PROPOSED

Species at Risk Act
Recovery Strategy Series

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

Recovery Strategy
Pink Coreopsis
Thread-leaved Sundew
Water Pennywort
Goldencrest
Plymouth Gentian

Management Plan
Sweet Pepperbush
New Jersey Rush
Eastern Lilaeopsis
Tubercled Spike-rush
Redroot

2015

Government of Canada
Gouvernement du Canada
Canada

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

2015

Recommended citation:

Environment Canada and Parks Canada Agency. 2015. Amended Recovery Strategy and Management Plan for Multiple Species of Atlantic Coastal Plain Flora in Canada [Proposed]. *Species at Risk Act* Recovery Strategy Series. Environment Canada and Parks Canada Agency. Ottawa. 141 pp. + appendices.

For copies of the recovery strategy, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the SAR Public Registry[1].

Cover illustrations:
Atlantic Coastal Plain Flora lakeshore habitat, Tusket River, Nova Scotia; inset photos (from left) Goldencrest, Pink Coreopsis, Thread-leaved Sundew and Plymouth Gentian. Photos from the Wildlife Division, NS Department of Natural Resources (NS DNR).

Également disponible en français sous le titre
« Programme de rétablissement et plan de gestion plurispécifiques modifiés pour la flore de la plaine côtière de l'Atlantique au Canada [Proposition] »

ISBN
Cat. no

[1] http://sararegistry.gc.ca/default.asp?lang=En&n=24F7211B-1

Amended Recovery Strategy and Management Plan for Multiple Species of Atlantic Coastal Plain Flora in Canada
[Proposed]
2015

The *Recovery Strategy and Management Plan for Multiple Species of Atlantic Coastal Plain Flora in Canada* (Environment Canada and Parks Canada Agency 2010) was posted on the Species at Risk Public Registry in January 2010.

Under Sections 45 and 70 of the *Species at Risk Act* (SARA), the competent Minister may amend a recovery strategy and management plan, respectively, at any time. This 2015 Recovery Strategy and Management Plan for Multiple Species of Atlantic Coastal Plain Flora in Canada (hereafter, 'Amended Recovery Strategy') is for the purposes of:

- Amending all sections of the *Recovery Strategy and Management Plan for Multiple Species of Atlantic Coastal Plain Flora in Canada* (Environment Canada and Parks Canada Agency 2010), to reflect changes in the COSEWIC status and SARA status of species

- Amending Critical Habitat Section 2.6 of the *Recovery Strategy and Management Plan for Multiple Species of Atlantic Coastal Plain Flora in Canada* (Environment Canada and Parks Canada Agency 2010), based on updated information

In some cases, additional changes have been made to the Amended Recovery Strategy to align the document with current guidelines and templates for recovery documents.

Since 2010, when the *Recovery Strategy and Management Plan for Multiple Species of Atlantic Coastal Plain Flora in Canada* (Environment Canada and Parks Canada Agency 2010) was written, the status of species have changed, critical habitat schedule of studies have been completed, and additional critical habitat has been identified.

This Amended Recovery Strategy is being posted on the Species at Risk Public Registry for a 60-day comment period. At the time of final posting, the Amended Recovery Strategy will replace the 2010 *Recovery Strategy and Management Plan for Multiple Species of Atlantic Coastal Plain Flora in Canada* (Environment Canada and Parks Canada Agency 2010).

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Acknowledgments

This document was prepared by Samara T. Eaton, J. Sherman Boates, and Mark F. Elderkin in consultation with the Atlantic Coastal Plain Flora Recovery Team. Individual members of the Atlantic Coastal Plain Flora (ACPF) Recovery Team have assisted in the development of this document. This document builds on the 1998 ACPF Recovery Plan drafted by Ruth Newell, Donald Sam, and Nick Hill and the 2005 ACPF Recovery Strategy and Action Plan drafted by Samara Eaton, Sherman Boates, Mark Elderkin and Donald Sam. The following are thanked for their contribution to the document: NS Department of Natural Resources (NS DNR); Environment Canada; Parks Canada Agency: National Office, Atlantic Service Centre, and Kejimkujik National Park and National Historic Site staff, in particular Megan Crowley; NS Museum of Natural History; Acadia University, EC Smith Herbarium; Nova Scotia Nature Trust (NSNT); Atlantic Canada Conservation Data Centre; Tusket River Environmental Protection Association (TREPA); Southwest Nova Biosphere Reserve Association; Nova Scotia Power Incorporated. Thanks the many members of the public including cottage owners, nature lovers, hikers, and concerned citizens who have helped and continue to assist with the recovery of ACPF. Brad Toms is also thanked for his contribution to amending this recovery strategy.

Preface

Section 37 of SARA requires the competent minister to prepare recovery strategies for listed extirpated, endangered or threatened species and Section 65 of SARA requires the competent minister to prepare management plans for special concern species. For the SARA-listed species of Special Concern (Vulnerable under *NS Endangered Species Act* (NS ESA)), their inclusion in this combined recovery strategy and management plan will also serve in lieu of a separate management plan as required under SARA (Sections 65-67) and the NS ESA (Section 15). The inclusion of Long's Bulrush and Spotted Pondweed in this document will serve as a management plan for these species as required under the NS ESA (section 15).

The Province of Nova Scotia, Environment Canada, and Parks Canada Agency led the development of this document. This recovery strategy and management plan was developed in cooperation or consultation with numerous other individuals and agencies including environmental non-government organizations, industry stakeholders, aboriginal groups, and private landowners.

This recovery strategy and management plan addresses the recovery of all 13 provincially and federally legally listed ACPF species at risk, including two Endangered species: Pink Coreopsis and Thread-leaved Sundew; the three Threatened species: Water Pennywort, Goldencrest, and Plymouth Gentian; and the five species of Special Concern (Vulnerable under the NS ESA): Sweet Pepperbush, Tubercled Spike-rush, New Jersey Rush, Eastern Lilaeopsis, and Redroot. It also addresses one species listed as Endangered under the NS ESA: Eastern Baccharis and two species listed as Vulnerable under the NS ESA: Spotted Pondweed and Long's Bulrush.[2] Note that Plymouth Gentian and Water Pennywort are listed provincially as Endangered and Goldencrest and Long's Bulrush are listed provincially as Vulnerable. The range of all species at risk in this document is primarily the United States (US), with disjunct populations in Nova Scotia (NS), Canada.

A unique aspect of this multiple species recovery strategy and management plan is that, in addition to the legally listed ACPF species, it deals with species at risk assessed under the provincial general status assessment process (colour ranks) that have not yet been assessed by COSEWIC, including species for which there is insufficient information to assess their status. Other unique aspects of this document include the diversity of habitat types and threats addressed, the collaboration and coordination among three jurisdictions, the ecosystem perspective that is maintained within this document, and the challenges and opportunities associated with the primarily private land tenure within NS (approximately 70% privately owned). There are some locations on provincial crown land and some locations on federal land.

The ACPF Recovery Team developed an initial multiple species Recovery Plan in 1998. This original plan was re-evaluated and expanded upon with the completion of a new ACPF Recovery Strategy and Action Plan in 2005. With the support of the Government of Nova Scotia, this 2015 amended recovery strategy builds on the 2010 recovery strategy and management plan which in turn was developed based on the 2005 document.

[2] The 10 provincially and federally legally listed ACPF species and the three species listed under provincially will be referred to hereafter as "the legally listed ACPF species". Long's Bulrush is also listed under Schedule 3 of SARA.

Executive Summary

This Amended Recovery Strategy and Management Plan for Multiple Species of Atlantic Coastal Plain Flora in Canada updates and replaces the *Recovery Strategy and Management Plan for Multiple Species of Atlantic Coastal Plain Flora in Canada* (Environment Canada and Parks Canada Agency 2010), including the updating of critical habitat within Section 2.6.

Atlantic Coastal Plain Flora (ACPF) in Nova Scotia (NS) consists of a group of 98 taxonomically unrelated herbaceous plants including flowering plants, shrubs, and herbs. ACPF are generally small, slow growing, and occur in habitats such as lake shorelines, fens, bogs, and estuaries. They are poor competitors and therefore limited to habitats where low fertility and continuous natural disturbance minimizes competition from more aggressive but stress-intolerant herbaceous plants.

Of the 98 ACPF species, 10 are legally listed under both the *Species at Risk Act* (SARA) and the *Nova Scotia Endangered Species Act (*NS ESA*)* and a further three are listed only under the NS ESA. An additional 13 are Red (May be at Risk), 16 are Yellow (Sensitive) and 2 are Undetermined (Data Deficient) under the provincial General Status Ranks. In Canada, ACPF species are at the northern limit of their range and for many of them the Canadian distribution is restricted to the province of NS. The focus of this multiple species recovery strategy and management plan is on the two provincially and federally legally listed Endangered species, Pink Coreopsis (*Coreopsis rosea*) and Thread-leaved Sundew (*Drosera filiformis*) and the three federally Threatened species, Water Pennywort *(Hydrocotyle umbellata)*, Goldencrest (*Lophiola aurea)* [provincially Vulnerable], and Plymouth Gentian *(Sabatia kennedyana)* [provincially Endangered]. This document also addresses the five provincially and federally listed Special Concern species (Vulnerable under the NS ESA): Sweet Pepperbush *(Clethra alnifolia*), Tubercled Spike-rush *(Eleocharis tuberculosa*), New Jersey Rush *(Juncus caesariensis*), and Eastern Lilaeopsis *(Lilaeopsis chinensis*), and Redroot *(Lachnanthes caroliniana*) [provincially Threatened]; and three species listed under the NS ESA but not SARA: Eastern Baccharis *(Baccharis halmifolia)* [provincially Threatened], Spotted Pondweed (*Potamogeton pulcher)* [provincially Vulnerable] and Long's Bulrush *(Scirpus Longii)* [provincially Vulnerable] [SARA Schedule 3] (Table 1). In addition, this document addresses Tall Beakrush (*Rhynchospora macrostachya*) an ACPF species assessed as Endangered by COSEWIC, but not yet listed under SARA or the NS ESA.

ACPF species are at risk as a result of both biologically limiting factors and anthropogenic threats. Biologically limiting factors include small population sizes, range limitations, and reduced sexual reproduction capabilities. However, most threats are a result of human activities that are increasingly affecting ACPF and their habitat. The majority of threats occur in two broad categories, ‘habitat loss and degradation’ and ‘changes in ecological dynamics or natural processes’. High priority threats include cottage and residential development, shoreline alterations, nutrient pollution from animal husbandry, off-highway vehicle (OHV) use, infilling, peat mining and cranberry growing. Globally, NS contains some of the largest remaining areas of intact coastal plain habitat, which highlights the importance of maintaining NS’s ACPF habitat and species. With approximately 70% of the province being privately owned, the majority of ACPF species and locations occur on private land and thus a diversity of recovery approaches is required.

A multi-species approach was adopted for the recovery and conservation of ACPF. Although the primary focus of this recovery strategy and management plan is the 13 legally listed ACPF species, it is being developed within the context of all 98 ACPF species. This will not only aid in the recovery of the legally listed ACPF species at risk, but also prevent additional ACPF species from becoming at risk. It is anticipated that this approach will benefit non-target species, ecological processes, and the environment.

Due to the complexities involved in multiple species recovery planning, priorities were established within biologically relevant categories including species status, habitat, and threats. Within these categories, ranks of high, medium, or low priority were assigned. This is a unique approach that enables recovery objectives and approaches to be targeted towards more than one species at a time. It also facilitates the planning and ultimately the delivery of both efficient and effective recovery actions.

Critical habitat is fully identified for the five Endangered and Threatened ACPF species listed under SARA. Examples of activities likely to result in the destruction of critical habitat are outlined.

The recovery of ACPF is considered technically and biologically feasible. The general goal of this recovery strategy and management plan is to maintain persistent populations of ACPF species and their habitat in NS. In addition, recovery goals are presented for all high priority species in this document. However there are knowledge gaps that prevent the establishment of quantitative recovery goals and objectives (i.e. a lack of population and distribution data, limited information on basic biology).

This recovery strategy and management plan sets three recovery goals for all high priority ACPF species; including the 13 legally listed ACPF species, the 13 non-legally listed Red (May be at Risk) ranked species, and 2 species of Undetermined ranked.

The recovery objectives, to be carried out in the next 5-10 years, are to:

1. **Protect all populations and their habitats** at the 53 high priority lakeshores, 56 high priority bogs/fens, all medium priority lakeshores, 6 high priority estuaries and 7 high priority saltmarshes.

2. **Prevent, remove, and/or reduce threats** to species and habitats, including all high priority threats on lakeshores, at bogs/fens, and at estuaries/coastal habitats.

3. Determine and update **information on population** abundance and distribution, **habitat** availability and suitability, and **threats**.

