moderate - Low
8	Invasive & other problematic species & genes	Not Calculated			Low
8.1	Invasive non-native/alien species	Not Calculated			Low
9	Pollution	Not Calculated			Low
9.3	Agricultural & forestry effluents	Not Calculated			Low

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

Table 17. Threat calculator assessment for Long's Bulrush.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Negligible	Small (1-10%)	Negligible	High
1.1	Housing & urban areas	Negligible	Small	Negligible	High
1.2	Commercial & industrial areas	Negligible	Negligible	Negligible	High
1.3	Tourism & recreation areas	Negligible	Negligible	Negligible	High
3	Energy production & mining	Not Calculated			Low
3.2	Mining & quarrying	Not Calculated			Low
4	Transportation & service corridors	Low	Small	Slight	High - Moderate
4.1	Roads & railroads	Low	Small	Slight	High - Moderate
6	Human intrusions & disturbance	Negligible	Large - Small	Negligible	High
6.1	Recreational activities	Negligible	Large - Small	Negligible	High
7	Natural system modifications	Unknown	Unknown	Unknown	High
7.1	Fire & fire suppression	Unknown	Unknown	Unknown	High
7.2	Dams & water management/use	Not Calculated			Insignificant/Negligible
8	Invasive & other problematic species & genes	Low	Large - Small	Slight	Moderate
8.1	Invasive non-native/alien species/diseases	Low	Large - Small	Slight	Moderate
8.2	Problematic native species/diseases	Unknown	Unknown	Unknown	High

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

2666 **Table 18.** Threat calculator assessment for New Jersey Rush.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Low	Small	Extreme - Moderate	Moderate - Low
1.1	Housing & urban areas	Low	Small	Extreme - Moderate	Moderate - Low
1.2	Commercial & industrial areas	Negligible	Negligible	Extreme - Moderate	Moderate - Low
1.3	Tourism & recreation areas	Negligible	Negligible	Extreme - Moderate	Moderate - Low
4	Transportation & service corridors	Low	Small	Extreme - Moderate	Moderate - Low
4.1	Roads & railroads	Low	Small	Extreme - Moderate	Moderate - Low
5	Biological resource use	Unknown	Small	Unknown	High
5.3	Logging & wood harvesting	Unknown	Unknown	Unknown	High
6	Human intrusions & disturbance	Negligible	Restricted - Small	Negligible	High
6.1	Recreational activities	Negligible	Restricted - Small	Negligible	High

2667 [a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each
2668 threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or
2669 decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds
2670 to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined
2671 (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is
2672 insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored
2673 as neutral or potential benefit.

2674 [b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species'
2675 population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

2676 [c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or
2677 three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–
2678 30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

2679 [d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in
2680 the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the
2681 past and unlikely to return, or no direct effect but limiting.

2682

Table 19. Threat calculator assessment for Redroot.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Medium - Low	Restricted - Small	Serious - Moderate	High
1.1	Housing & urban areas	Medium - Low	Restricted - Small	Serious - Moderate	High
1.2	Commercial & industrial areas	Negligible	Negligible	Serious - Moderate	High
1.3	Tourism & recreation areas	Negligible	Negligible	Serious - Moderate	High
6	Human intrusions & disturbance	Low	Small	Moderate - Slight	High
6.1	Recreational activities	Low	Small	Moderate - Slight	High
7	Natural system modifications	Medium - Low	Large	Moderate - Slight	Moderate - Low
7.2	Dams & water management/use	Medium - Low	Large	Moderate - Slight	Moderate - Low
9	Pollution	Not Calculated			Low
9.3	Agricultural & forestry effluents	Not Calculated			Low

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

2702 **Table 20.** Threat calculator assessment for Tubercled Spikerush.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Low	Restricted - Small	Moderate	High
1.1	Housing & urban areas	Low	Restricted - Small	Moderate	High
1.2	Commercial & industrial areas	Negligible	Negligible	Moderate	High
1.3	Tourism & recreation areas	Negligible	Negligible	Moderate	High
6	Human intrusions & disturbance	Low	Small	Serious - Moderate	High
6.1	Recreational activities	Low	Small	Serious - Moderate	High
9	Pollution	Not Calculated			Low
9.3	Agricultural & forestry effluents	Not Calculated			Low

2703 [a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each
2704 threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or
2705 decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds
2706 to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined
2707 (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is
2708 insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored
2709 as neutral or potential benefit.

2710 [b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species'
2711 population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

2712 [c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or
2713 three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–
2714 30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

2715 [d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in
2716 the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the
2717 past and unlikely to return, or no direct effect but limiting.

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2719

Table 21. Threat calculator assessment for Water Pennywort.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Medium - Low	Restricted	Moderate - Slight	High
1.1	Housing & urban areas	Medium - Low	Restricted	Moderate - Slight	High
1.2	Commercial & industrial areas	Negligible	Negligible	Moderate - Slight	High
1.3	Tourism & recreation areas	Negligible	Negligible	Moderate - Slight	High
6	Human intrusions & disturbance	Low	Small	Moderate - Slight	High
6.1	Recreational activities	Low	Small	Moderate - Slight	High
7	Natural system modifications	Low	Small	Serious - Slight	Moderate
7.2	Dams & water management/use	Low	Small	Serious - Slight	Moderate
8	Invasive & other problematic species & genes	Not Calculated			Low
8.1	Invasive non-native/alien species	Not Calculated			Low
9	Pollution	Unknown	Restricted	Unknown	High - Low
9.2	Industrial & military effluents	Unknown	Restricted	Unknown	High - Low

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

Appendix E: Critical Habitat maps

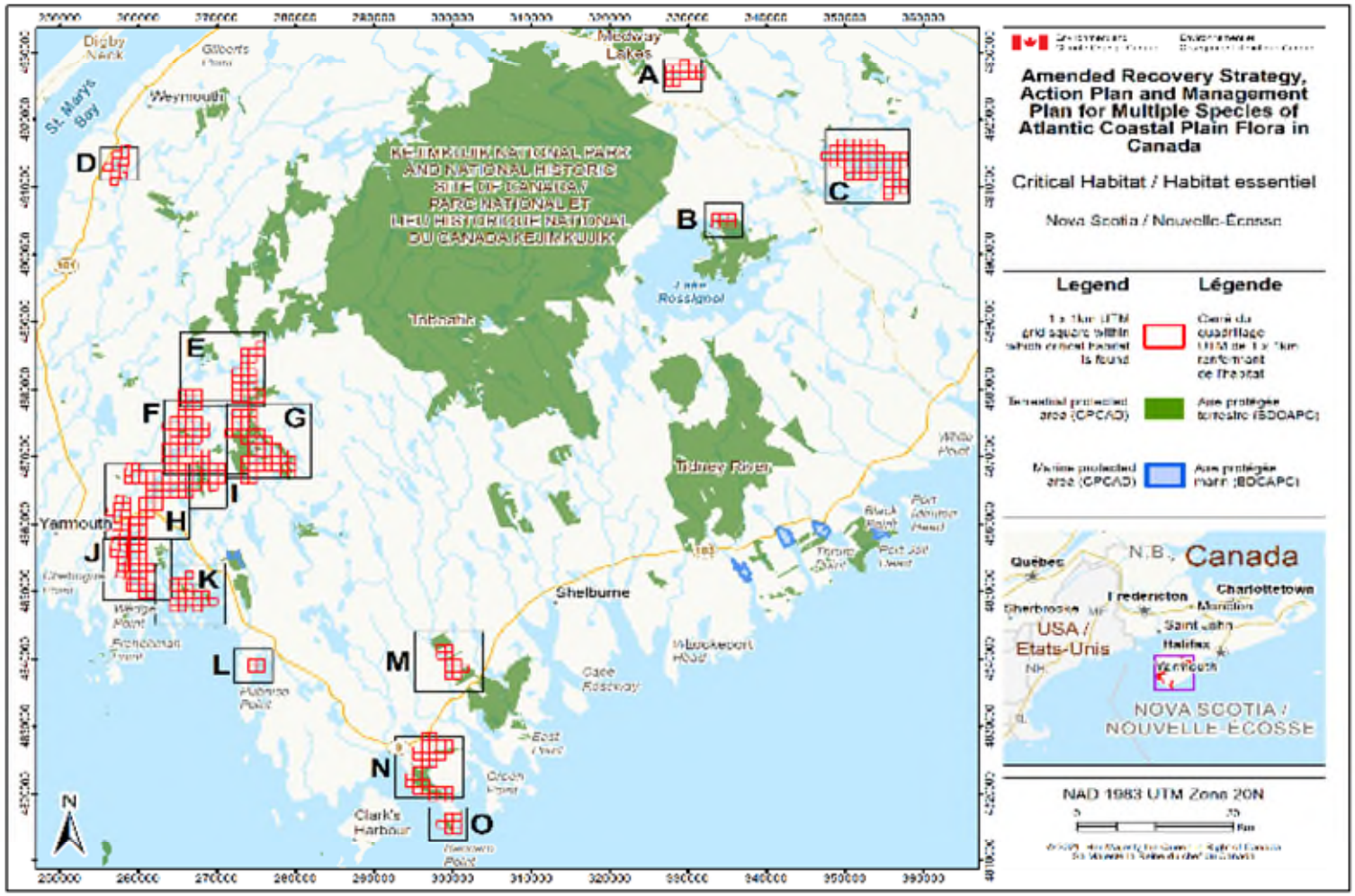

Figure 27. Overview map for all Endangered and Threatened ACPF. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found.