4. Attain **information on population biology and ecological requirements** needed to support conservation and recovery.

5. Continue and/or implement **stewardship activities** at the 53 high priority lakeshores and 56 high priority bogs/fens and the medium priority lakeshores and three bogs/fens.

6. Increase **public awareness and education** pertaining to the existence, threats, and conservation value of all high priority species and their habitats.

7. Define needs and methods for implementing **restoration** for Pink Coreopsis, Water Pennywort, and Plymouth Gentian.

Approaches to recovery are outlined to achieve the recovery objectives, and are organized in three broad interrelated strategies (Information Acquisition, Management, and Stewardship). This provides a framework for future development of specific recovery actions, helps participants identify their role in the recovery process, and increases efficiency and cost-effectiveness of recovery actions. The federal SARA specific requirements for an action plan will be met in a single action plan for the ACPF that will be completed within two years of the final posting of this document on the Species at Risk Public Registry.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. Background Information

1.1 Introduction to Atlantic Coastal Plain Flora

The Atlantic Coastal Plain is a term that refers to the relatively flat land along the Atlantic Coast of the United States, from Florida to southern Massachusetts. The Atlantic Coastal Plain Flora (ACPF) refers to the group of plant species largely or entirely restricted to this region (Keddy and Rezincek 1982). Concentrations of ACPF occur outside the strict limits of the Atlantic Coastal Plain in a number of areas. Within Canada they occur to a limited degree in southwestern New Brunswick (NB), with a greater diversity in the southern Georgian Bay region of Ontario, and most extensively in southern NS.

In NS, ACPF consists of a unique suite of 98 species of taxonomically unrelated vascular plants, including both herbaceous and woody species. They are best represented in habitats in and around lakes and rivers, and in fens, bogs, saltmarshes and estuaries. There are 13 provincial and/or federal legally listed ACPF species at risk that, within Canada, occur only in the province of NS. Globally, NS has some of the most intact and best remaining habitat for these species.

ACPF are poor competitors and are therefore limited to habitats where low fertility and continuous disturbance minimizes competition from more aggressive but stress-intolerant herbaceous plants (Keddy and Wisheu 1989, Morris et al. 2002). In NS, ACPF are at the northern limit of their range and their distribution may be limited due to scarcity of suitable habitat, slow growth, and low reproductive rates (Sweeney and Ogilvie 1993). The legally 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, infilling, and alterations to natural disturbance regimes.

1.1.1 Species Addressed in this Recovery Planning Document

This recovery strategy and management plan addresses species that are legally listed and uses the best available information to provide recovery planning for species that are of high conservation concern, but have not yet been assessed for legal listing.

The focus of this document are the 13 legally listed ACPF species, including the two provincially and federally legally listed Endangered species, Pink Coreopsis (*Coreopsis rosea*) and Thread-leaved Sundew (*Drosera filiformis*) and the three federally Threatened species, Water Pennywort *(Hydrocotyle umbellata*) [provincially Endangered], Goldencrest (*Lophiola aurea*) [provincially Vulnerable], and Plymouth Gentian (*Sabatia kennedyana*) [provincially Endangered]. This document also addresses the five provincially and federally listed Special Concern species (Vulnerable under the NS ESA), Sweet Pepperbush (*Clethra alnifolia*), Tubercled Spike-rush (*Eleocharis tuberculosa*), New Jersey Rush *(Juncus caesariensis*), Redroot *(Lachnanthes caroliniana*) and Eastern Lilaeopsis *(Lilaeopsis chinensis*); and three species listed under the NS ESA but not SARA: Eastern Baccharis *(Baccharis halmifolia*) [provincially Threatened], Spotted Pondweed *(Potamogeton pulcher*) [provincially Vulnerable] and Long's Bulrush *(Scirpus longii*) [provincially Vulnerable] [SARA Schedule 3] (Table 1), as well as one species, Tall Beakrush *(Rhynchospora macrostachya*), assessed as Endangered by COSEWIC in November 2014, but not yet listed under SARA or the NS ESA.

The document also addresses ACPF species for which there is a conservation concern, but that are not legally listed. These are species that have been assigned provincial General Status ranks assessed under the Wild Species 2010 process (CESCC 2011) (herafter refered to as the provincial general status ranks or process). By explicitly including these additional species in the recovery process, this multiple species recovery strategy and management plan enables the integration of *recovery* and *conservation* of species at risk as well as the *prevention* of species from becoming at risk. This is a key element of long term recovery planning for this suite of species because should additional ACPF species be listed under SARA or NS ESA, this document will be updated to include them as legally listed ACPF species. If additional ACPF species are not legally listed, they will still benefit from the approaches outlined in this document.

Under the provincial general status process, 13 of the 98 ACPF speices are ranked Red (May be at Risk), 16 Yellow (Sensitive) and 2 Undetermined.A species is assigned an 'Undetermined' rank due to insufficient information to assess their status (Data deficient). The remaining 50 ACPF species are ranked Green (Secure). There are an additional four species that are Extirpated or Historic in NS (Purple rank). A description of each legally listed ACPF species and its needs, along with more detailed information on populations and distribution, can be found in Section 3. See Appendix 1 and 2 for the complete list of ACPF species[3] and Appendix 3 for definitions of terms and risk categories.

The list of NS's ACPF (Appendix 1 and 2) includes all species that have been added since the 2005 and 2010 Recovery Strategies (ACPF RT 2007 and EC and PCA 2010). Species that were candidates for inclusion on the ACPF list, but had not previously been examined by the Recovery Team were reviewed in 2007 and in 2012 Species were added to the list if they met at least two of the following three criteria (Blaney, pers. comm. 2007):

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

[3] Appendix 1 provides information on the provincially and federally legally listed ACPF species, the non-legally listed Red (May be at Risk), Yellow (Sensitive) species, the Undetermined species and the Purple (Historic/ Extirpated) rank species. Appendix 2 provides information on the Green (Secure) species.

Table 1: The 13 legally listed Atlantic Coastal Plain Flora species and the one additional species assessed by COSEWIC but not yet legally listed.

Common Name	COSEWIC[a] Status & Year		SARA[b]	NS ESA[c] Status & Year		Global Rank	Estimated Population	Summary of Rationale for Status
Pink Coreopsis	E	1984 (2000, 2012)	E	E	2000	G3	> 6,000 flowering plants 276,600 to 328,000	A shoreline species with a limited geographic range and significant decline in range in NS. It is found along the shorelines of 8 lakes where it reproduces mainly vegetatively. It is subject to continued threats from development of recreational properties.
Thread-leaved Sundew	E	1991 (2001)	E	E	2000	G4	Unknown (likely tens of 1000's)	Peat bog species occurring in 5 sites highly disjunct from the main range of the species and subject to on-going risk of new developments such as peat extraction and cranberry farming.
Plymouth Gentian	E	1984 (2000, 2012)	T	E	2001	G3	73,400 to 90,700 flowering stems	A shoreline species disjunct from its main range and found at 11 lakes. These populations are subject to continued threat from recreational land use and development and increased nutrients due to animal husbandry (i.e. mink farming).
Eastern Baccharis	T	2011	T[5]	T	2013	G5	2850	Small, restricted and highly disjunct (400+ km from northern Massachusetts) population on saltmarsh margins in southernmost Nova Scotia, where rising sea levels and development could threaten habitat.
Sweet Pepperbush	T	1986 (2001, 2001, 2014)	SC	V	2000	G5	Unknown <51,870 stems (far fewer genetic individuals)	A disjunct and vigorous clonal species found only along the shores of 6 lakes. Invasive Glossy Buckthorn, habitat destruction from cottage development, and possibly nutrient enrichment from an inactive hog farm undergoing conversion to mink farming are threats. Uplisted from Special Concern in 2014..
Tubercled Spike-rush	SC	2000 (2010)	SC	V	2013	G5	3,000-4,000 plants	Highly localized species disjunct in NS; occurs at 5 sites covering small areas of lakeshore habitats. Populations are threatened by recreational activities, cottage development and water pollution.
Water Pennywort	SC	1985 (1999, 2000, 2014)	T	E	2001	G5	231,000+ plants	A disjunct, primarily clonal species, found along the shorelines of only 3 lakes two of which are subjected to heavy recreational use. Downlisted from Endangered in 1998.
New Jersey Rush	SC	1992 (2004)	SC	V	2001	G2	~ 5,000 - 10,000 plants	A disjunct, globally rare species, found along the periphery of 30 bogs and fens in southeastern Cape Breton Island, NS. This comprises a large proportion of the global population. It is sensitive to activities that alter the hydrologic regime such as logging, road construction, and infilling.

Common Name	COSEWIC[a] Status & Year		SARA[b]	NS ESA[c] Status & Year		Global Rank	Estimated Population	Summary of Rationale for Status
Redroot	SC	2000 (2009)	SC	V	2013	G4	>5,000 vegetative & flowering plants	Range restricted in NS to the shorelines of 6 lakes. Limited sexual reproductive potential and considerable threats from on-going development of the shoreline habitat.
Eastern Lilaeopsis	SC	1987 (2004)	SC	V	2006	G5	130,000-187,000 mature plants	Small perennial herb present in 5 estuaries in NS with the area of occupancy very small, but the population large. No significant declines in the last 15 years. Threats do not appear imminent; however, future shoreline development or degradation could destroy extant populations.
Goldencrest	SC	1987 (2000, 2012)	T	V	2013	G4	>300,000 individuals	A disjunct species at the northern edge of its range reproduces mainly vegetatively. It is present in only a few lakeshore and wetland habitats subject to continued threats from development and habitat alteration.
Spotted Pondweed	-	2014	-	V	2013	G5	unknown	A freshwater aquatic plant found in highly acidic, nutrient poor wetlands in only 16 populations in NS. Threats include activities that change water quality or quantity.
Long's Bulrush	SC	1994	-	V	2001	G2G3	unknown (many thousands of rosettes, but likely quite low number of genetic individuals)	A globally rare, slow growing perennial species restricted in Canada to southwestern Nova Scotian wetlands and lakeshores. Sexual reproduction is very limited in NS.
Tall Beakrush	E	2014	Not yet listed		Not yet listed	G5	688	A shoreline species with a very small number of individuals, restricted to two lakes, with one site being highly susceptible to near-future cottage development, and the other also having some potential for future development.

[a] COSEWIC Status: E = Endangered, T = Threatened, SC = Special Concern; status was re-examined in years in brackets
[b] **SARA Status: E= Endangered, T = Threatened, SC = Special Concern**
[c] NS ESA Status: E = Endangered, T = Threatened, V = Vulnerable

1.1.2 Ecological Role

All legally listed ACPF species are at the northern limit of their distribution in NS and are disjunct from the rest of their range along the eastern seaboard of the US. Species at the edge of their distribution may be genetically and/or morphologically distinct. Genetic research has been completed on Pink Coreopsis (Woods 2006), Thread-leaved Sundew (Cody 2002), and Plymouth Gentian (Sutton 2007), but the extent of genetic isolation and variability from the US populations is not yet clear. Further work is required to understand the rangewide significance of the genetic diversity of Nova Scotian ACPF populations.

In general, NS has a small percentage of the global range of each species; however ACPF habitats in NS are considered some of the most intact in the world. Populations in the US are experiencing mounting pressure from development, resulting in major habitat losses. For several species, such as the New Jersey Rush and Long's Bulrush, NS's populations are some of the largest remaining in the world.

There are several species from a variety of taxonomic groups, other than the vascular flora, that are associated with the Atlantic Coastal Plain. This includes interesting and rare insects, lichens, mosses, amphibians, and reptiles, however, it is not clear at this time whether there are any obligate relationships between any of these species and the ACPF. It is possible that they occur but this would require additional research and knowledge to assess.

1.1.3 Limiting Factors

All of the legally listed ACPF species at risk have some biologically limiting factors that result in rarity and may influence recovery potential. Their distribution may be limited due to scarcity of suitable habitat, slow growth, and low reproductive rates (Sweeney and Ogilvie 1993). Almost all of these species occur in a specific habitat typeof limited occurrence in southwestern NS (Wisheu and Keddy 1989a). The 'rescue effect' from outside of Canada for these species is low as they are isolated, disjunct populations with limited chance of recolonization from distant populations along the eastern US seaboard. Natural disturbance regimes, including water level fluctuations, wave action, and ice scouring, are critical in minimizing interspecies competition, preventing the establishment of more aggressive species, including shrubs and invasive exotics.

Low, or no, seed production in NS is characteristic of several species of ACPF and instead of producing seeds these plants often reproduce clonally, using fragmentation, runners or sucker growth. These asexual reproductive strategies successfully enable the spread of the species, however, low levels of sexual reproduction, coupled with a limited seed bank and a small number of populations, limits genetic diversity. This can lead to poor environmental adaptability and thus a reduced ability to recover from severe habitat disturbance.

1.2 Populations and Distribution

The presence of ACPF in NS has been linked to the retreat of the ice at the end of the Wisconsin Glaciation, approximately 10,000 years ago. With glaciation sea levels were lower and a series of now-submerged islands may have served as a biological link between southern NS and the Cape Cod region of Massachusetts (Keddy and Wisheu 1989, Pielou 1991). Recent evidence, however, has shown offshore land to have been more limited in time and area than was previously assumed, and that offshore land had an Arctic or sub-Arctic climate that may not have been suitable for ACPF (see summary in Clayden et al. 2009), meaning that other explanations for dispersal of ACPF into Nova Scotia are likely equally or more important.

In general, the distribution of ACPF ranges from Texas to Southern Maine in the US, coinciding with the Gulf and Atlantic Coastal Plain of the eastern seaboard of North America (Figure 1). Disjunct zones of ACPF occur in the southern Georgian Bay region of Ontario, to a limited degree in southwestern New Brunswick, and more extensively in NS. Within Canada the 12 of the 13 legally listed ACPF species in this document occur only in the province of NS. Spotted Pondweed occured in Ontario but has not been observed there since 1939.

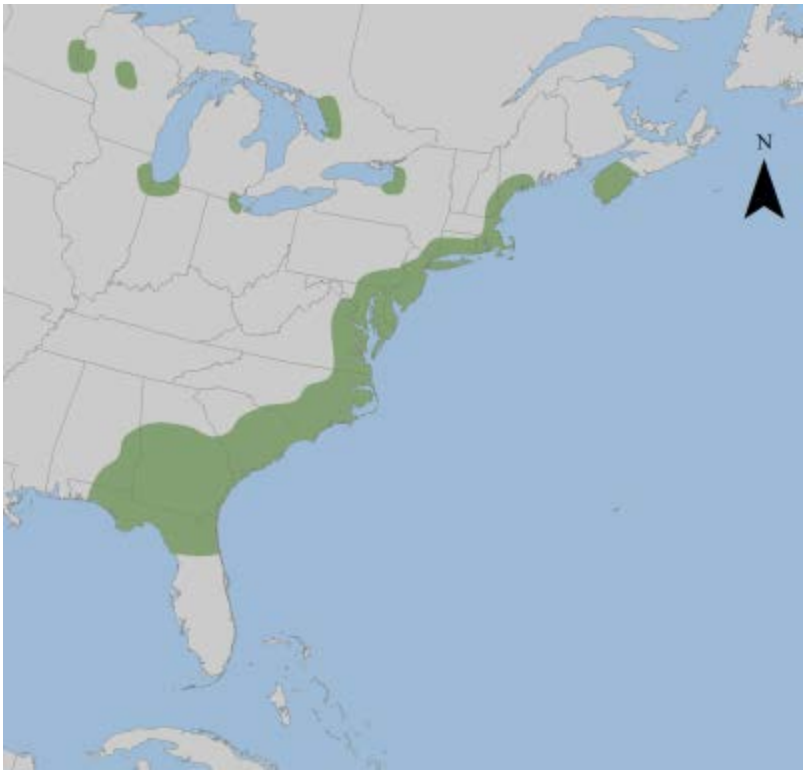


Figure 1: The general distribution (green shading) of ACPF in North America (from www.speciesatrisk.ca).

The majority of ACPF species at risk in NS are concentrated in the southwestern portion of the province where 12 of the 13 legally listed ACPF species are located (Figure 2). However, ACPF habitat does exist in other regions of the province, including, for example, the coast-influenced peatlands supporting New Jersey Rush in southeastern Cape Breton Island.

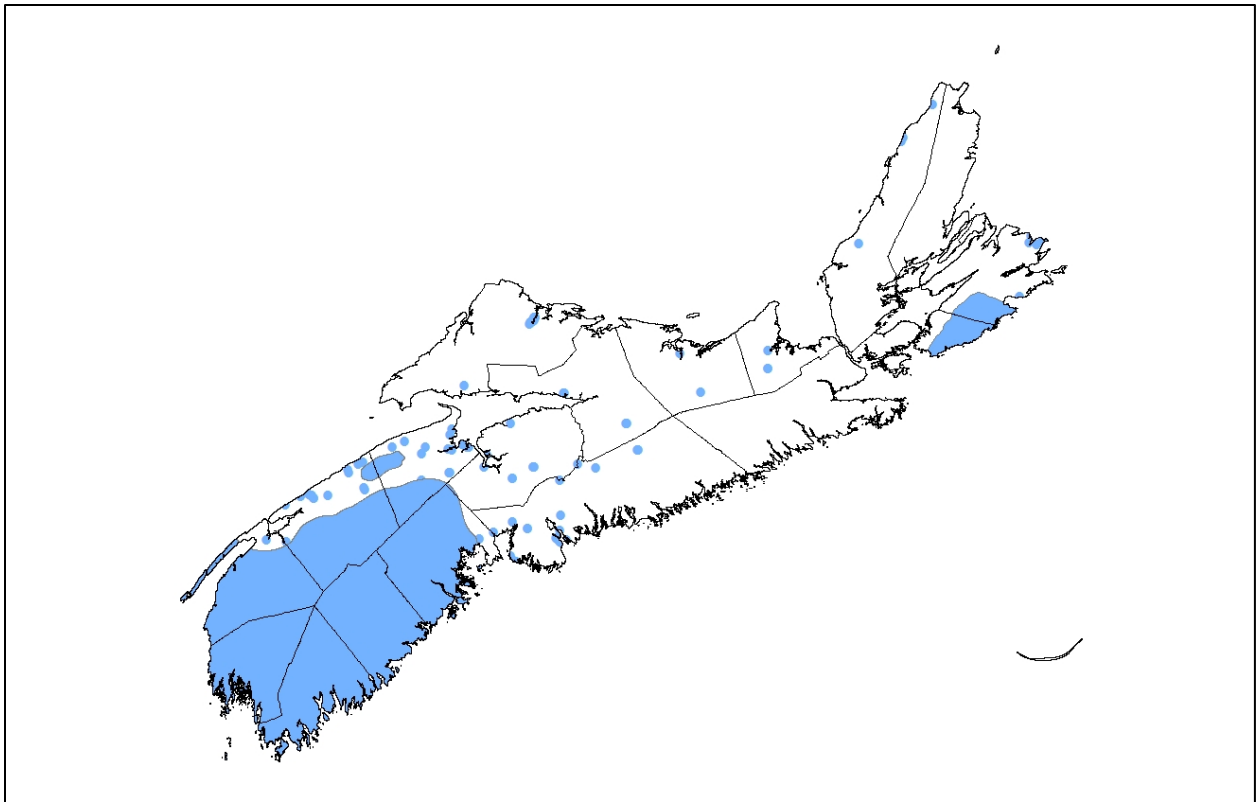


Figure 2: Blue shading indicates the general distribution of legally listed ACPF species, non-legally listed Red (May be at Risk) and Yellow (Sensitive) ranked species.

Five of the 94 ACPF species in NS are considered at risk globally with a Global rank (G-rank) of G2 or G3 (see Appendix 3 for G-rank definitions). These include four of the legally listed ACPF species: Pink Coreopsis, Plymouth Gentian, New Jersey Rush, Long's Bulrush plus Curly Grass Fern, which is relatively secure in NS (Appendix 1). All five of these species have a very limited distribution along the eastern seaboard of North America and are at risk over most of their range. This highlights the importance of the populations in NS to the global conservation and recovery of these species at risk.

1.3 Rationale for Multiple Species Approach to Recovery

Multiple species and ecosystem approaches to recovery planning are explicitly permitted under SARA and the NS ESA. While there are currently only a handful of multiple species recovery strategies in Canada, recognition of their value and utility is increasing (Moore and Wooler 2004). A multiple species approach to the conservation and recovery of ACPF was adopted dating back to the original ACPF Recovery Plan in 1998.

Key factors in deciding on a multiple species approach include the high number of legally listed ACPF species at risk which have similarities in regards to habitat requirements, threats, and geographic distribution within NS. These 13 legally listed ACPF species are part of a broader complement of 98 ACPF species. A multiple species approach enables the conservation of other non-legally listed ACPF species to be addressed within the document as well. This facilitates the recovery of species at risk and enables the prevention of further ACPF species from becoming at

risk. This multi-species approach can achieve efficient use of limited recovery funds and ecological and human resources while maximizing conservation and recovery efforts (Wisheu and Keddy 1994). It is effective for addressing conflicting needs between species, developing appropriate recovery actions, and establishing priorities. Multi-species recovery planning can be complex and therefore, establishing priorities is a challenging but essential part of the process, providing the organizational structure for the recovery planning document and ultimately facilitating a more effective development and delivery of recovery actions.

1.4 Characterizing and Prioritizing Recovery Planning for ACPF

Priorities in this document address conservation priorities and have been determined by experts reviewing information. Priorities have been examined in an effort to determine where to focus recovery planning. Once priorities are established they provide the basis for recovery objectives and approaches and ultimately help guide the structural content and planning of the document.

When using a multiple species approach to conservation and recovery, establishing priorities is challenging, but essential. In this document priorities are established within biologically relevant categories enabling recovery approaches and steps to be grouped and targeted to benefit more than one species at a time. By examining all priorities within these categories, and through the integration across categories, overall priorities emerge. The emergent priorities then provide the organizational structure for conservation and recovery approaches and steps.

In this section a level of priority (*high, medium, low*) is established for each of three biologically relevant categories (*species, habitats, threats*). Each category is characterized, providing relevant background information upon which priorities are based. The levels of priority assigned to each species, habitat, and threat represent the degree of emphasis that will be place on recovery approaches and is described in more detail for each of the categories.

1.4.1 Characterizing and Prioritizing Species

It is important to indicate the level of priority for recovery and conservation planning for all species because this document addresses the recovery of the 13 legally listed ACPF species within the context of the full complement of 98 ACPF species. A high, medium, or low level of priority is assigned to all 98 ACPF species and with each of these levels comes a difference in the necessary or required approaches to conservation and recovery.

Under half of the 98 ACPF species are assigned a high or medium priority for recovery. High priority species include legally listed ACPF species at risk, and non-legally listed ACPF species with provincial Red (May be at Risk) and Undetermined ranks (Table 2). The primary focus of the recovery strategy and management plan is the 13 federally and provincially legally listed ACPF species (Table 1). The 13 Red (May be at Risk) species are also assigned a high priority for recovery as they are assessed as ‘may be at risk’ based on their risk of extirpation in the province and on the Recovery Team decision (Table 3). Biological and other information available for these species has been reviewed by botanical experts and they see these species as candidates for more detailed status reports and potential legal listing as species at risk. The two Undetermined rank species are also assigned a high priority (Table 3). These species will require additional research and monitoring before a status can be assigned as there is still much to be learned about these are cryptic, hard to identify species.

All high priority species will be explicitly addressed in terms of recovery goals, objectives, and approaches. There are some instances where the legally listed ACPF species will receive greater attention, however, because of requirements under provincial (NS ESA) and federal (SARA) legislation. The legal requirements and aspects of recovery are one part of the conservation response.

The 16 Yellow (Sensitive) species are assigned a medium priority (Table 2) include the (see Appendix 1 for species list). Without conservation attention these species have a high probability of becoming at risk. Medium priority species are not considered to be at risk currently and thus recovery goals, objectives, and approaches are not explicitly included in this document. It is important to recognize that as a result of their geographical and ecological association with the high priority species the medium priority species will also receive benefits from recovery approaches. However, proactive approaches can ensure that stewardship and management actions for high priority species also address medium priority species. This will be the primary means to prevent these species from becoming at risk.

Just over half of the 98 ACPF species are considered Green (Secure) (Table 2, see Appendix 2 for species list) and these species are assigned a low priority. The four species ranked Purple (Extirpated or Historic), are also assigned a low priority (see Appendix 1 for species list). Conservation and recovery of these extirpated species as well as the Green (Secure) species is not required at this time and therefore goals, objectives, and approaches are not set. As with the medium priority species it is important to recognize that as a result of their geographical and ecological association with the high priority species the low priority species will also receive benefits from recovery approaches. It is still important to include them in the document however, in order to provide the full context of how many ACPF species are in NS.

Purple (Extirpated or Historic) species have not been documented in NS for over 25 years, so their status in the province is uncertain. The four species with this rank are all difficult to identify gresses or sedges, and all may still occur in the province. If any of these species are rediscovered in NS their priority status within this document will re-evaluated.

The status of the group as a whole should continue to be tracked because conservation information could change and it is important that conservation priorities reflect the state of the information. As is the case with this amended document, the recovery strategy can be amended and updated whenever it is necessary to do so.

Table 2: The ranking or status for each of the 94 ACPF species and the assigned level of priority for each rank.