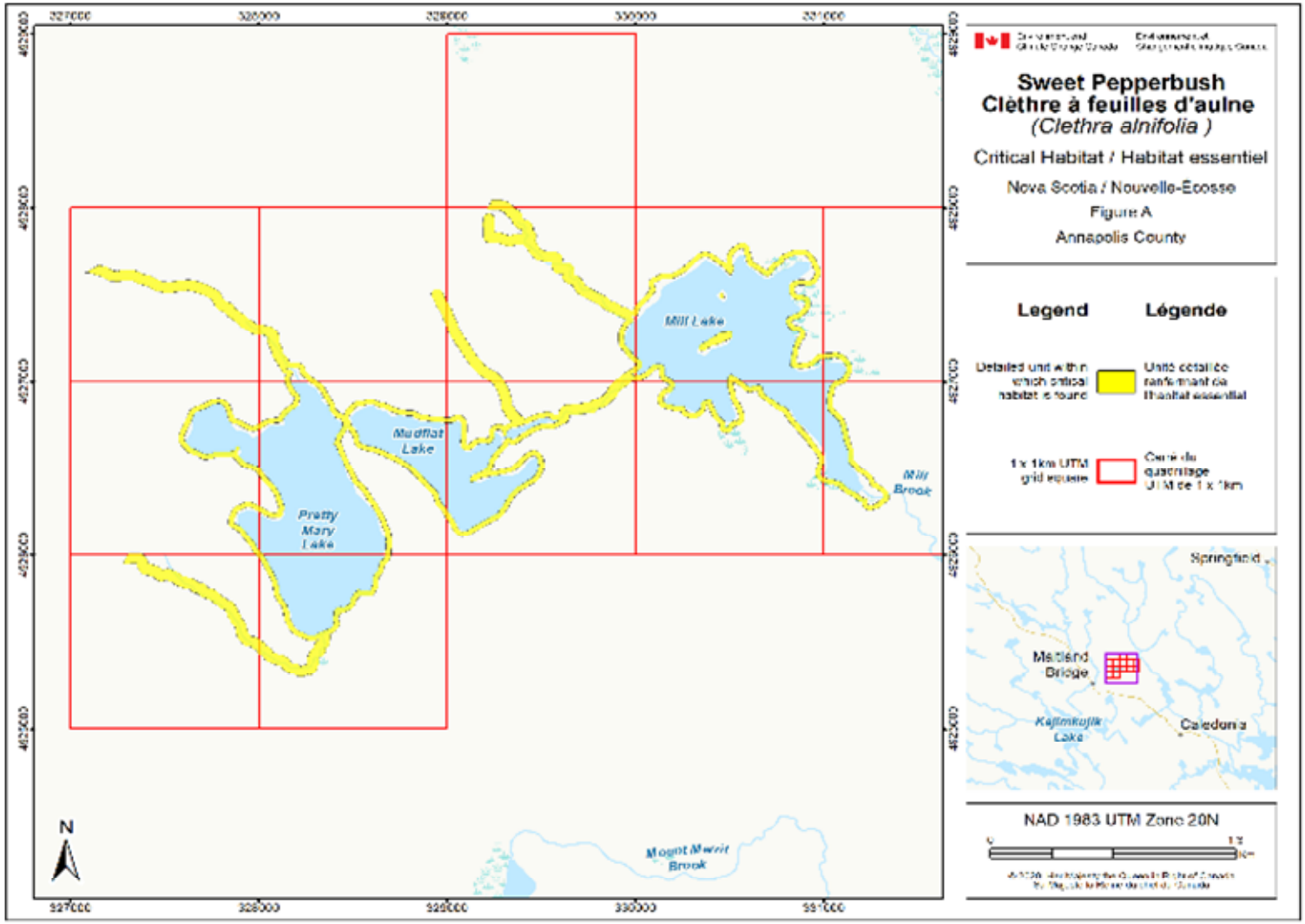

Figure 28. Critical habitat for Sweet Pepperbush in Annapolis County, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

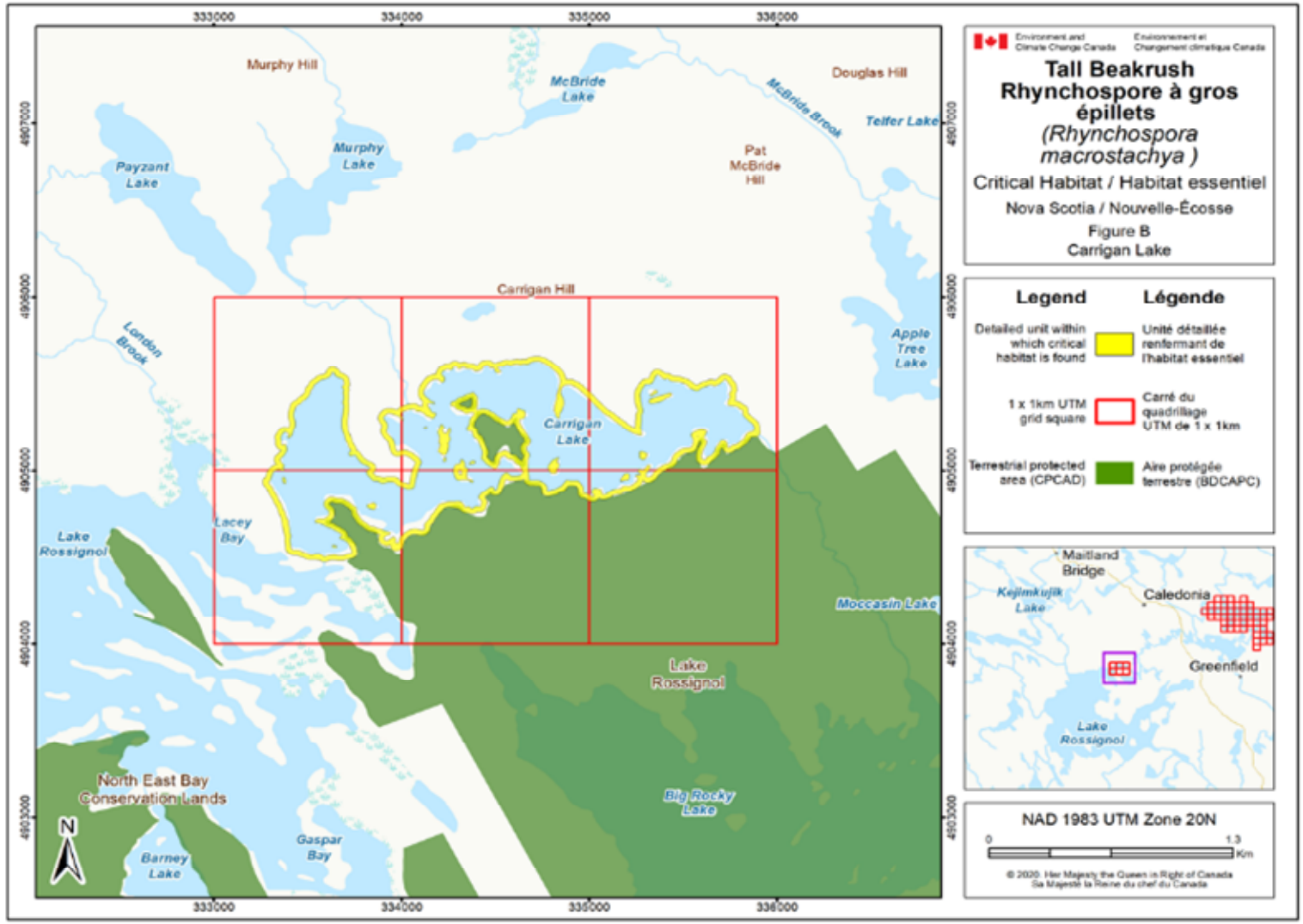

Figure 29. Critical habitat for Tall Beakrush at Carrigan Lake, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

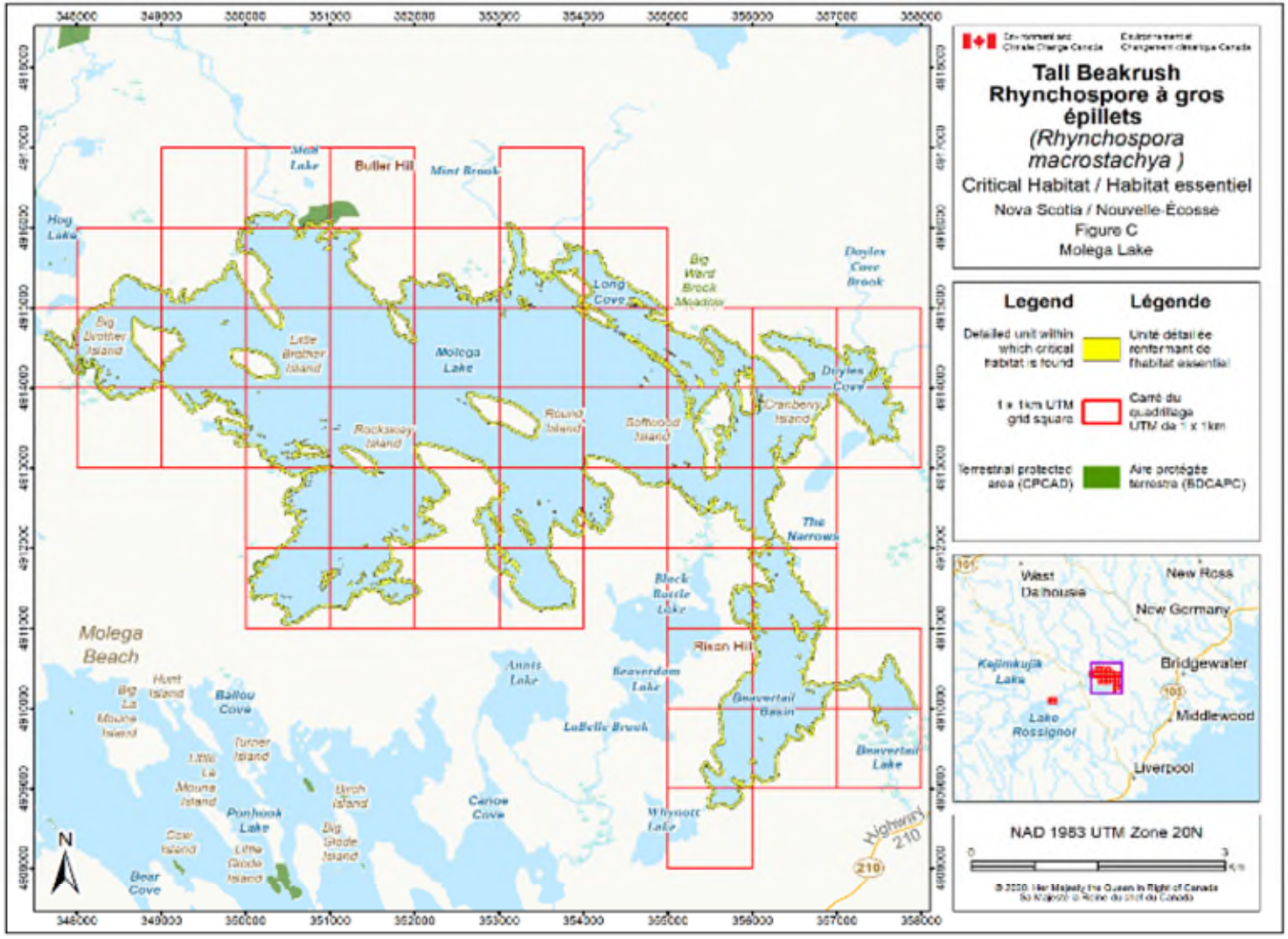

Figure 30. Critical habitat for Tall Beakrush at Molega Lake, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