Status Process*	Ranking/ Status	# of Species	% of Total # of Species	Level of Priority for Recovery
Legally listed provincially or federally	SARA & NS ESA[a]	13	14	High
Provincial General Status (Non-Legally Listed)	Red (May be at Risk)	13	14	High
	Undetermined	2	2	High
	Yellow (Sensitive)	16	17	Medium
	Purple (Extirpated or Historic)	4	4	Low
	Green (Secure)	50	53	Low
Total # High & Medium Priority Species		44	47	
Total # Species		94		

***** See Appendix 3 for an explanation of species status assessment processes and definitions of ranks

[a] Eight of these species are Red (May be at Risk) rank and five Yellow (Sensitive) rank under the general status assessment process

Table 3: The non-legally listed high and medium priority species ranked as Red (May be at Risk), Yellow (Sensitive) or Undetermined by the provincial General Status process.

Scientific Name	Common Name	NS DNR General Status
Amelanchier nantucketensis	Nantucket Shadbush	Red (May Be At Risk)
Eutrochium dubium	Joe-pye-weed (Coatal Plain Joe-Pye-Weed)	Red (May Be At Risk)
Iris prismatica	Slender Blue Flag	Red (May Be At Risk)
Lyonia ligustrina	Maleberry	Red (May Be At Risk)
Panicum dichotomiflorum var. puritanorum	Spreading Panic-Grass	Red (May Be At Risk)
Proserpinaca intermedia	Intermediate Mermaid-Weed	Red (May Be At Risk)
Proserpinaca palustris var. palustris	Marsh Mermaid-Weed	Red (May Be At Risk)
Rhynchospora macrostachya	Tall Beakrush	Red (May Be At Risk)
Salix sericea	Silky Willow	Red (May Be At Risk)
Schoenoplectus torreyi	Torrey's Bulrush	Red (May Be At Risk)
Sisyrinchium fuscatum	Coastal-Plain Blue-Eyed-Grass	Red (May Be At Risk)
Toxicodendron vernix	Poison Sumac	Red (May Be At Risk)
Trichostema dichotomum	Forked Bluecurls	Red (May Be At Risk)

Scientific Name	Common Name	NS DNR General Status
Elymus virginicus var. halophilus	Terrell Grass	Undetermined
Suaeda maritima ssp. richii	Rich's Sea-blite	Undetermined
Agalinis maritima	Salt-Marsh False-Foxglove	Yellow (Sensitive)
Alnus serrulata	Brook-side Alder	Yellow (Sensitive)
Carex longii	Greenish-White Sedge	Yellow (Sensitive)
Cephalanthus occidentalis	Buttonbush	Yellow (Sensitive)
Eleocharis olivacea	Capitate Spikerush	Yellow (Sensitive)
Eleocharis rostellata	Beaked Spikerush	Yellow (Sensitive)
Galium obtusum	Large Marsh Bedstraw	Yellow (Sensitive)
Hudsonia ericoides	Hudsonia	Yellow (Sensitive)
Iva frutescens ssp. oraria	Marsh Elder	Yellow (Sensitive)
Juncus marginatus	Grassleaf Rush	Yellow (Sensitive)
Juncus subcaudatus	Woodland Rush	Yellow (Sensitive)
Najas gracillima	Thread-Like Naiad	Yellow (Sensitive)
Platanthera flava var. flava	Southern Rein-Orchid	Yellow (Sensitive)
Shoenoplectus americanus	Three-Square Bulrush	Yellow (Sensitive)
Spiranthes casei var. novascotiae	Case’s Ladies’-Tresses	Yellow (Sensitive)
Utricularia resupinata	Northeastern Bladderwort	Yellow (Sensitive)

1.4.2 Characterizing and Prioritizing Habitats

Maintaining and protecting habitat is central to the conservation and recovery of ACPF. Since ACPF species share habitat commonalities, protecting whole habitats benefits multiple species and maximizes the efficiency of conservation actions. Habitat protection increases the probability that the protected system will be self-perpetuating, maintain its functional processes, and be more resistant to occasional perturbations (Keddy and Wisheu 1989).

ACPF species are generally poor competitors and are often unable to coexist with more aggressive plants. This characteristic usually prevents them from occurring in nutrient rich habitats (Sweeney and Ogilvie 1993). As a result, ACPF species grow in areas where most other plants have difficulty surviving; typically acidic, nutrient-poor, wet habitats exposed to high levels of natural stress and disturbance. ACPF tend to coincide with stress tolerant plant species such as submerged, short-stemmed aquatic plants (isoetids) and carnivorous species that are also associated with low nutrient, infertile soils (Wisheu and Keddy 1989a, Wisheu and Keddy 1994). Table 4 provides an overview of key habitat and reproductive characteristics for the 13 high-priority legally listed ACPF species. Additional specific habitat information for these 13 species is provided in Section 3.

For the purpose of assigning priorities within this recovery planning document, habitat is divided into three biologically relevant categories; *habitat types* (i.e. lake, bog/fen, and coastal), *locations* (i.e. specific lakes and bogs), and *watersheds* in which these species occur.

Table 4: Species-specific habitat and reproductive characteristics for the 13 legally listed ACPF species. For references please refer to species-specific information in Section 3

Species	# of Locations per high priority Habitat Type[a]	Habitat Description	Essential Requirements	E/T/SC Species Co-occurring in at least one Location	Reproductive Strategy	Flowering Season	Pollination[b]	Seed Dispersal Mechanisms[c]
Pink Coreopsis	8 L 2 HL	Infertile, gently sloping sandy, gravel, peat, or cobblestone lake shorelines	Natural disturbances: fluctuating water conditions, ice scour, wave action	Water Pennywort, Plymouth Gentian, Long's Bulrush	Asexual (rhizomes); Sexual (sporadic seed production)	Mid July-Sept.	I	U
Thread-leaved Sundew	5 B/F	Raised (or plateau) bogs which are infertile, acidic open wetlands dominated by peat mosses, heath shrubs, short sedges and grasses. It is typically found in peaty hollows where competition from other vegetation is limited.	Open conditions (shade intolerant)	Long's Bulrush	Sexual (seeds)	Mid July-Aug.	I	Wa
Plymouth Gentian	11 L 3 HL	Broad, infertile, gently sloping lakeshores of sand, cobble, gravel, or peat.	Open lakeshore maintained by natural disturbances: fluctuating water levels, ice scour, wave action	Pink Coreopsis, Water Pennywort, Long's Bulrush	Asexual (stolons); Sexual (sporadic seed production)	Mid July-Sept.	I	Wa
Water Pennywort	2 L	Primarily on sand or gravel lake shorelines in a narrow band above or below the waterline. In NS restricted to acidic and nutrient poor sites.	Open lakeshore maintained by natural disturbances: fluctuating water levels, ice scour, wave action	Pink Coreopsis, Plymouth Gentian	Asexual (stolons); Sexual (seeds not observed in NS)	July-Sept.	N/A	U
Goldencrest	6 L 3 F	Cobble lakeshores, bay bogs and fens in locations where peat accumulates from stands of Twigrush (*Cladium mariscoides*), sometimes on floating mats. Occasionally large, open peatlands not associated with lakes	Open lakeshore maintained by natural disturbances: fluctuating water levels, ice scour, wave action OR Saturated open peatland	Redroot, Long's Bulrush, , Spotted Pondweed	Asexual (rhizomes); Sexual (sporadic seed production)	Aug. - Sept.	I	U

Species	# of Locations per high priority Habitat Type[a]	Habitat Description	Essential Requirements	E/T/SC Species Co-occurring in at least one Location	Reproductive Strategy	Flowering Season	Pollination[b]	Seed Dispersal Mechanisms[c]
Eastern Baccharis	7 E/C	Upper estuarine saltmarsh margins near transition to non-saline habitats in sites protected from open ocean exposure and having especially mild winter temperatures.	Highly moderated winter temperatures; moderate soil salinity reducing ability of competing shrubs to survive		Asexual (rhizomes, branch rooting); Sexual (seeds)	Aug	I(?)	Wi, Wa
Sweet Pepperbush	6 L	Bouldery acidic lakeshores and adjacent wet, often peaty sites. Unlike some lakeshore ACPF herbaceous species, it occurs above the zone of most intense ice scour and it is not known from high catchment area lakes.	Lakeshore and associated wetlands above zone subject tp intensive ice scour	None	Asexual (vegetative suckers); Sexual (seeds, but seed production may be limited in NS)	Mid Aug.-Oct.	U	U
Tubercled Spike-rush	5 L	Sandy or stony lakeshores and gravel bars, on the fringes of peat layers, and on the edges of peaty wetlands bordering lakes. It is also found on vegetative mats that are either floating or pushed onto shorelines in storms or by ice.	Open lakeshore maintained by natural disturbances: fluctuating water levels, ice scour, wave action	None	Asexual (vegetative); Sexual (seeds)	Aug.	Wi	Wi Wa
New Jersey Rush	30 B/F	Edges of small lobes of open peatland extending into surrounding forest, and in small boggy openings in coniferous woods; generally with some nutrient enrichment from groundwater flow. It is found in wet areas but does not tolerate prolonged standing water conditions. It is sensitive to hydrological changes and is negatively affected by events such as site drainage or flooding.	Saturated open peat, Enrichment relative to surrounding peatland through groundwater flow, intolerant of hydrological changes	None	Asexual (rhizomes); Sexual (seeds not observed in NS)	July-Aug.	Wi	U
Redroot	6 L	Lakeshores on peat, sand, gravel. Abundance is highest on cobble or gravel beaches with a thin peaty soil layer, often within meadows of Twigrush.	Natural disturbances: fluctuating water conditions, wave and ice action to reduce competition	Goldencrest, Long's Bulrush	Asexual (rhizomes); Sexual (seeds)	Aug.-Sept.	I (?)	U

Species	# of Locations per high priority Habitat Type[a]	Habitat Description	Essential Requirements	E/T/SC Species Co-occurring in at least one Location	Reproductive Strategy	Flowering Season	Pollination[b]	Seed Dispersal Mechanisms[c]
Eastern Lilaeopsis	6 E/C	Intertidal zone along the shorelines of river estuaries, within zones where salinity is strongly moderated by freshwater inflow; mainly on gentle, muddy slopes, and occasionally on gentle slopes of fine gravel.	Tidal fluctuations with salinity moderated by freshwater inflow	None	Asexual (rhizomes); Sexual (seeds)	Aug.-Sept.	U	Wa
Spotted Pondweed	11 L 2 R	Shallow water (to ~1.5m) of lakes and rivers; generally acidic and nutrient poor sites.	Near-constant inundation	Redroot, Goldencrest, Long's Bulrush, Tubercled Spikerush, Water Pennywort, Pink Coreopsis, Tall Beakrush	Asexual (rhizomes); Sexual (seeds)	July-Aug	U (may be Wi & Wa)	Wa, An (esp. ducks)
Long's Bulrush	6 L 16 B/F	Open peatlands of various types [a) large peatlands not associated with lakes; b)"bay bogs" and "barrier bogs" – peatlands developed at the margins of lakes; c) stillwater fens – marshy peatlands on the margins of slow-moving rivers. It also occurs on much shallower peat on the shorelines of a few large catchment area lakes. Generally in especially wet and/or low competition areas. It tends to grow in the most waterlogged areas of these habitats, and on east-facing shores.	Saturated peaty soil with minimal tree and tall shrub cover (shade intolerant)	Thread-leaved Sundew, Water Pennywort, Plymouth Gentian, Goldencrest, Redroot	Asexual (rhizomes); Sexual (irregular seed production)	June-early July	Wi	Wa Wi

[a]**High priority habitat type: L**-lake, **B**-bog, **F**-fen, **E/C**-estuary/coastal, **HL**-historic lake;
[b]**Pollination: I**-insect, **Wi**-wind, **U**-unknown, **N/A**-not applicable;
[c]**Seed Dispersal Mechanisms: Wa**-water, **Wi**-wind, An - Animal, **U**-unknown.

1.4.2.1 ACPF Habitat Types

For the purposes of recovery planning and defining priorities, habitat types were identified based on broad ecological and functional groups (eg. lakeshore, bog/fen, estuary/coastal, river, forest) (Table 5). Members of the ACPF Recovery Team evaluated all species and indicated which habitat types the species is known to occur in. Appendix 4 contains a complete listing of all ACPF species according to habitat type. All habitat types that contain ACPF species are important for conservation and recovery; however, establishing priorities enables efforts to be more directed which is particularly important when resources are limited.

The level of priority was determined by assessing the number of high and medium priority species (Table 5) as well as other conservation factors such as recovery feasibility, adequate knowledge, and threat management options. High priority was assigned to lakeshore and bog/fen habitat types because together they contain 11 of the 13 legally listed ACPF species. Estuary habitat is the only known habitat type for Eastern Lilaeopsis and saltmarsh is the only known habitat for the final legally listed ACPF species (Eastern Baccharis) and therefore is also assigned a high priority. Medium priority was assigned to river/stream shore, marsh, and aquatic habitat types because at least one legally listed ACPF species and a few other high priority species are known to occur in it. The remaining habitat types (marsh, swamp/wooded swamp, meadow/field, barrens) have been assigned a low priority.

High priority habitats will be specifically targeted within this document for all recovery approaches. Whereas conservation and recovery of species in medium priority habitat types will primarily be opportunistically included when approaches associated with high priority habitats are conducted. Low priority habitat types, even if they contain high priority species will not be directly targeted in this recovery planning document.

Table 5: The frequency of occurrence of ACPF species by habitat type and the level of conservation priority assigned to each habitat type. Note that some species occur in more than one habitat.

Habitat Type	High Priority Species			Medium Priority Species	
	Legally listed, N=13*	Red (May Be At Risk), N=13	Undetermined, N=2	Yellow (Sensitive) N=16[1]	Level of Priority
Lakeshore	8	10		8	High
Bog/ Fen	4	5		2	High
Estuary/Coastal (saltmarsh, sea beach, tidal river)	2	1	2	4	High
River/stream Shore	4	4		5	Medium
Aquatic	2	2		2	Medium
Marsh	0	4		2	Low

Swamp/ Wooded Swamp	1	3		5	Low
Meadow/ Field	0	2		2	Low
Barrens	0	3		3	Low

*Habitat type for Red (May Be At Risk) and Yellow (Sensitive) species that are also legally listed are included in this column

1.4.2.2 Characterization of Lakeshore Habitat

Eleven of the 13 legally listed ACPF species occur on lakeshores. ACPF lakeshore species occur throughout the gradient or cross-section of a lake shoreline, from the shrub zone, through the shore zone and into the aquatic zone. However, they are typically found within the shore zone and are most abundant where there is glacial "red till", (Keddy 1984, Keddy 1985a). This till generally occurs on broad, gently sloping shorelines made up of smooth sand or gravel and tends to be water-saturated and low in nutrients (Keddy and Wisheu 1989).

Important habitat characteristics associated with lakeshores include water depth, shoreline gradient (low gradient correlating with greater width), till type, and exposure to disturbance (Keddy and Wisheu 1989). Shoreline width and low gradient are important for the persistence of ACPF and are good predictors of the presence of rare ACPF in a region (Hill and Keddy 1992). ACPF tend to grow in areas below the shrub zone that are often flooded and where exposure to disturbance is greatest (Keddy and Wisheu 1989). There are some exceptions, notably Sweet Pepperbush, which tends to occur in bouldery acidic lakeshores within the shrub zone where shorelines are steeply sloped, free of ice scour disturbance..

Natural disturbances are important in maintaining populations of ACPF on lakes. Natural disturbances can remove competing plant species and create new areas of suitable habitat. ACPF species are associated with lakes characterized by three key natural disturbances: (a) seasonally fluctuating water levels, (b) high wave energy and, (c) ice scouring.

(a) Seasonally fluctuating water levels: high water levels create an open shoreline suitable for ACPF species by inhibiting shrub growth and thereby preventing competitor establishment (Keddy and Wisheu 1989, Wisheu and Keddy 1994). However, consistent and sustained high water levels may negatively affect reproductive efforts in ACPF species by preventing growth from the seed bank (Keddy and Reznicek 1982, Keddy and Wisheu 1989). Therefore, fluctuating water conditions are ideal in terms of reproduction and competitor reduction (Keddy and Reznicek 1982).

(b) High wave energy: the exposure of shorelines to battering wave action has two primary effects that benefit ACPF. Firstly, wave action decreases shoreline competition by preventing shrubs from establishing (Keddy 1985b, Keddy and Wisheu 1989). Secondly, this exposure reduces the fertility of shorelines and helps create low nutrient conditions by washing fine particles and nutrients out of the soil (Keddy 1985b). Wave energy is inversely proportional to the level of organic matter, silt, clay, phosphorous, potassium, magnesium, and calcium in the shoreline substrate (Keddy 1985b, Keddy and Wisheu 1989).

(c) Ice scouring: ice scouring tends to benefit ACPF by promoting the colonization of ACPF in surrounding areas. Heavy shifting ice often uproots mats of soil and plants and transports it to

nearby shorelines, potentially creating habitat and new populations (Wisheu and Keddy 1989b, Sweeney and Ogilvie 1993, Morris 1994). Wisheu and Keddy (1989b) observed that soil infertility, wave damage, and ice scour was greatest along shoreline areas composed of red till.

1.4.2.3 Characterization of Bog and Fen Habitat

As with lakeshore habitats, bogs and fens present favourable conditions for ACPF species because they are low biomass communities that exhibit low levels of interspecific competition. However, the diversity of ACPF species is lower within bog and fen habitats than in lakes. The National Wetlands Working Group (1997) defines bogs as acidic, low nutrient peatlands, with the water table at or slightly below the surface. The surface of bogs is raised or level with the surrounding landscape and as a result groundwater and surface runoff do not provide a source of water. Consequently water is primarily obtained from precipitation and snowmelt, which is low in dissolved minerals. In comparison, fens are peatlands rich in dissolved minerals with a fluctuating water table at or near the surface (National Wetlands Working Group 1997). Water sources include surface runoff, precipitation, and groundwater inflows. Water may or may not be flowing at the surface of the fen through channels, pools, or open water bodies (National Wetlands Working Group 1997). These two habitat types are not always distinct and many wetlands may have both bog and fen components.

ACPF species are found in several different types of bog habitats, including bay, barrier, and plateau bogs. Bay bogs, as defined by Hill and Johansson (1992), form when sheltered bays of lakes become entirely filled with accumulated peat. Barrier bogs, as defined by Hill and Johansson (1992), are separated from water bodies by a rocky barrier and are flooded in the winter when the water level of the neighbouring waterbody rises. The high water levels are maintained by the rocky barrier after the water levels recede in the spring (Hill and Johannson 1992).

Plateau (or raised) bogs are distinctly located above the surrounding landscape and often have steeply slopping edges (National Wetlands Working Group 1997). Plateau bogs in southwestern NS are characterized by mud bottoms and 50-60 cm high conical hummocks (Damman and Dowhan 1981). The hummocks provide raised and lowered areas that support different types of vegetation that are adapted to wetter or drier conditions. As is typical of many bogs, the pH tends to be very low and the water levels rise and fall with the level of precipitation.

1.4.2.4 Characterization of Estuary/ Coastal Habitat

An estuary is the region of interaction between rivers and nearshore ocean waters, where tidal action and river flow create a mixing of freshwater and saltwater (Environment Canada 2006). These areas may include bays, mouths of rivers, saltmarshes, and lagoons (Environment Canada 2006). Estuarine habitat is characterized by gently sloping muddy shorelines or shorelines with fine gravel and often is located in intertidal mudflats between large boulders. One legally listed ACPF species, Eastern Lilaeopsis, occurs in estuaries at the mouths of large rivers in NS, and a second Eastern Baccharis occurs around saltmarsh margins in sheltered southern Nova Scotia bays. Eastern Baccharis occurs in a restricted range of coastal habitats in unshaded or partially

shaded sites on the margins of well-developed salt marshes or on upper beaches, usually fronted by saltmarsh. This habitat is above the extent of daily tidal inundation and is in estuaries or bays that provide significant protection from onshore wind and waves. The species is often found in the upland fringe of salt marshes, in or near the transition zone to coastal forest, where soil salinity is lower and vegetation cover is predominantly graminoids and low shrubs. Estuarine species are adapted to daily fluctuations in water levels and are inundated by several meters of water for part of each day.

Coastal habitat describes areas such as saltmarshes, tidal beaches and tidal rivers where water level and water composition are affected by marine processes such as tide cycles. High priority ACPF species occur in coastal habitats, including two Undetermined ranked species (Appendix 4).

1.4.3 ACPF Habitat: Locations

For this document *location* priorities will be established only for the three high priority habitat types (lakeshores, bogs/fens and estuary/coastal). Although all locations with ACPF species are important for conservation and recovery, establishing priorities enables efforts to be more directed. Characterization and prioritization by *location* is an important level from the perspective of species recovery, as a geographically definable unit at which to target efforts and a level at which communities can be engaged. The level of priority was assigned based on the number of legally listed ACPF species, the total number of other non-legally listed high priority (Red (May Be At Risk) and Undetermined ranked) species, and then the number of medium priority (Yellow (Sensitive)) species.

Characterization and prioritization provides an overview of the depth and breadth of locations that must be addressed. It may be perceived that the conservation and recovery of multiple species of ACPF will require actions of a large number of locations. However, less than 2% of all 6,700 lakes in NS are known to contain high and medium priority ACPF species. Similarly, less than 0.5% of the greater than 22,000 bogs in NS have high priority ACPF species.

High, medium, or low priority will be assigned to each location, indicating the level of conservation and recovery efforts required. High priority lakes will receive the greatest attention with respect to recovery approaches and actions to follow. These include all locations for the 13 legally listed ACPF species recovery approaches and will include legal protection of species and habitats, targeted reduction of threats, necessary research, as well as stewardship and management. Medium priority lakes will receive primarily stewardship and management approaches and efforts will be less targeted and more opportunistic. Low priority lakes do not contain high priority species and will not be directly addressed in this document.

1.4.3.1 Prioritization of Lakes

Table 6 indicates which lakes have the greatest number of high and medium priority APCF species and are thus assigned a high priority for conservation efforts. Note that the relevance of the watershed column included in Table 6 is explained in Section 1.5 below. High priority was assigned to lakes that contained one or more legally listed ACPF species as these are the primary

focus of the document. Lakes containing one or more non-legally listed Red (May Be At Risk) or Undetermined ranked species were assigned a medium priority (see Appendix 6). There are 53 high priority lakes many of which have more than one high priority species and as a result many conservation and recovery efforts for species can be combined when priority lakes are targeted. A table indicating which high and medium priority ACPF species occur on each of the lakes is included in Appendix 5 and 6. Yellow listed species of ACPF also exist on approximately 70 other lakes with no legally listed, Red (May Be At Risk) or Undetermined ACPF species.

Table 6: The 53 high priority lakes for ACPF species in NS, including the total number of high priority species and the primary watershed where they are located.

Watershed	Location	High Priority Legally Listed Species			High Priority Non-Legally Listed Species		Total # High Priority Species
		E*	T*	SC*	Red (May Be At Risk)	Undetermined	
Tusket	Wilsons Lake	2	1	1	2	0	6
Medway	Hog Lake	0	1	2	1	1	5
Medway	Molega Lake	0	1	3	1	0	5
Tusket (Annis)	Pleasant Lake	1	0	1	3	0	5
Medway	Little Ponhook Lake	0	1	2	1	0	4
Medway	Ponhook Lake	0	1	2	1	0	4
Tusket	Bennetts Lake	2	0	0	2	0	4
Tusket	Lac de l'Ecole	1	0	1	2	0	4
Tusket	Lake Fanning	1	0	0	3	0	4
Tusket (Annis)	Salmon Lake	1	0	1[4]	1	1	4
Barrington	Barrington Lake	0	0	1	1	1	3
Medway	Cameron Lake	0	0	1	2	0	3
Medway	Shingle Lake	0	1	2	0	0	3
Mersey	Carrigan Lake	0	0	1[3]	2	0	3
Mersey	Kejimkujik Lake	0	0	2	1	0	3
Tusket	Gillfillan Lake	2	0	0	1	0	3
Tusket	Raynards Lake	1	0	1[3]	1	0	3
Barrington	Great Pubnico Lake	0	0	1	1	0	2
Barrington (Clyde)	Harpers Lake	0	0	1	1	0	2
Medway	Beartrap Lake	0	1	1	0	0	2
Medway	First Christopher Lake	0	0	2	0	0	2
Medway	Mill Lake	0	0	2[3]	0	0	2
Mersey	Little Ten Mile Lake	0	0	1	1	0	2

[3] Spotted Pondweed, provincially Vulnerable not COSEWIC assessed

Watershed	Location	High Priority Legally Listed Species			High Priority Non-Legally Listed Species		Total # High Priority Species
		E*	T*	SC*	Red (May Be At Risk)	Undetermined	
Meteghan	Belliveau Lake	0	1	1[3]	0	0	2
Tusket	Kegeshook Lake	1	0	0	1	0	2
Tusket	Mill Lake	0	1	1[3]	0	0	2
Tusket	Pearl Lake	1	0	0	0	1	2
Tusket (Annis)	Agard Lake	2	0	0	0	0	2
Annapolis	Grand Lake	0	0	1	0	0	1
LaHave	Hirtles Lake	0	0	1	0	0	0
LaHave	Rhodenizer Lake	0	0	1	1	0	0
LaHave	Seven Mile Lake	1	0	0	1	0	0
Mersey	Loon Lake	0	0	1	0	0	1
Mersey	Ten Mile Lake	0	0	1	0	0	1
Mersey	McBride Lake	0	0	1	1	0	1
Medway	Beavertail Lake	0	0	1	0	0	1
Medway	Fancy Lake	0	1	0	0	0	1
Medway	Moosehorn Lake	0	0	1	0	0	1
Medway	Mudflat Lake	0	1	0	0	0	1
Medway	Pretty Mary Lake	0	1	0	0	0	1
Roseway	Gold Lake	0	0	1	0	0	1
Roseway	Western Lake	0	0	1	0	0	1
Tusket	Long Lake	0	0	1	0	0	1
Tusket	Placides	0	0	1	0	0	1
Tusket	Springhaven Duck Lake	0	1	0	1	0	2
Tusket	Canoe Lake	0	1	0	0	0	1
Tusket	Louis Lake	0	1	0	0	0	1
Tusket	Sloans Lake	1	0	0	0	0	1
Tusket	Third Lake	1	0	0	0	0	1
Tusket	Travis Lake	1	0	0	0	0	1

* COSEWIC status: E= Endangered, T= Threatened, SC= Special Concern

1.4.3.2 Prioritization of Bogs and Fens

Table 7 indicates which bogs/fens have the greatest number of legally listed high priority APCF species. Only three of the 56 bogs/fens known to support legally listed ACPF contain more than one species, while the remaining 53 bogs/fens contain only one legally listed ACPF species. These locations are as important as those that contain more than one species and as a result, high

priority was assigned to all 56 bogs/fens. Since only three of the bogs have more than one legally listed high priority species, conservation and recovery efforts for species cannot be combined for the bog/fen habitat. However, common strategies and approaches to conservation and recovery can be applied across bogs/fens.