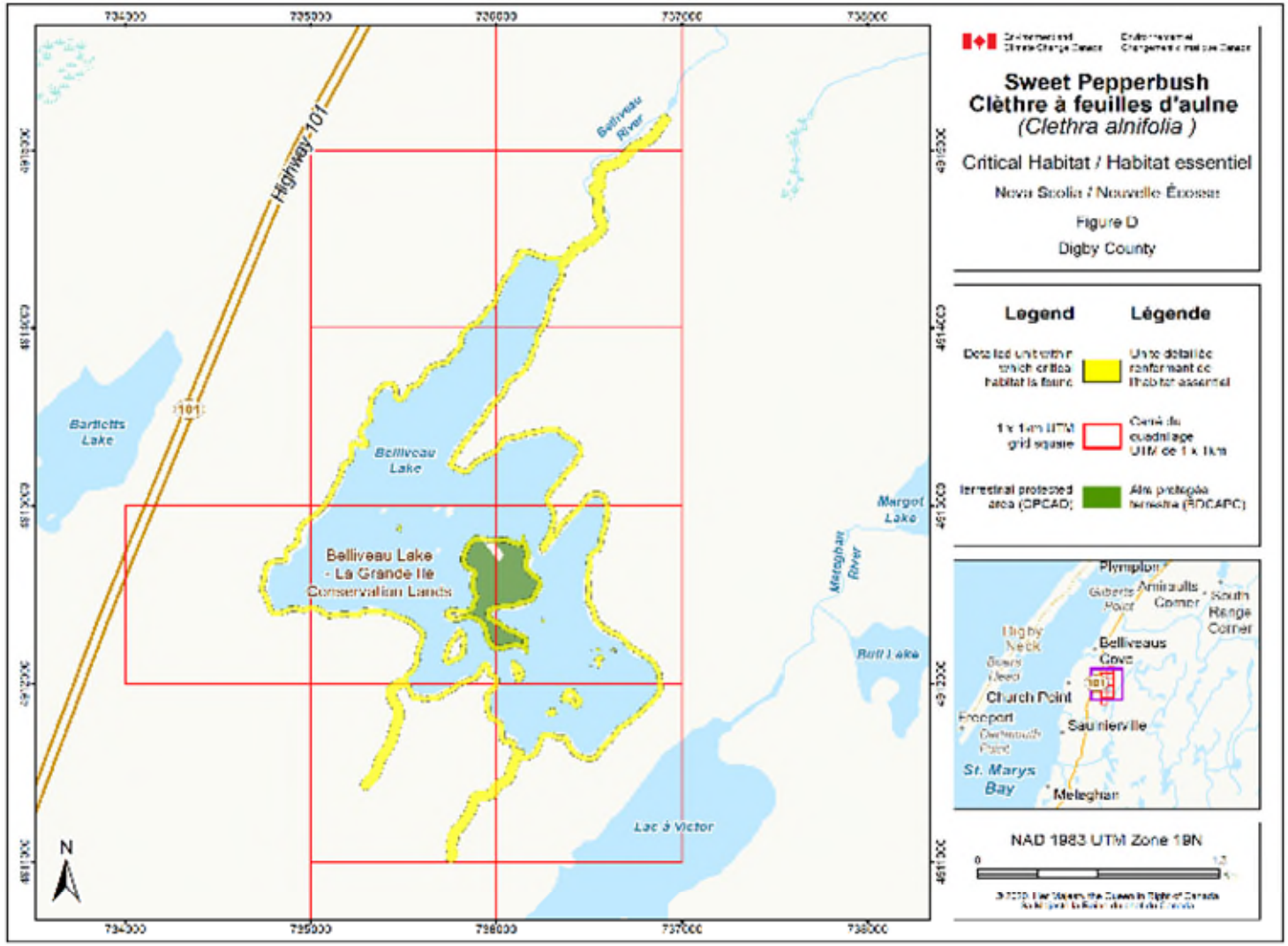

Figure 31. Critical habitat for Sweet Pepperbush in Digby County, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

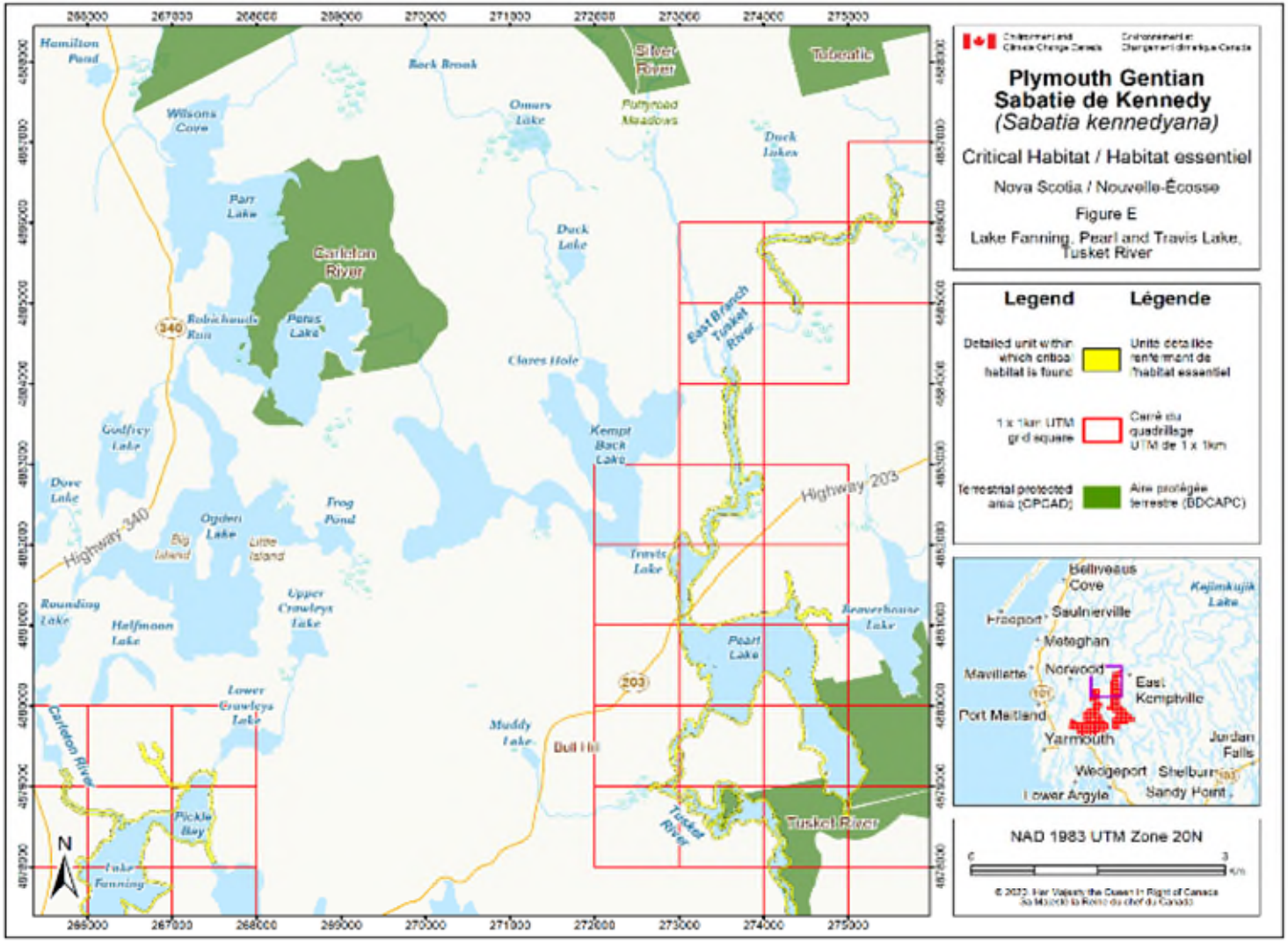

Figure 32. Critical habitat for Plymouth Gentian at Lake Fanning, Pearl Lake and Travis Lake, Tusket River, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

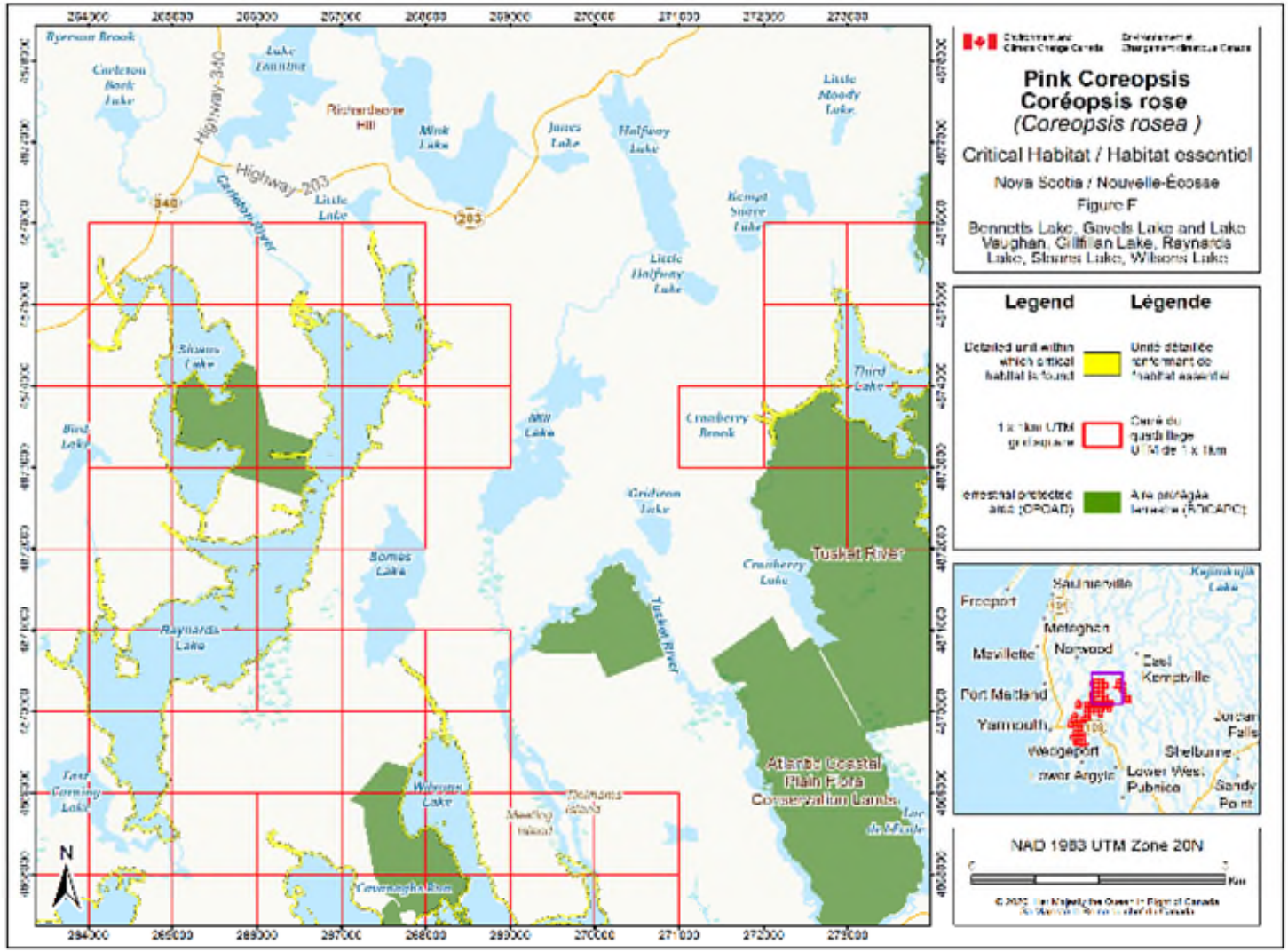

Figure 33. Critical habitat for Pink Coreopsis at Bennetts Lake, Gavels Lake and Lake Vaughan, Gilfillan Lake, Raynards Lake, Sloans Lake and Wilsons Lake, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

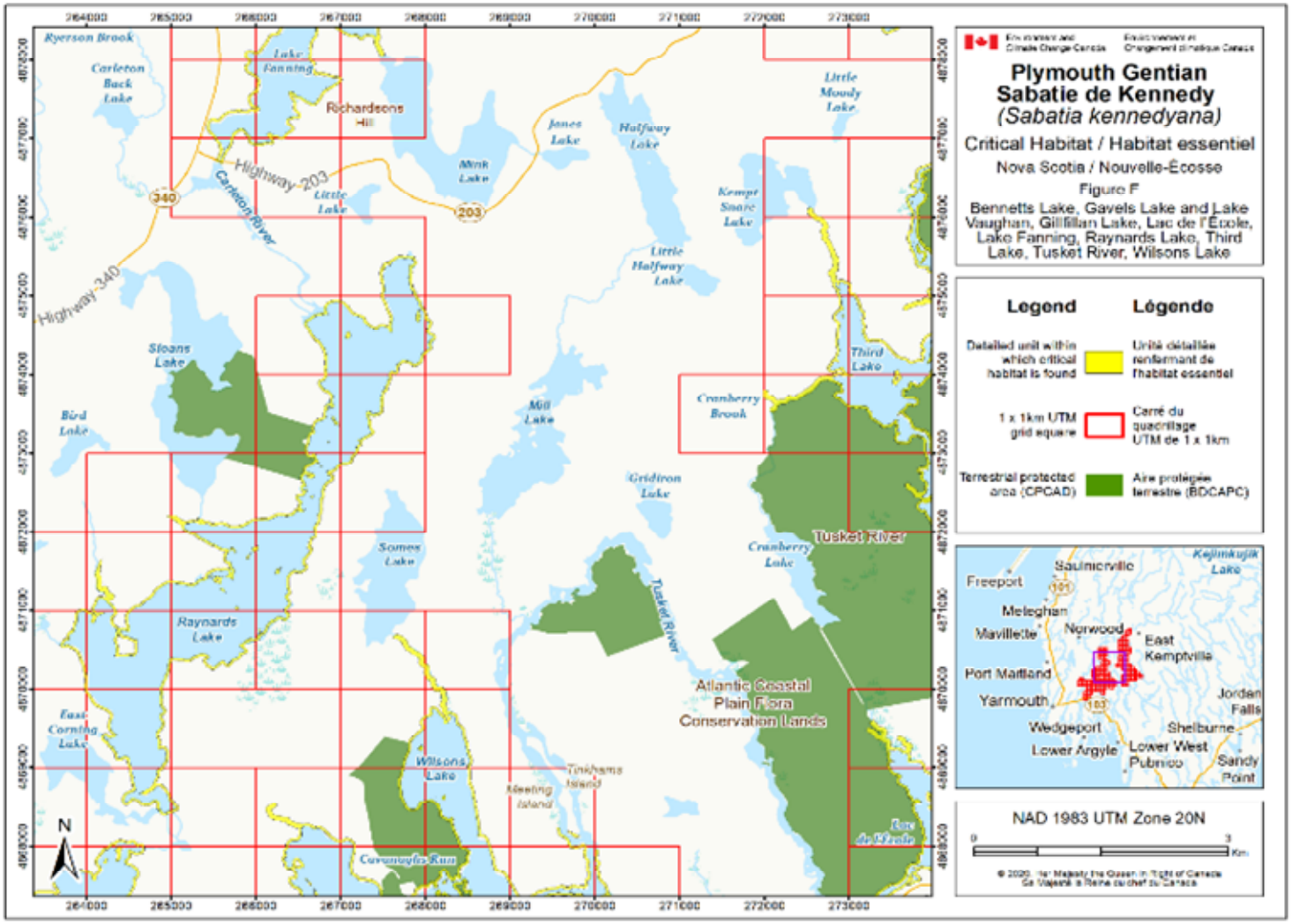

Figure 34. Critical habitat for Plymouth Gentian at Bennetts Lake, Gavels Lake, Lake Vaughan, Gilfillan Lake, Lac de l'École, Lake Fanning, Raynards Lake, Third Lake, Tusket River, and Wilsons Lake, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

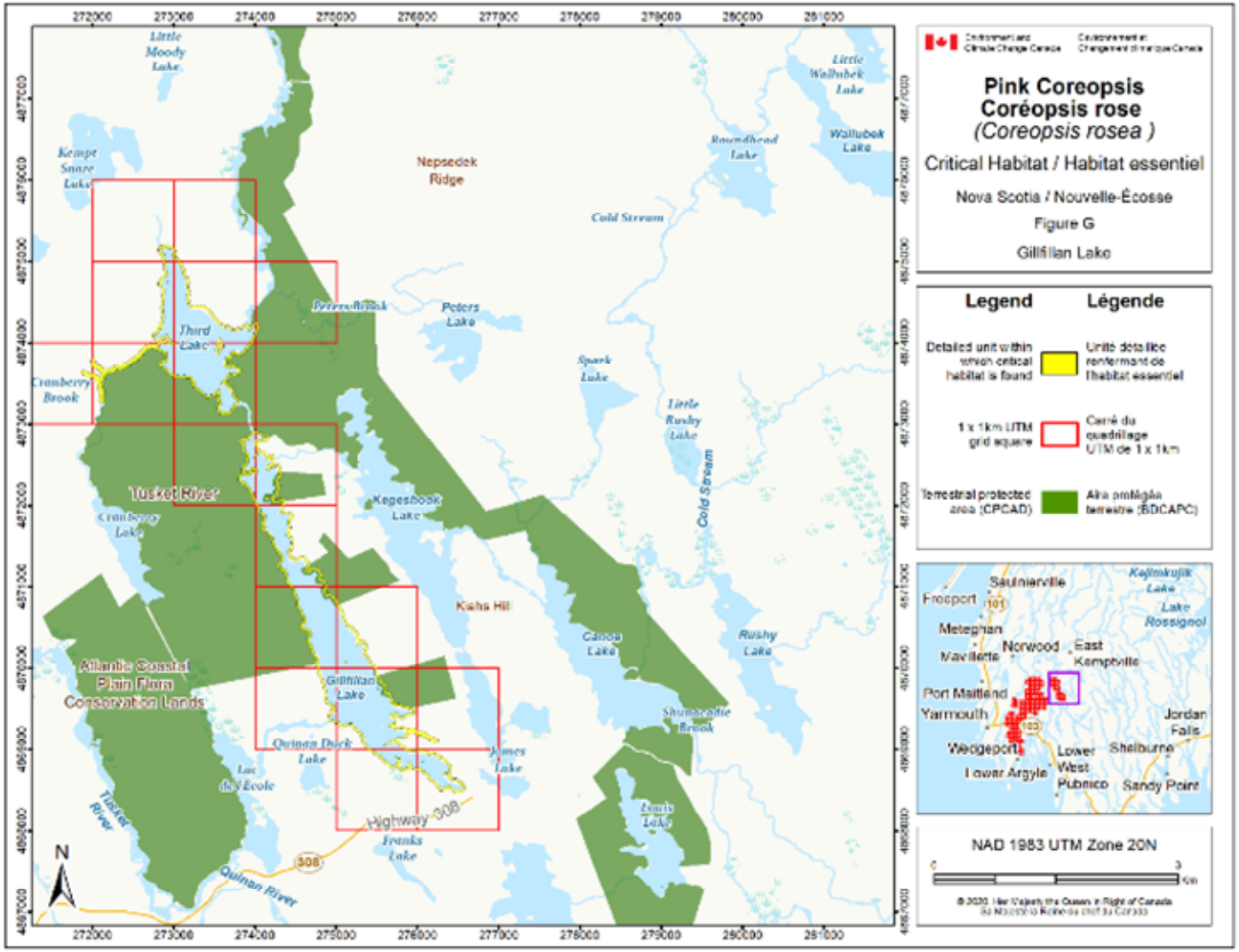

Figure 35. Critical habitat for Pink Coreopsis at Gillfillan Lake, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

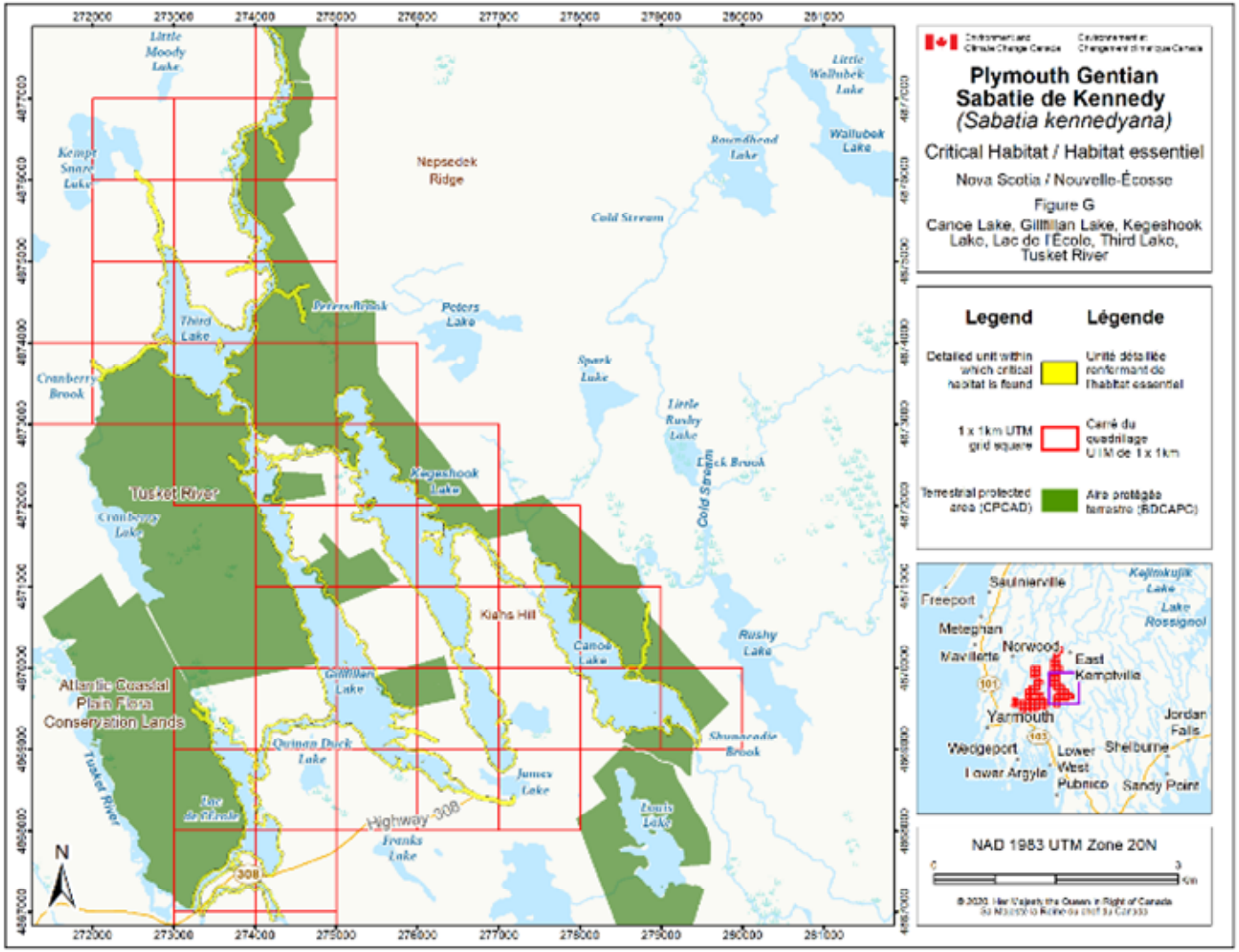

Figure 36. Critical habitat for Plymouth Gentian at Canoe Lake, Gillfillan Lake, Kegeshook Lake, Lac de l'École, Third Lake, Tusket River, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