Five high priority non-legally listed Red (May Be At Risk) and Undetermined rank species are known to occur in bog/fen habitat and include: Greenish-white Sedge, Large Marsh Bedstraw, Slender Blue Flag, Intermediate Mermaid-Weed and Poison Sumac. There are two known historic records for Goldencrest at Big Meadown Bog/Fen complex on Brier Island and Sandy Cove, Digby County, NS.

Table 7: The 56 high priority bogs/fens for the legally listed ACPF species in NS, including which species occur in each location, and the watershed where they are located.

	COSEWIC Status[a]	E	T	SC	SC	
Watershed	**Location**	Thread-leaved Sundew	Goldencrest	Long's Bulrush	New Jersey Rush	**Total # of Species**
Mersey	Dunraven Bog		√	√		2
Roseway	Quinns Meadows Bog	√		√		2
Roseway	Port La Tour Bog	√				1
Roseway	Swaines Road Bog	√				1
Roseway	Villagedale Bog	√				1
Roseway	West Baccaro Bog	√				1
LaHave	Smith Lake Bog			√		1
LaHave	Demones Run Bog		√	√		2
Roseway	Blue Hill Bog Brook			√		1
Little River	Moores Lake Bog		√			1
Little River	Tiddville Bog		√			1
Mersey	Bog at Big Sixteen Mile Bay			√		1
Mersey	Bog/fen at outlet of Bull Moose Lake			√		1
Mersey	Bog near McGowan Lake			√		1
Mersey	Bog west of Wilkins Lake			√		1
Mersey	Bog NW of East Brook Bay, Lake Rossignol (Previously named - Bog S of Little Rocky Lake)			√		1
Medway	Barren Meadow Brook Bog N - Near Hwy 325			√		1
Medway	Barren Meadow Brook Bog S – Near Cow Moose Bay, Shingle Lake			√		1
Medway	Eel Weir Stillwater Bog/Fen			√		1
Medway	Fen at Eighteen Mile Brook			√		1
Medway	Bog/Fen near Molega Lake - S of Salmon Bay			√		1
Medway	Bog/Fen near Molega Lake - W of Bear Cove			√		1
Medway	Medway River Bog/Fen - Glode Meadow Brook (Previously named Medway River Bog/Fen #1)			√		1
Medway	Medway River Bog/Fen - Wentworth Brook / Poltz Falls (Previously named Medway River Bog/Fen #2 and #3)			√		1
Medway	Medway River Bog/Fen - Echo Lodge Road (Previously named Medway River Bog/Fen #4)			√		1
Medway	Wildcat River			√		1
Grand	Barren Hill				√	1
Grand	Gracieville Bog/Fen complex – includes Bog 1& 2*, 3, 4, and 5				√	1
Grand	Grand River (Indian Point)				√	1
Grand	Grand River East 1				√	1

	COSEWIC Status[a]	E	T	SC	SC	
Watershed	**Location**	Thread-leaved Sundew	Goldencrest	Long's Bulrush	New Jersey Rush	**Total # of Species**
Grand	Grand River East 2				√	1
Grand	Grand River West				√	1
Grand	MacAskills Brook bog/fen complex Includes Point Michaud bogs/fens (unnamed bog/fen, German Bog, Elbow Bog), and Grand River bogs/fens (Bog 8, Bog 9b)				√	1
Sydney & Mira	Belfry Lake				√	1
Sydney & Mira	Bog E of South Arm Breeches Lake				√	1
Sydney & Mira	MacLeods Pond (Previously named Bog near Framboise/Fourchu and Framboise/Fourchu (opposite Morrison Beach Road))				√	1
Sydney & Mira	Bog S. of Kennington Cove Road				√	1
Sydney & Mira	Fen N. of Kennington Cove Road				√	1
Sydney & Mira	Bog/Fen complex E of Cricket Lake (Previously named Bog W of Mulcuish Lake and Mulcuish Lake (near gravel pit))				√	1
Sydney & Mira	Cricket Lake				√	1
Sydney & Mira	Bog/Fen NW of Jimmy MacLeods Brook (Previously named Fen near Stirling)				√	1
Sydney & Mira	Gabarus Lake				√	1
Sydney & Mira	MacLeods Lakes - SE of lakes (Previously named Loch Lomond (Grace's Road Fen- new location)				√	1
Sydney & Mira	MacLeods Lakes - W of lakes (Previously named Loch Lomond (Grace's Road Fen)				√	1
Sydney & Mira	Silver Mine				√	1
Sydney & Mira	L'Archevêque/ St. Esprit				√	1
Sydney & Mira	Lower St. Espirit Bog/Fen complex				√	1
Sydney & Mira	St. Espirit/ Ferguson Road Bog				√	1
Sydney & Mira	St. Esprit – Matheson Brook				√	1
Sydney & Mira	St. Paul Island Bog 2				√	1
Sydney & Mira	Barren Hill				√	1
Sydney & Mira	Upper Marie Joseph Lake				√	1
Sydney & Mira	Bog/Fen NW of Upper Marie Joseph Lake				√	1
Sydney & Mira	Lower Marie Joseph Lake				√	1
Sydney & Mira	Bog/Fen N of Powderhorn Lake				√	1
Sydney & Mira	Bog/Fen complex W of Belfry Lake				√	1

[a] COSEWIC Status: E = Endangered, T = Threatened, SC = Special Concern

*Bog 1 and Bog 2 are separated only by a highway and are considered a single population in the 2004 COSEWIC Assessment and Update Status Report.

1.4.3.3 Prioritization of Estuary/Coastal Habitat

High priority is assigned to the six estuaries where Eastern Lilaeopsis is found because these are the only known locations for Eastern Lilaeopsis. These five estuaries are located at the mouth of the Annis, Tusket, Medway, LaHave, and Roseway Rivers in southwestern NS and the River Philip in north-west NS.

High priority is assigned to seven saltmarshes because these are locations that contain Eastern Baccharis. These seven saltmarshes are in in Yarmouth County at the Tusket River Estuary: Arnold Point, Johnston Cove (north), Johnston Cove (south) and Bird Point; as well as Morris Island - Roberts Island, Surrettes Island, and West Pubnico.

1.4.4 ACPF Watersheds

When planning conservation and recovery priorities and actions, it is important to examine immediate and broad contexts. Watersheds are widely recognized as an important planning and management unit, providing the opportunity to address broad-scale threats and deal with cumulative effects that have the potential to impact more than one location. The watershed is considered an important ecological unit for ACPF species (Hill and Keddy 1992, Hill et al. 2000), however management and stewardship at this scale is more challenging and thus a less obvious consideration for recovery than location.

More information is needed to fully understand the importance of the watershed scale for the conservation and recovery of ACPF in NS. However Hill and Keddy (1992) have determined that lakes positioned lower in watersheds, and hence with a larger watershed area, typically have greater species richness and higher numbers of rare ACPF. This is likely due to the increased disturbance that arises from the funnelling of a large catchment area of melt-water in the spring, or rainfall from storms. Spring flooding and storm surges cause shorelines to be cleared of shrubs and other vegetation that might out-compete ACPF. These actions also leach nutrients from the soil, thus favouring the ACPF that are poor competitors, but tolerant of low-nutrient substrate. Not all ACPF species are found on lakes with large watersheds and therefore low catchment lakes cannot be excluded from conservation and recovery actions (Hill et al. 2000). For bog or estuary species the importance of the watershed in relation to the distribution, abundance, or persistence has not yet been examined.

Prioritization at the watershed level will have the least impact on the implementation of recovery approaches and actions because it is such a broad scale at which to deliver. However, some management decisions and research must take place at this scale and therefore identification of the priority watersheds is important. ACPF are known to occur in approximately 75% of the 46 primary watersheds in NS. However, only 13 primary watersheds have legally listed high priority ACPF species. All 13 of these watersheds have been identified as high priority because they contain the legally listed high priority species and because the majority of other high priority and medium priority species also occur within these watersheds. Figure 3 shows the location of these 13 high priority watersheds, with nine of the 13 occurring in southwestern NS. This highlights the importance of this southwestern region of the province for ACPF species conservation and recovery.

Appendix 7 summarizes the occurrences of the legally listed high priority species in each of the 13 high priority watersheds. The Tusket, Medway, and Roseway River watersheds contain the highest number of species with five in each. These watersheds also contain at least one species that occurs in no other watershed. The Grand River and Sydney/Mira River watersheds in Cape Breton Island, NS contain the only locations of New Jersey Rush.

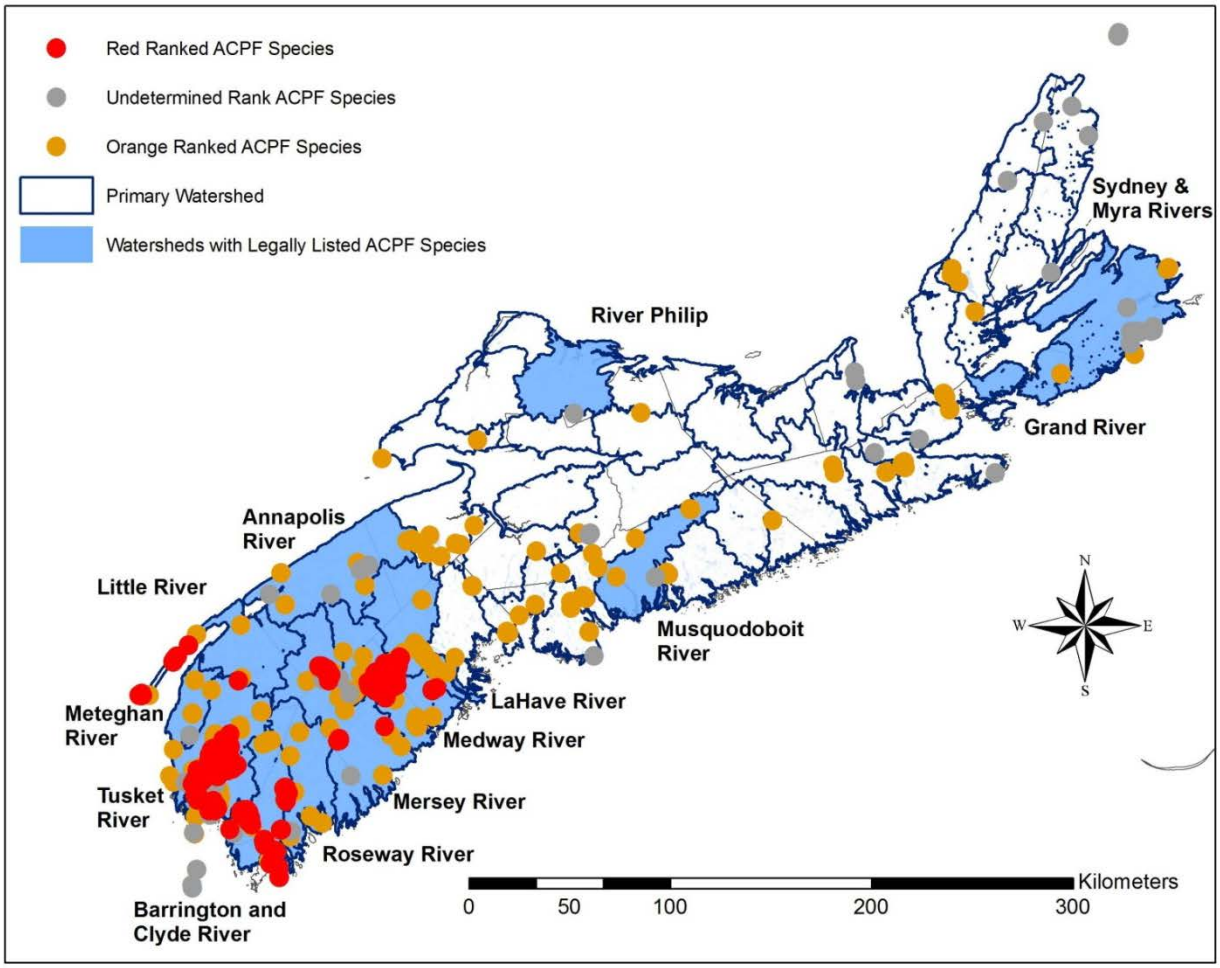


Figure 3: The 13 high priority primary watersheds in NS that contain high priority ACPF species.

1.5 Characterizing and Prioritizing Common Threats

1.5.1 Threat classification

Table 8 summarizes the 24 general and specific threats to the 13 legally listed ACPF species addressed in this document. The threats are organized according to six broad threat categories defined in the RENEW guidelines: Habitat Loss and Degradation, Changes in Ecological Dynamics or Natural Processes, Pollution, Disturbance or Persecution, Exotic or Invasive Species, and Climate and Natural Disasters (RENEW 2006). It also provides the indicators of stress caused by the threat, additional threat information such as occurrence and frequency as well the level of priority of the threat for each priority habitat type (see Appendix 9 for

definitions of each Threat Information category). Many of these threats are common across species and habitat type; however, Table 9 provides a summary of which species are affected by each threat.

ACPF species at risk are constrained by biologically limiting factors including small population sizes, northern range limitations, and reduced reproductive capabilities (see Section 1.1.2). However, there are also many significant anthropogenic threats that have an effect on all of the legally listed high priority ACPF species (Table 8 and 9). Several of these threats are interrelated and the stresses on the species are likely a result of complex interactions and cumulative effects of more than one threat.

The assessment of threat information presented in Table 8 and Table 9 is based on documented research (see References Section 4) or expert opinions from members of the ACPF Recovery Team. For some of the threats additional research is required to empirically assess the causal certainty of threats and the biological stresses induced.

Table 8: Threat classification table for threats impacting all 13 legally listed ACPF species

General Threat (Alpha-numeric Threat Code)	Specific Threat	Stress	Threat Information[+] Extent	Occurrence	Frequency	Causal Certainty	Severity	Level of Concern	Priority by Habitat Type* Lakeshore	Bog/Fen	Estuary/ Coastal
A. THREAT CATEGORY: Habitat Loss or Degradation											
1. Cottage and residential development	Habitat conversion & fragmentation; Erosion; Increased siltation; Eutrophication (increased nutrients)	↑ mortality, poor reproductive success; ↑ interspecific competition	W	C	C	H	H	H	H	L	L
2. Shoreline alterations (*i.e.* mowing & raking, boat docks & launches, wharves, breakwaters)	Habitat conversion & fragmentation; Alteration of habitat characteristics (substrate composition)	↑ mortality; poor reproductive success; ↑ interspecific competition	W	C	C	H	H	H	H	-	M
3. Off-highway vehicle (OHV) use	Reduced microhabitat; Alteration of habitat characteristics (species composition, substrate compaction)	↑ mortality; poor reproductive success	W	C	C	H	H	H	H	H	L
4. Infilling (*i.e.* filling in wetland areas for development, recreational or industrial purposes)	Habitat conversion & fragmentation	↑ mortality	L	C	OT	H	H	H	H	H	H
5. Forest harvesting practices (*i.e.* clear cutting, harvesting in the riparian zone, rotation times)	Erosion; Increased siltation; Eutrophication (increased nutrients)	↑ interspecific competition	L	C	C	L	U	L	L	L	-
6. Agricultural practices (*i.e.* tilling, crop production)	Erosion; Increased siltation; Eutrophication (increased nutrients)	↑ interspecific competition	L	C	C	L	U	L	L	-	L
7. Animal husbandry (*i.e.* mink)	Erosion; Increased siltation; Eutrophication (increased nutrients)	↑ interspecific competition	L	C	C	H	H	H	H		
8. Peat mining	Habitat conversion; Removal of substrate	Local extinction; poor reproductive success	L	A	OT	H	H	H	-	H	-
9. Cranberry growing	Habitat conversion; Removal of substrate	Local extinction; poor reproductive success	L	A	C	H	H	H	-	H	-
10. Road construction	Habitat conversion & fragmentation; Increased access for further OHV use	↑ mortality; poor reproductive success; ↑ interspecific competition	L	A	C	H	M	M	-	M	M

General Threat (Alpha-numeric Threat Code)	Specific Threat	Stress	Extent	Occurrence	Frequency	Causal Certainty	Severity	Level of Concern	Lakeshore	Bog/Fen	Estuary/ Coastal
			Threat Information[+]						Priority by Habitat Type*		
11. Diatomaceous earth mining	Removal of substrate	Local extinction	L	H	OT	H	H	L	-	L	-
12. Dam construction (Hydroelectric)	Habitat conversion	Local extinction	L	H	OT	H	H	L	L	-	-
13. Livestock (i.e, pigs)	Erosion; Increased siltation; Eutrophication (increased nutrients)	↑ interspecific competition	L	A	C	M	H	M	M	-	-
B. THREAT CATEGORY: Changes in Ecological Dynamics or Natural Processes											
1. Cottage and residential development	Alteration of natural disturbance regime; Fragmentation of pollinator habitat	↑ mortality; poor reproductive success; ↑ interspecific competition	W	C	C	H	M	H	H	L	L
2. Shoreline alterations (*i.e.* mowing & raking, boat docks & launches, wharves, breakwaters)	Alteration of natural disturbance regime	↑ mortality; poor reproductive success; ↑ interspecific competition	W	C	C	H	M	H	H	-	-
3. Dam operation (Hydroelectric)	Alteration of natural disturbance regime (stabilization of water levels)	Poor reproductive success; ↑ interspecific competition	L	C	C	H	M	M	-	L	-
4. Forest harvesting practices (i.e. clear cutting, harvesting in the riparian zone, rotation times) **and Agricultural practices** (i.e. tilling, crop production)	Alteration of natural disturbance regime (stabilization of water levels)	Poor reproductive success; ↑ interspecific competition	L	C	C	H	M	M	L	L	-
5. Peat mining	Hydrologic regime changes (water table changes)	↑ mortality; poor reproductive success	L	A	OT	H	H	H	-	H	-
6. Cranberry growing	Hydrologic regime changes (flooding)	↑ mortality; poor reproductive success	L	A	C	H	H	H	-	H	-
C. THREAT CATEGORY: Pollution											
1. Waste Water (*i.e.* septic, industrial, livestock, animal husbandry)	Eutrophication (increased nutrients)	↑ interspecific competition	W	C	C	M	H	H	H	-	-
2. Pesticide Use (*i.e.* landscaping, crop and animal	Direct exposure; Alteration of habitat characteristics (species composition)	↑ mortality; ↑ interspecific competition	W	C	C	L	U	L	M	-	-

General Threat (Alpha-numeric Threat Code)	Specific Threat	Stress	Extent	Occurrence	Frequency	Causal Certainty	Severity	Level of Concern	Lakeshore	Bog/Fen	Estuary/ Coastal
			Threat Information[+]						Priority by Habitat Type*		
production)											
3. Gas and oil leakage and spills (*i.e.* motorboats, OHVs, washing cars)	Direct exposure; Alteration of habitat characteristics (substrate conditions)	↑ mortality; poor reproductive success	L	C	C	L	U	L	L	L	L
D. THREAT CATEGORY: Disturbance or Persecution											
1. Off-highway vehicle (OHV) use		↑ mortality	W	C	C	H	H	H	H	H	L
2. Picking and trampling		↑ mortality	W	C	C	H	L	L	L	L	-
E. THREAT CATEGORY: Exotic or Invasive Species											
1. Various plant species	Resources competition	↑ interspecific competition; poor reproductive success	L	A	C	L	U	L	M	M	M
F. THREAT CATEGORY: Climate and Natural Disasters											
1. Climate change	Alteration to water levels and natural disturbance regime	Uncertain	W	U	C	L	U	U	U	U	H

[+]**Extent:** W (widespread) or L (local). **Occurrence**: H (historic), C (current), I (imminent), A (anticipated), or U (unknown). **Frequency**: OT (one-time), S (seasonal), C (continuous), R (recurrent), or U (unknown). **Causal Certainty**: H (high), M (medium), or L (low). **Severity**: H (high), M (moderate), L (low), or U (unknown). **Level of Concern** (H: high, M: medium, L: low, or U: Uncertain) See Appendix 9 for definitions of each of the threat information categories.
***Habitat Priority** (H: high, M: medium, L: low, U: Uncertain, or - [dash]: not applicable).

Table 9: A summary of the threats that impact the high priority legally listed ACPF species.

	High Priority Species (legally-listed)*												
	Lakeshore (L)							**L & B/F**		**Bog/Fen (B/F)**		**Estuary/ Coastal**	
General Threat	Pink Coreopsis	Tubercled Spike-rush	Plymouth Gentian	Water Pennywort	Redroot	Sweet Pepperbush	Spotted Pondweed	Goldencrest	Long's Bulrush	Thread-leaved Sundew	New Jersey Rush	Eastern Lilaeopsis	Eastern Baccharis
A. THREAT CATEGORY: Habitat Loss or Degradation													
1. Cottage and residential development	√	√	√	√	√	√	√	√	√	√	√	√	√
2. Shoreline alterations (*i.e.* mowing & raking, boat docks & launches, wharves, breakwaters)	√	√	√	√	√	√	√	√	-	-	-	-	√
3. Off-highway vehicle (OHV) use	√	√	√	√	√	√	√	√	√	√	√	√	
4. Infilling (*i.e.* filling in wetland areas for development, recreational or industrial purposes)	√	√	√	√	√	√	√	√	√	√	√	√	
5. Forest harvesting practices (*i.e.* clear cutting, harvesting in the riparian zone, rotation times)	√	√	√	√	√	-	√	√	√	√	√	-	-
6. Agricultural practices (*i.e.* tilling, crop production)	√	√	√	√	√	√	√	√	√	-	-	√	-
7. Peat mining	-	-	-	-	-	-		√	√	√	√	-	-
8. Cranberry growing	-	-	-	-	-	-		√	√	√	√	-	-
9. Road construction	-	-	-	-	-	-		-	-	-	√	√	
10. Diatomaceous earth mining	-	-	-	-	-	-		√	-	-	-	-	-
11. Dam construction (Hydroelectric)	√	-	√	√	-	-	√	-	-	-	-	-	-
B. THREAT CATEGORY: Changes in Ecological Dynamics or Natural Processes													
1. Cottage and residential development	√	√	√	√	√	√	√	√	√	√	√	√	√

	High Priority Species (legally-listed)*												
	Lakeshore (L)							**L & B/F**		**Bog/Fen (B/F)**		**Estuary/ Coastal**	
General Threat	Pink Coreopsis	Tubercled Spike-rush	Plymouth Gentian	Water Pennywort	Redroot	Sweet Pepperbush	Spotted Pondweed	Goldencrest	Long's Bulrush	Thread-leaved Sundew	New Jersey Rush	Eastern Lilaeopsis	Eastern Baccharis
2. Shoreline alterations (*i.e.* mowing & raking, boat docks & launches, wharves, breakwaters)	√	√	√	√	√	√	√	√	-	-	-	-	√
3. Dam operation (Hydroelectric)	√	-	√	√	-	-	√	-	-	-	-	√	-
4. Forest harvesting practices (*i.e.* clear cutting, harvesting in the riparian zone, rotation times) **and Agricultural practices** (*i.e.* tilling, crop production)	√	√	√	√	√	-	√	√	√	√	√	-	-
5. Peat mining	-	-	-	-	-	-	-	√	√	√	√	-	-
6. Cranberry growing	-	-	-	-	-	-	-	√	√	√	√	-	-
C. THREAT CATEGORY: Pollution													
1. Waste Water (*i.e.* septic, industrial)	√	√	√	√	√	√	√	√	√	-	-	-	-
2. Pesticide Use (*i.e.* landscaping, crop and animal production)	√	√	√	√	√	√	√	√	-	-	-	-	
3. Gas and oil leakage and spills (*i.e.* motorboats, OHVs, washing cars)	√	√	√	√	√	√	√	√	√	√	√	√	-
D. THREAT CATEGORY: Disturbance or Persecution													
1. Off-highway vehicle (OHV) use	√	√	√	√	√	√	√	√	√	√	√	√	
2. Picking and trampling	√	√	√	√	√	√	√	√	-	√	-	-	-

	High Priority Species (legally-listed)*												
	Lakeshore (L)							**L & B/F**		**Bog/Fen (B/F)**		**Estuary/ Coastal**	
General Threat	Pink Coreopsis	Tubercled Spike-rush	Plymouth Gentian	Water Pennywort	Redroot	Sweet Pepperbush	Spotted Pondweed	Goldencrest	Long's Bulrush	Thread-leaved Sundew	New Jersey Rush	Eastern Lilaeopsis	Eastern Baccharis
E. THREAT CATEGORY: Exotic or Invasive Species													
1. Various plant species	√	√	√	√	√	√	√	√	-	-	-	-	-
F. THREAT CATEGORY: Climate and Natural Disasters													
1. Climate change	√	√	√	√	√	√	√	√	√	√	√	√	√
TOTALS	**18**	**16**	**18**	**18**	**16**	**16**	**18**	**21**	**13**	**14**	**14**	**10**	**5**

* - (dash) indicates that it is not applicable for that species

1.5.2 Description of threats

The majority of threats to ACPF fall into the two broad categories: 'Habitat loss and degradation' and 'Changes in Ecological Dynamics and Natural Processes' (Table 8 and Table 9). It is known that ACPF are poor competitors and are dependent upon habitats with specific characteristics, particularly low nutrient substrates that are subject to natural disturbance that maintains the habitat characteristics and reduces competition (Wisheu and Keddy 1989a). The persistence of ACPF populations is dependent upon maintaining the current levels of natural disturbance (Wisheu and Keddy 1989a). Thus human actions that have an effect on ACPF habitats or natural processes pose a considerable threat to ACPF species at risk.