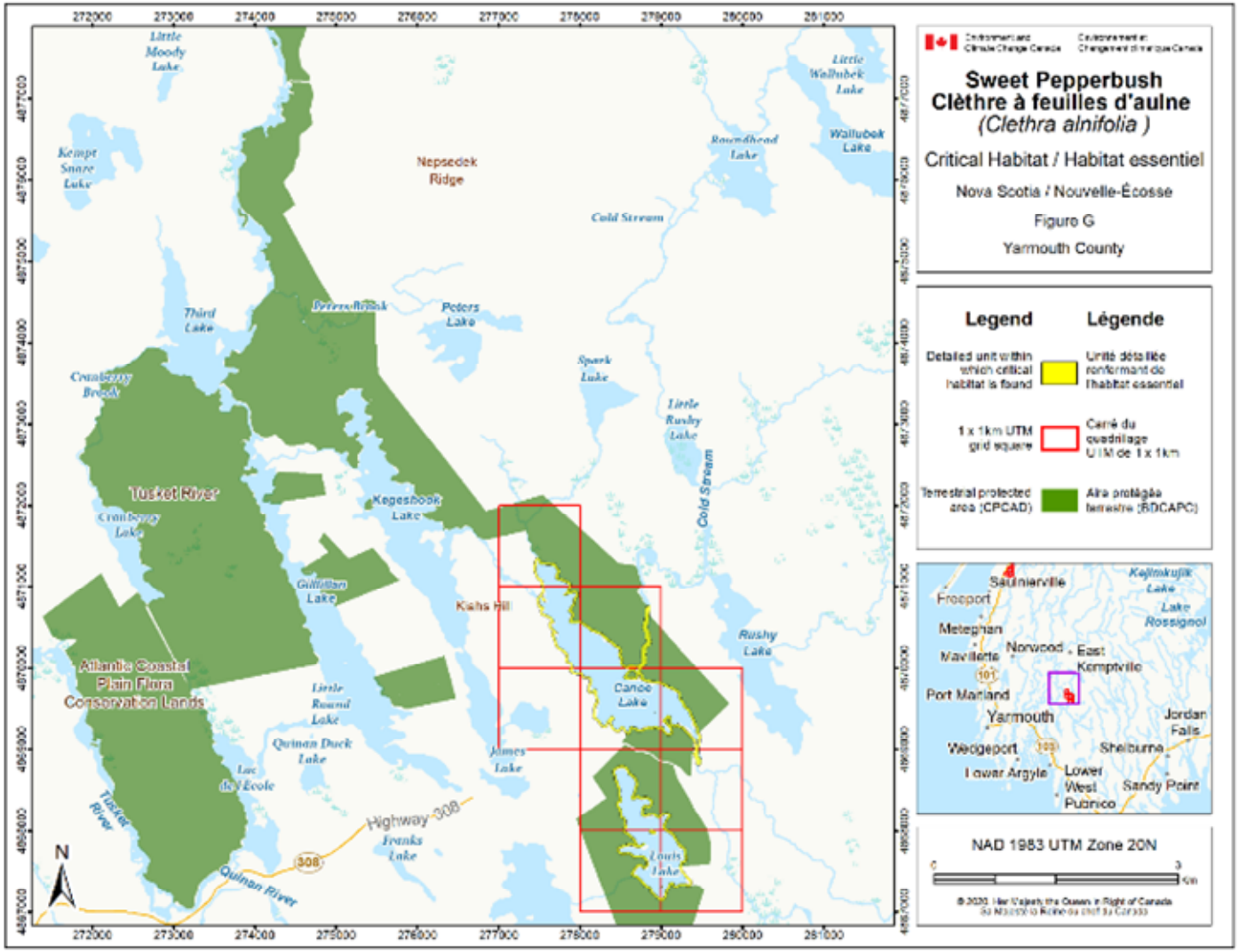

Figure 37. Critical habitat for Sweet Pepperbush in Yarmouth County, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

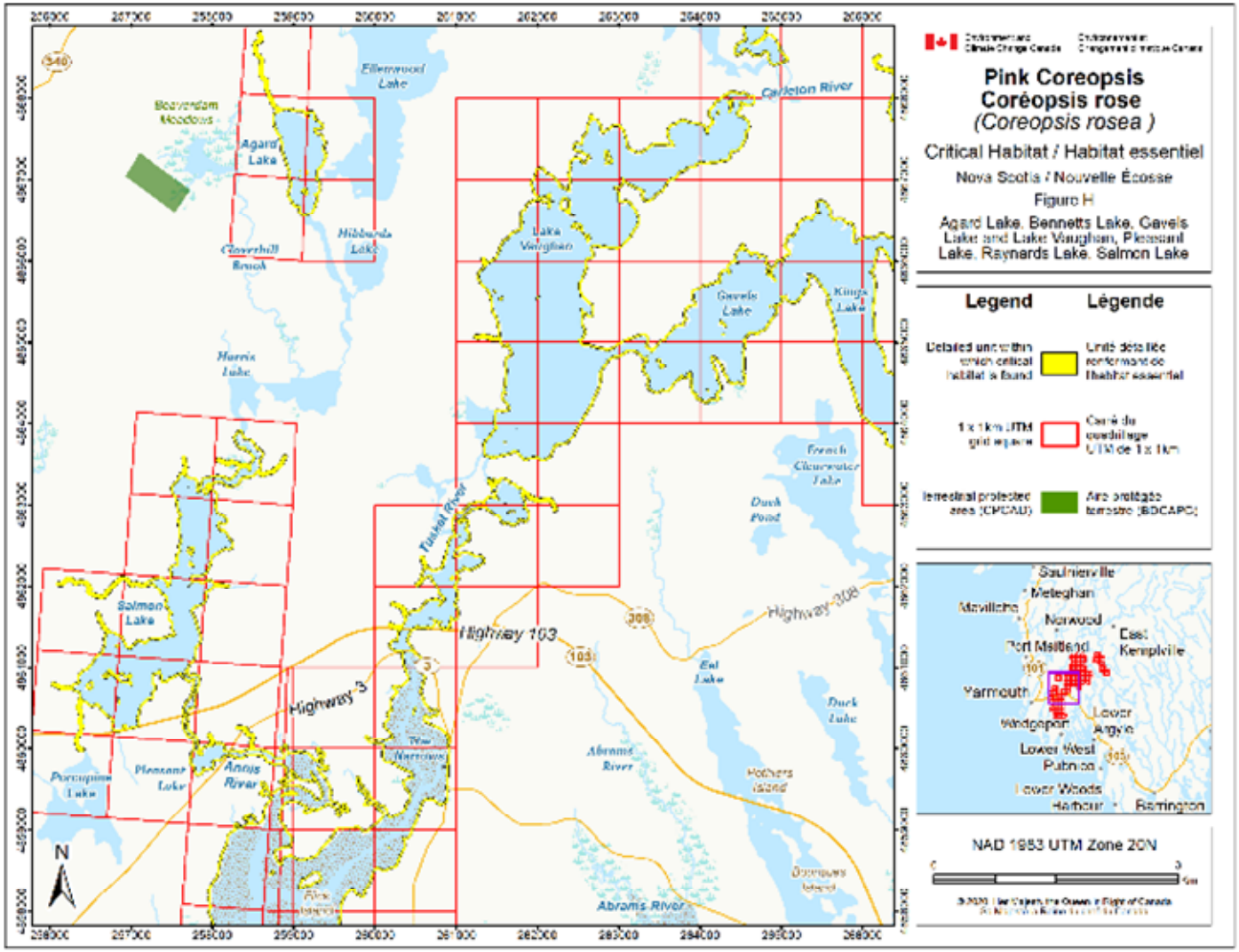

Figure 38. Critical habitat for Pink Coreopsis at Agard Lake, Bennetts Lake, Gavels Lake and Lake Vaughan, Pleasant Lake, Raynards Lake and Salmon Lake, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

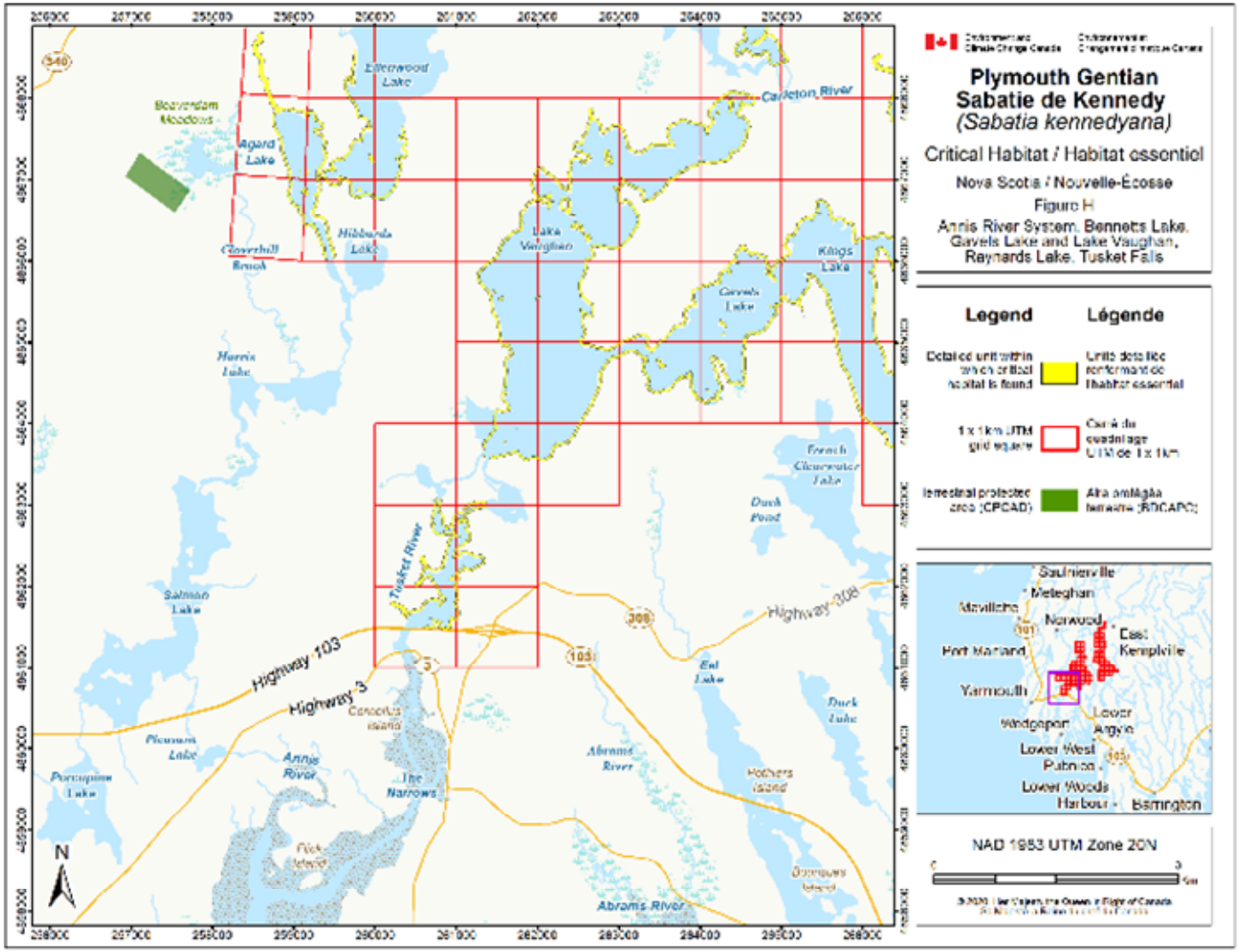

Figure 39. Critical habitat for Plymouth Gentian at Annis River System, Bennetts Lake, Gavels Lake, Lake Vaughan, Raynards Lake, Tusket Falls, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

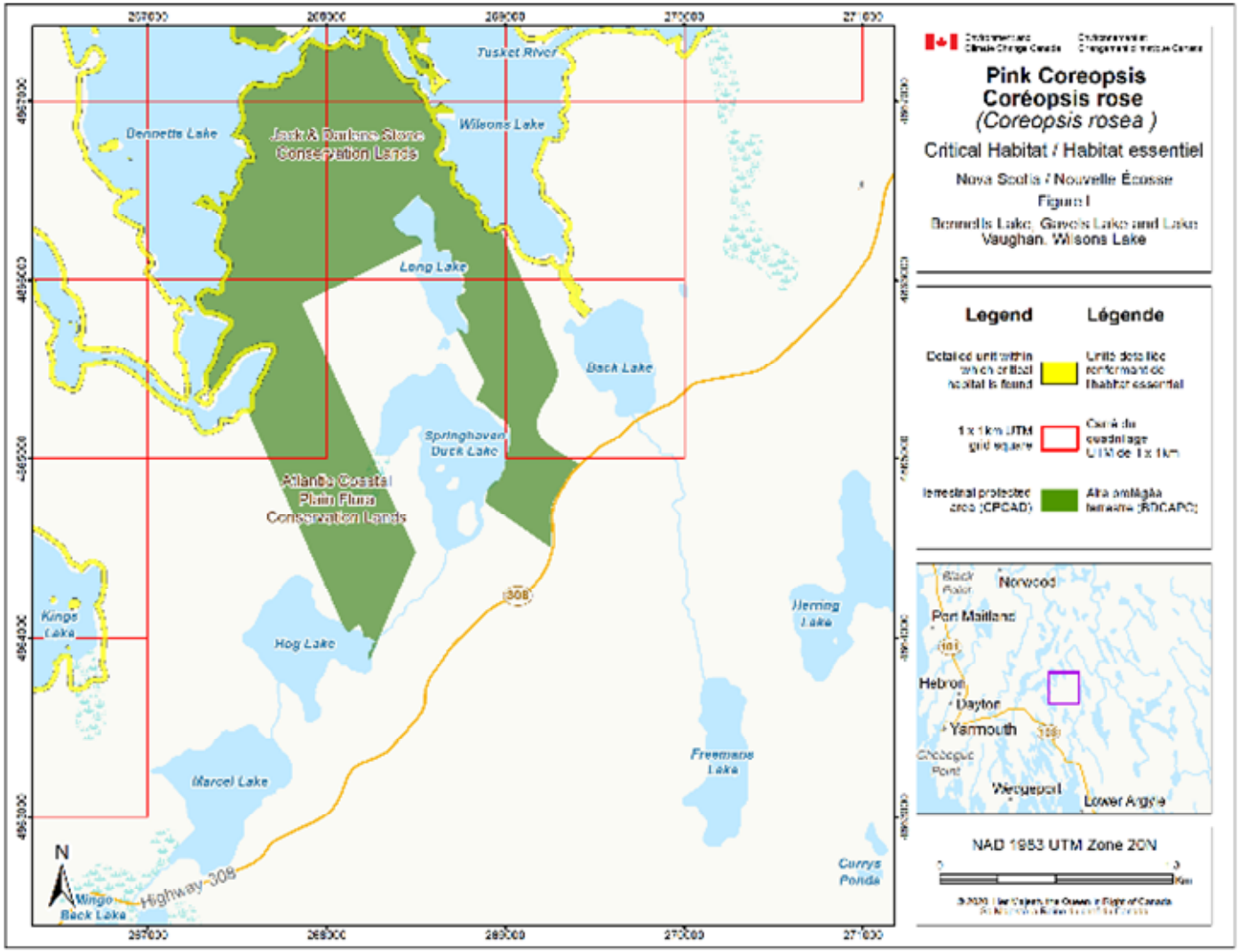

Figure 40. Critical habitat for Pink Coreopsis at Bennetts Lake, Gavels Lake, Lake Vaughan and Wilsons Lake, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

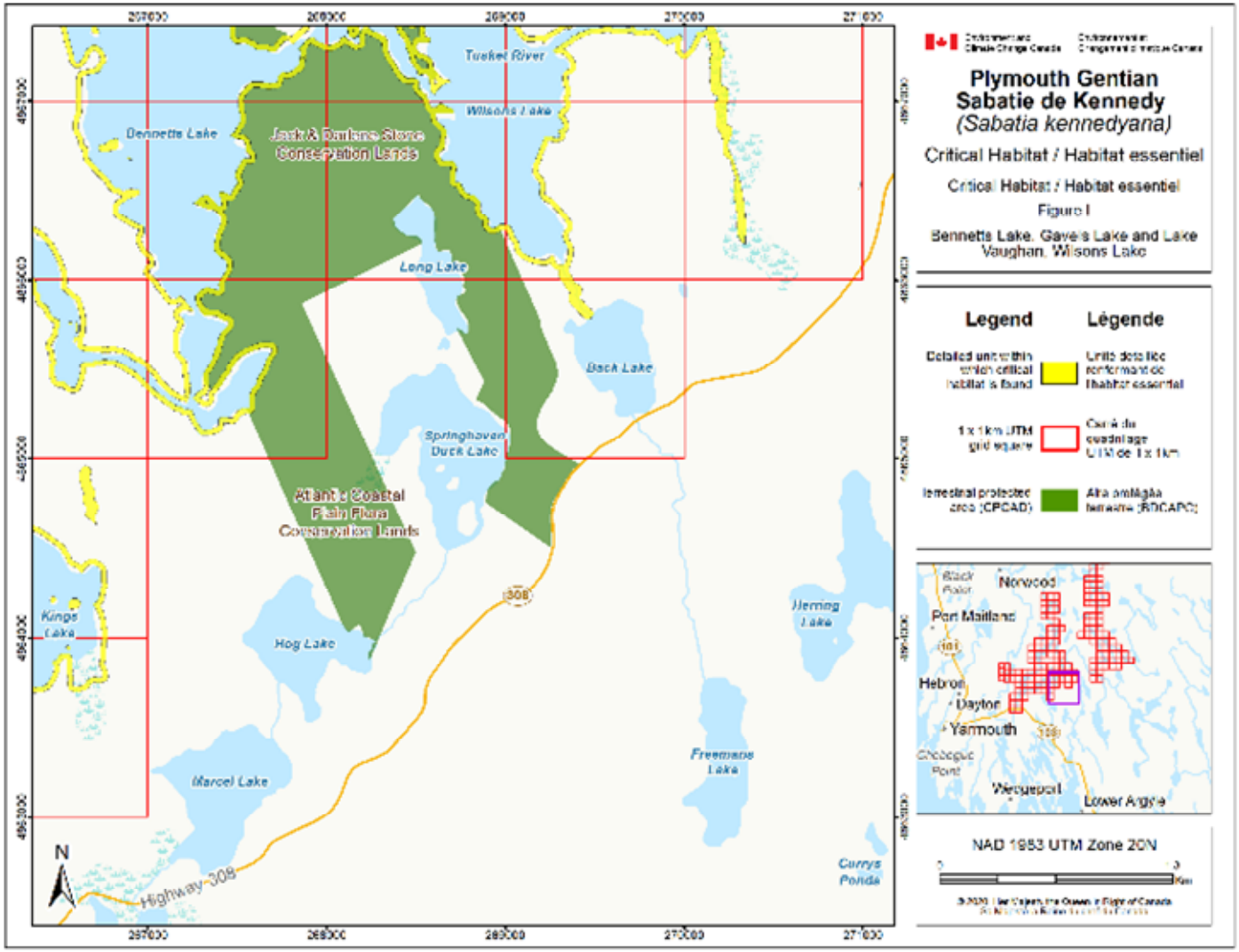

Figure 41. Critical habitat for Plymouth Gentian at Bennetts Lake, Gavels Lake, Lake Vaughan and Wilsons Lake, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

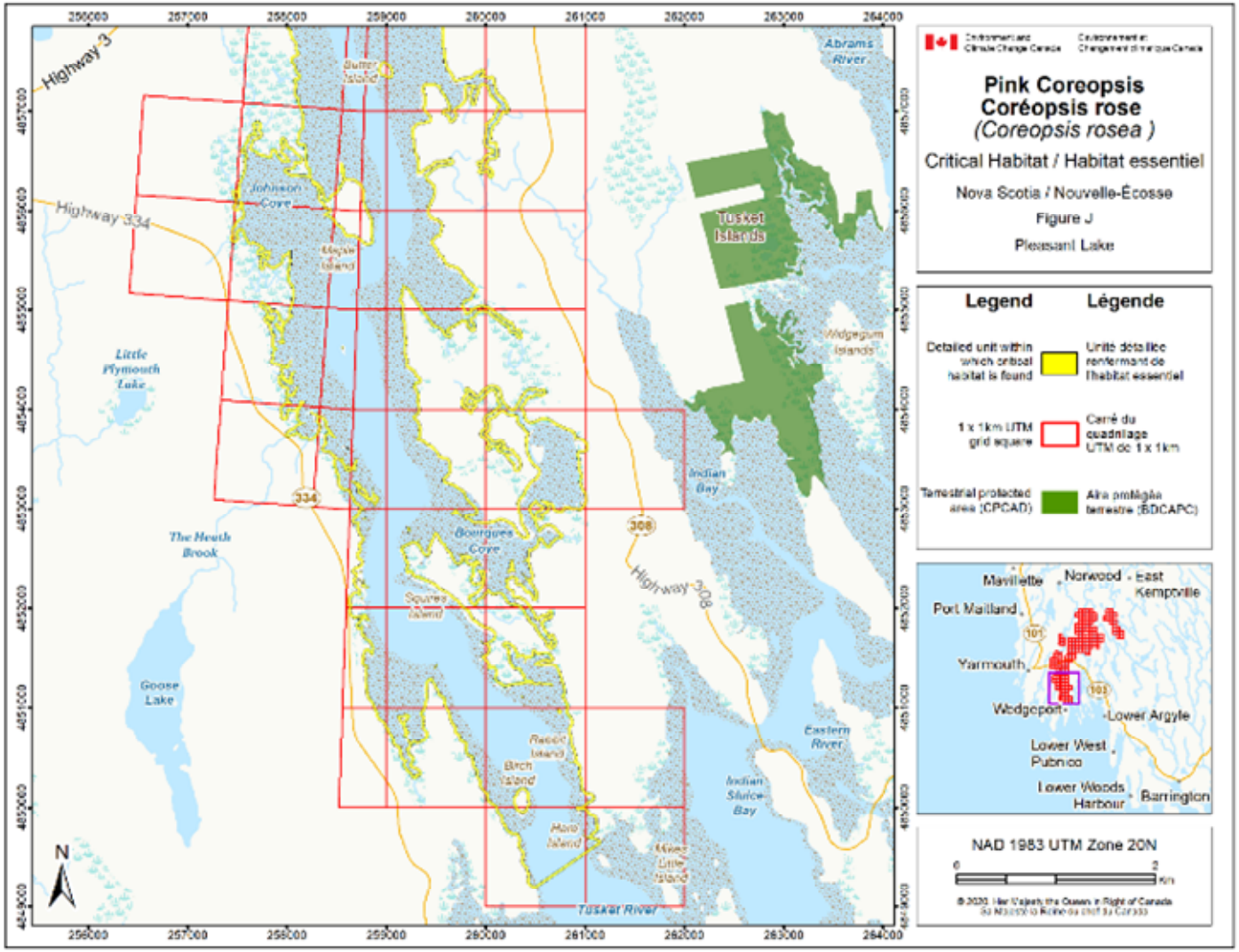

Figure 42. Critical habitat for Pink Coreopsis at Pleasant Lake, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

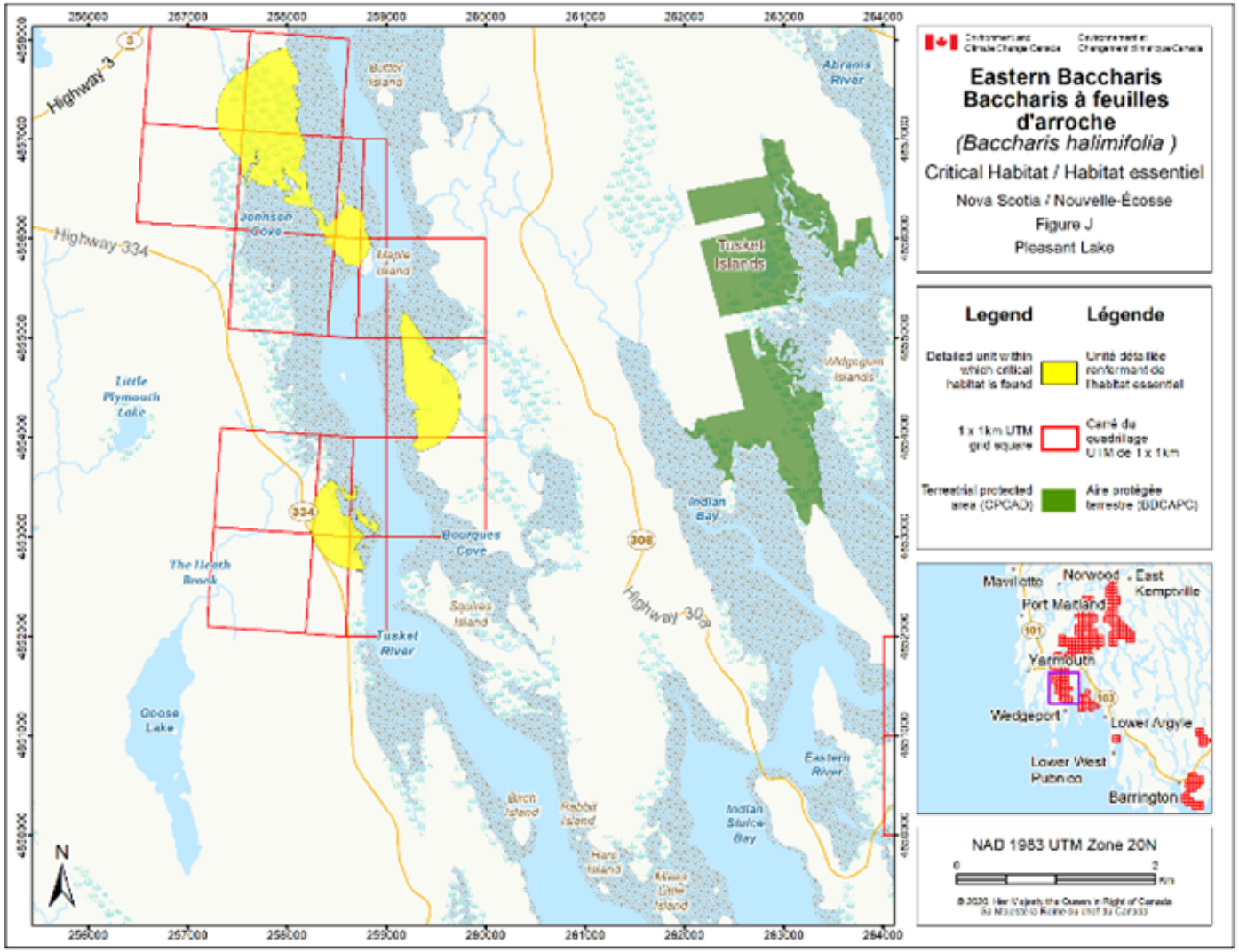

Figure 43. Critical habitat for Eastern Baccharis at Pleasant Lake, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

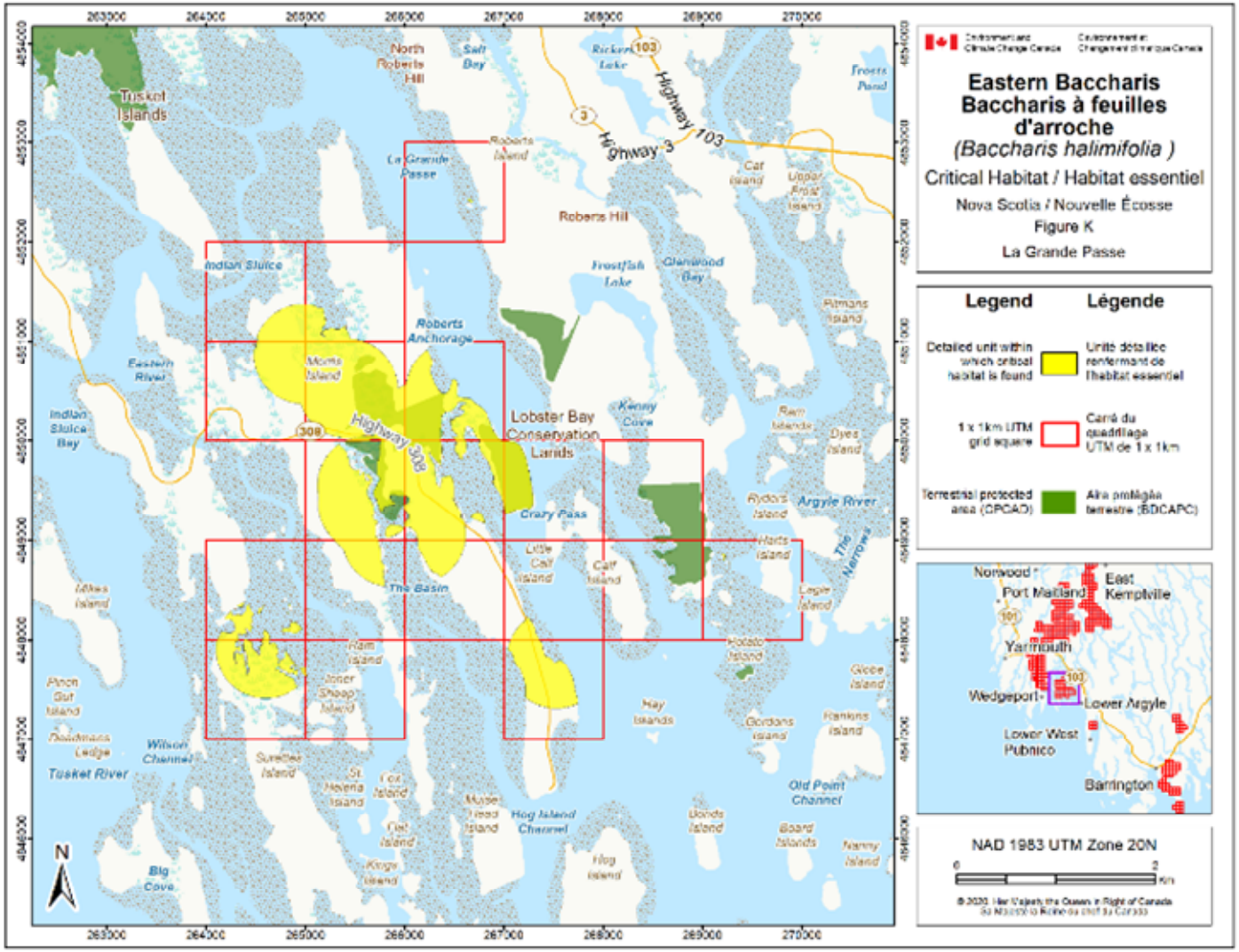

Figure 44. Critical habitat for Eastern Baccharis at La Grande Passe, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

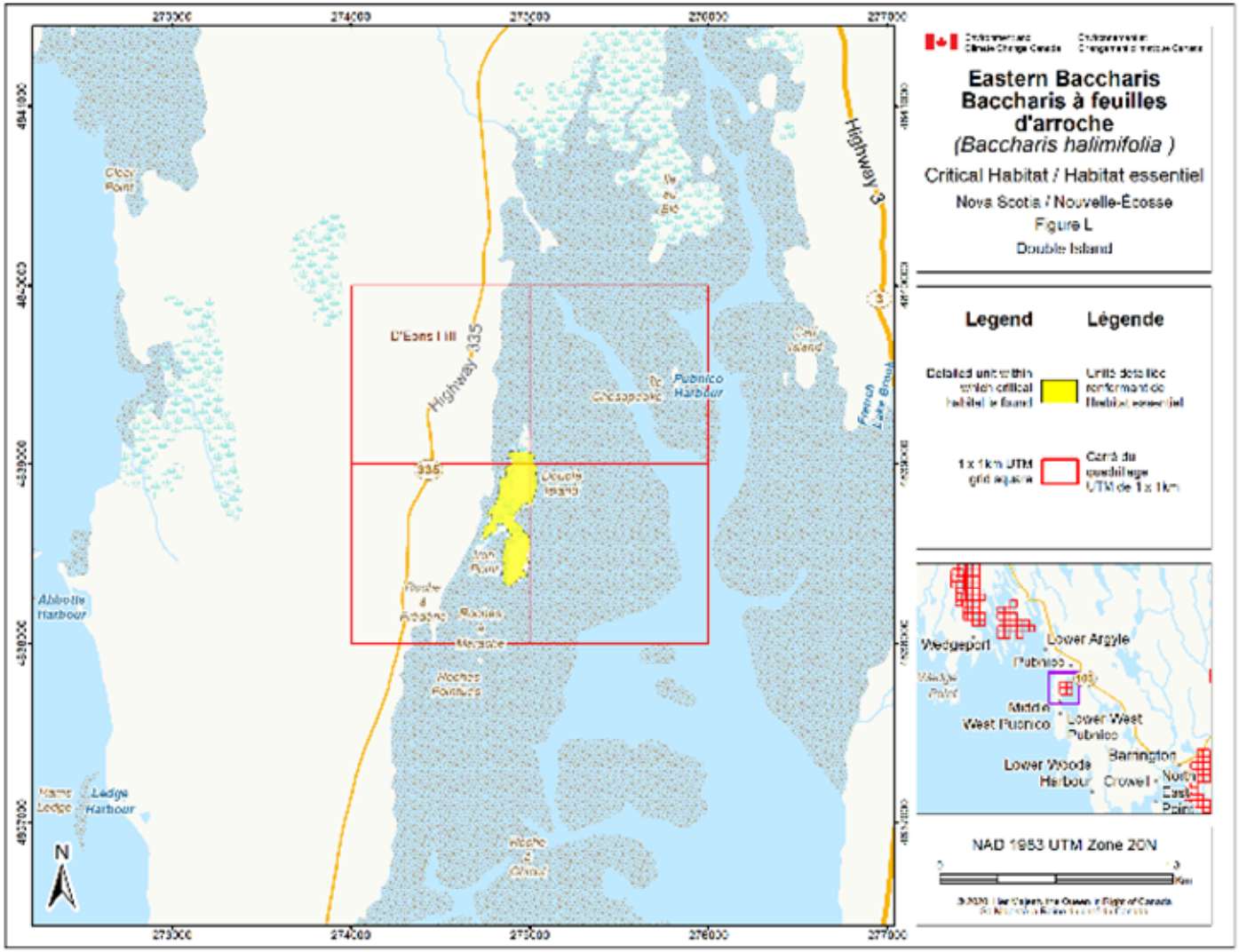

Figure 45. Critical habitat for Eastern Baccharis at Double Island, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

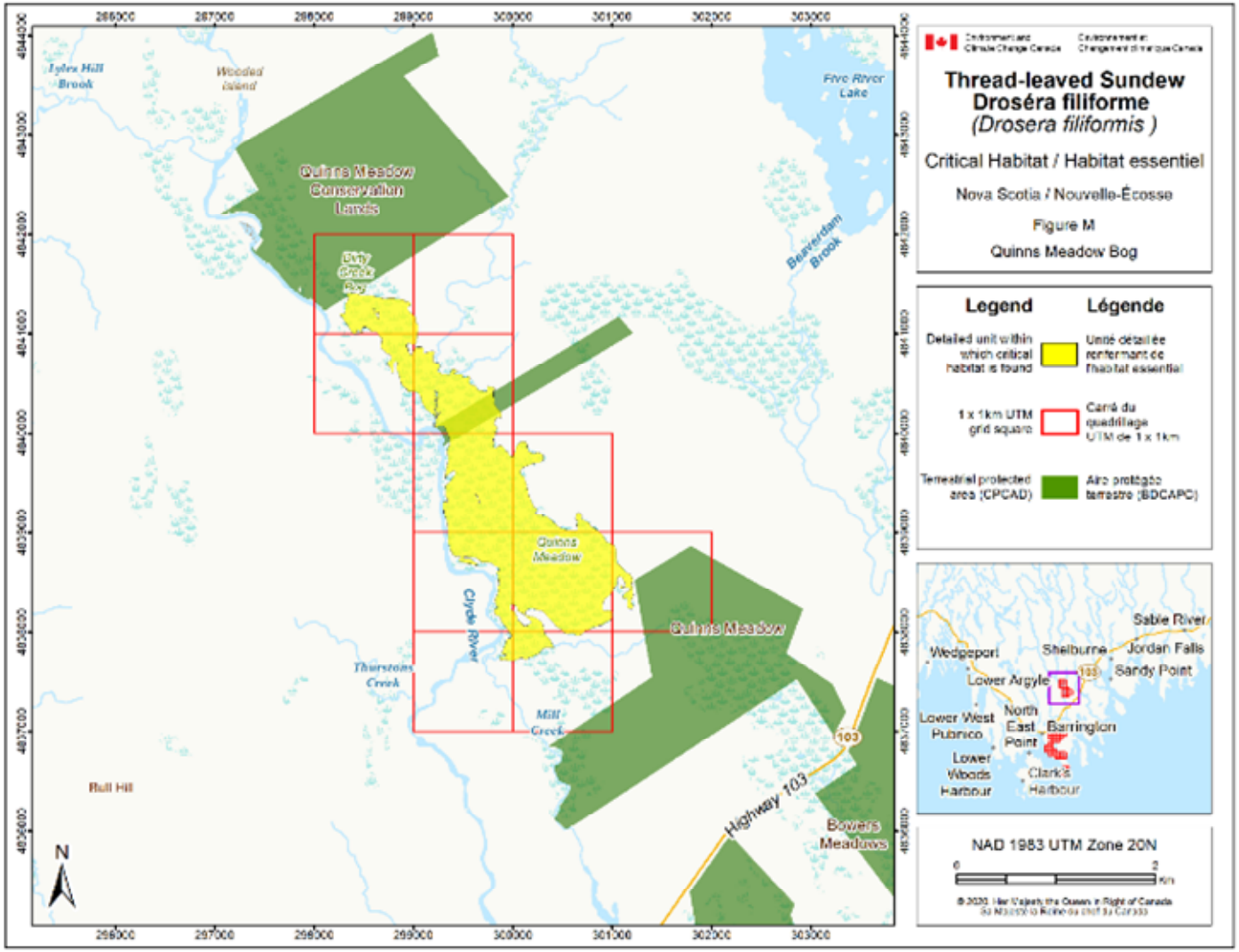

Figure 46. Critical habitat for Thread-leaved Sundew at Quinns Meadow Bog, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

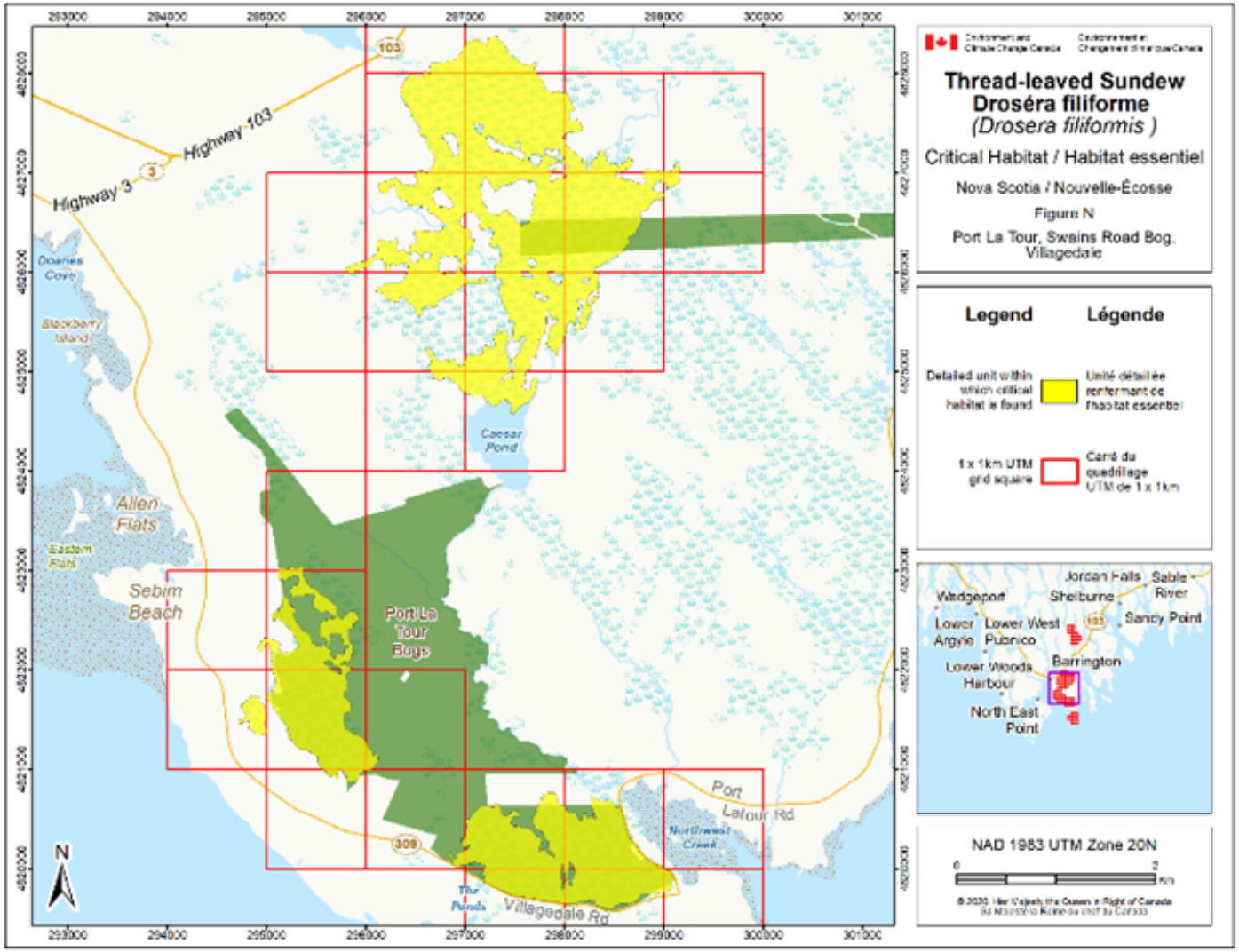

Figure 47. Critical habitat for Thread-leaved Sundew at Port La Tour, Swains Road Bog in Villagedale, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.

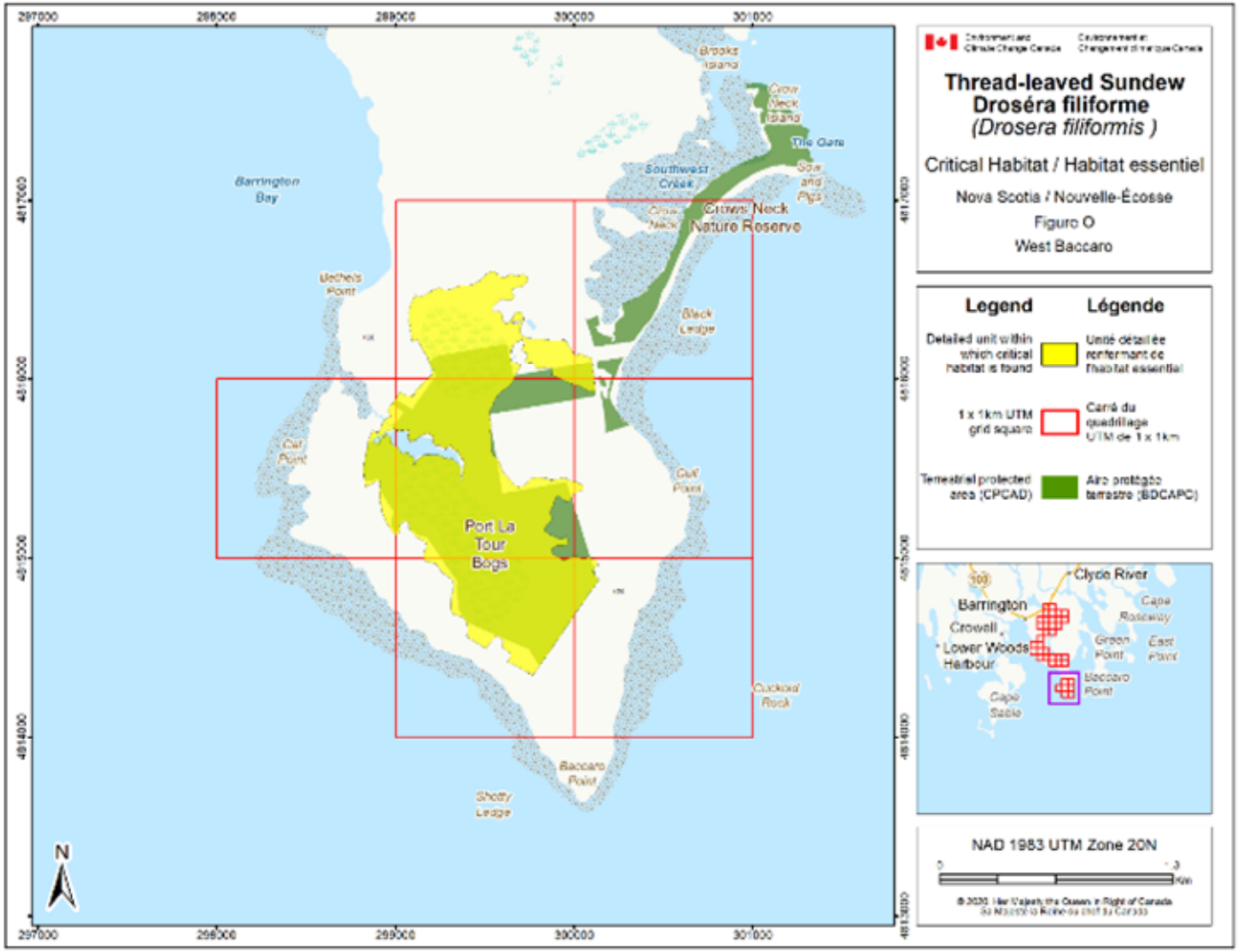

Figure 48. Critical habitat for Thread-leaved Sundew in West Baccaro, NS is represented by the yellow shaded polygon where the habitat occupancy and biophysical attributes criteria (sections 7.1.1 and 7.1.2) and methodology (section 7.1.3) set out in the recovery strategy are met. Areas outside of the shaded polygon do not contain critical habitat. The 1 x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid system used to indicate the general geographic area within which critical habitat is found. Areas outside the shaded yellow polygons do not contain critical habitat.