Threats that are assigned a High level of concern (Table 8) are considered High priority and will be the emphasis of recovery approaches and actions. Lakeshore and bog/fen species both have seven high priority threats. However, these are not the same threats for each habitat type and for the bog/fen species only three of the threats are current and the other four are anticipated. Lakeshore species face the greatest total number of threats with up to 18 general threats. Bog/fen species have up to 14 threats and the estuary/coastal species have up to 10 threats (Table 9). Goldencrest occurs in both bog/fen and lakeshore habitats and therefore faces the greatest total number of threats with 21.

Wisheu and Keddy (1989) found that the greatest threat to ACPF is an increase in human disturbance, particularly cottage and residential development and off-highway vehicle (OHV) use, which have an effect on all three priority habitat types (bog/fen, lake, and estuarine). As indicated in Table 9, cottage and residential development, OHV use, and infilling are the only threats that affect all 13 legally listed ACPF species. The severity of the affect of these threats

varies by habitat type, with development being a more serious concern for lakeshore species (Eaton and Boates 2003). Several of the threats included in Table 8 and Table 9 are not described in the COSEWIC status reports for the species. Threats in these tables are based on the expert opinion of the ACPF Recovery Team and other referenced sources.

Threats to Lakeshore Habitats and Species

Cottage development around key ACPF lakes is steadily increasing. Over the past 55 years the number of cottages on key ACPF lakes has increased by an average of 353% (Eaton and Boates 2002). The threat of development is compounded because it is directly correlated with an increase in the number of shoreline alterations, including boat wharves and docks, infilling, raking, mowing, and OHV use (Eaton and Boates 2003). There are already significant effects of existing development and the potential for it to have a continued and increased effect on ACPF species and their habitats is high. Eaton and Boates (2002) presented data on the total number of cottages per lake and the number of properties not yet developed, at 13 lakes, and estimated that on average the number of cottages per lake could increase by an average of almost 100%.

Off-highway vehicle use on lakeshores can have several negative effects on ACPF species and habitats (Table 8). Not only does it lead to soil compaction and destruction of existing plants, it also can reduce the seed bank. Areas of severely disturbed shorelines have 10% of the seed bank compared to areas with no OHV use (Wisheu and Keddy 1991). Of the remaining seeds, 91% failed to germinate, suggesting that the seed bank is not only severely reduced but also damaged by OHV use (Wisheu and Keddy 1991).

Other concerns associated with development include potential effects on ecological processes such as pollination. Recent work on Plymouth Gentian indicates that the number of pollinators and time spent at flowers decreases in disturbed shorelines (Trant 2005). It is speculated that this is as a result of fragmentation of the shoreline habitat and degradation of the shrub zone used by the pollinators for overwintering and nesting (Trant 2005), however it has not yet been empirically evaluated.

Hydroelectric dam construction in the late 1920's resulted in the extirpation of Pink Coreopsis and Plymouth Gentian from lakes in the Tusket River watershed and alteration of suitable habitat on several lakes. It is estimated that 50% of the suitable shoreline habitat for rare ACPF has been lost due to hydroelectric dam installation (Morris et al. 2002). Large catchment area lakes (>50,000 ha) are generally the target for hydroelectric dam operations, however, these lakes are also positively correlated with the presence of rare ACPF (Hill et al. 1998). Although significant new losses related to power generation are unlikely, there are still potential negative effects on ACPF species because hydro dams disrupt and stabilize natural seasonal water levels within a watershed (Hill et al. 1998). Stabilization of a lake's water level would result in fewer disturbances and thus less regeneration from buried seeds (Keddy and Reznicek 1982). There may be opportunities to mitigate past and current affects through the planned management of water levels for ACPF (Morris et al. 2002, Lusk 2006).

Threats that result in increased runoff and eutrophication will require additional research to determine the severity of their effects on ACPF species and habitats. However, ACPF are generally located on nutrient-poor, infertile substrates and thus soil enrichment from nutrient runoff may alter shoreline habitats by providing suitable growing conditions for species that are able to out-compete ACPF (Wisheu and Keddy 1989a, Wisheu and Keddy 1994). It has been documented that nutrient runoff from cottages and/or disturbance could alter the species composition of shoreline vegetation (Wisheu et al. 1994). In addition, it is likely that some forest harvesting practices and agricultural practices could contribute to the input of sediments and nutrients as well and lead to shoreline soil enrichment (Wisheu and Keddy 1989a). Future work is needed to examine the cumulative effects of nutrient loading from lake developments, forest harvesting and agriculture at a watershed level (Wisheu et al. 1994). ACPF along the Tusket river face threats of nutrient input from animal husbandry operations (mink farms). Studies are currently underway to determine source and amounts of nutrients from those operations and whether they are contributing to downstream algal blooms on ACPF lakes (Fanning, Raynards).

Another threat that is often tied to cottage development and agriculture is the introduction of exotic or invasive species. A preliminary examination of invasive plant species on six priority lakes in the Tusket River watershed revealed that this is not currently a serious threat (Eaton and Boates 2003). However, because of the dynamic element of invasives (rapid spread and unpredictable introduction) and the potential severity of effects, the potential future threat to ACPF from invasive plant species should not be underestimated and should continue to be monitored.

Threats to Bog and Fen Habitats and Species

The number of current high priority threats affecting bog/fen habitat is considerably less than in lakeshore habitats. Certain human activities, including residential and cottage development, forest harvesting, road construction, and infilling can alter the hydrology of the bog/fen, changing the vegetation community to favour more aggressive species which could out-compete ACPF (Hill and Johansson 1992). Although no current plans exist for commercial peat mining or cranberry production at ACPF locations, this continues to be an anticipated threat. In the past, proposals have been made to extract peat from one of the Thread-leaved Sundew locations. Development of peat mining has been restricted in this bog due to the presence of the Thread-leaved Sundew.

Threats to Estuary/ Coastal Habitats and Species

Eastern Lilaeopsis and Eastern Baccharis are the high priority ACPF species that occur in estuary/coastal habitats. Eastern Lilaeopsis, which occurs in esturine habitat, faces fewer severe current threats than lakeshore and bog/fen species. The only high priority threat to this species is infilling which can occur as a result of land reclamation for development or road construction. Road construction has had a negative effect in the past, resulting in changes to the hydrology of the estuary and direct loss of habitat, however, this is considered an anticipated threat as there are no current proposals for road development near the known locations. Human alteration of the coastal habitats used by Eastern Baccharis is the most immediate threat. Climate change induced

increases in storm frequency and severity and sea level rise is also a threat to this species; however, there is uncertainty regarding the impact of this threat (Blaney and Mazerolle 2011).

1.6 Actions Already Completed or Underway

Work on the conservation of ACPF species in NS have been underway for at least three decades with recovery and conservation efforts being formalized in 1996 with the creation of the ACPF Recovery Team. The Team developed an initial multiple species Recovery Plan in 1998. In 2005 this Plan was evaluated and expanded upon with the completion of a new ACPF Multiple Species Recovery Strategy and Action Plan. This 2015 Recovery Strategy and Management Plan builds on these plans, retaining much of the content but including additional information as required under SARA.

Although research and conservation efforts have been underway for decades, actions undertaken have not always been systematically planned and initiatives have often been opportunistic, not necessarily strategic. As a result of this ad hoc approach there are some fundamental knowledge gaps that still need to be addressed. This recovery planning document and subsequent Action Plan will provide the guidance necessary to ensure progress towards conservation and recovery. This section provides an overview of the progress to date organized by the three broad strategic approaches identified in Section 2.4 (Information Acquisition, Management, and Stewardship).

1.6.1 Information Acquisition

Databases

The most comprehensive databases on ACPF species are housed and maintained by NS DNR and Atlantic Canada Conservation Data Centre (AC CDC). Other databases are maintained by the NS Museum of Natural History, Acadia University Museum, NS Department of Environment and Labour (NS DEL) - Protected Areas Branch, KNP, and Nova Scotia Nature Trust (NSNT), as well as individual researchers. Databases contain historic and current records for ACPF species, often including specific location information, population estimates, and additional field notes. A database of monitoring efforts from 2010-2012 coordinated by Mersey Tobeatic Research Institute (MTRI) (including population, habitat, water quality and threat data) are stored in an online, password protected database. Population monitoring data for this project are also stored at the ACCDC.

Surveying and Monitoring

Since 1998, a number of high priority ACPF locations have been visited regularly. Field work has been conducted by several different individuals and organizations and a complete summary of this work and lakes surveyed can be obtained from the ACPF Recovery Team. However, before 2010, in general the selection of locations for surveying and monitoring has been opportunistic rather than systematic. Standards and protocols for field sampling and monitoring of different species have not been formally developed for ACPF species, with the exception of the Water Pennywort population in KNP (Vasseur 2005). As a result there has been considerable variation in the amount and quality of survey data collected. Since 2010, however, new protocols for lakeshore surveys, threat monitoring, as well as volunteer monitoring program have been developed and adopted. Also, the identification of new areas of potential habitat for high priority

species has occurred informally and unsystematically. It has been based primarily on predicted possible locations in the literature, proximity to other known locations, or fortuitously while conducting other research. A five year monitoring program that engages both researchers and volunteers commenced in 2010 that will monitor populations, habitat and threats along the entire shore length of the 36 high priority lakes outlined in appendix 5 of the 2010 recovery strategy.

Research
In NS, extensive research and conservation work began in the 1980's by botanists such as Dr. Paul Keddy, Cathy Keddy and Dr. Irene Wisheu. Work on ACPF included the examination of habitat characteristics, shoreline zonation and distribution, the role of disturbance regimes, competitive abilities and limitations, seed bank representation, and the effect of threats such as cottage development and ATV use, ultimately highlighting the need for conservation attention. Subsequent work has continued to increase the body of knowledge surrounding ACPF and is summarized in Appendix 8. In 1990, a Coastal Plain Flora workshop was held in Halifax, NS and was attended by researchers and conservation agencies from eastern Canada and US.

At several NS universities research is ongoing or has recently been conducted on ACPF, under Dr. Sara Good-Avila, Dr. Tom Herman and Dr. Ed Reekie at Acadia University, Dr. Liette Vasseur at Saint Mary's University, Dr. Nick Hill and Dr. Ron MacKay at Mount Saint Vincent University. Studies include research on genetics, reproductive biology, seed bank composition, shoreline development, and hydroelectric reservoir lakes (Appendix 8). Research by NS DNR, Environment Canada, and Parks Canada (KNP) include studies such as an inventory of the anthropogenic threats to ACPF in the Tusket River Watershed, the effects of water quality and alien invasive species on ACPF, and the development of a monitoring protocol for the Water Pennywort (Appendix 8).

Traditional Ecological Knowledge
Preliminary discussions and assessment of Traditional Ecological Knowledge (TEK) related to ACPF species indicate that there may be little known about these plants. Mi'kmaq communities were contacted and offered the opportunity to participate on the ACPF Recovery Team.

1.6.2 Management

Management recovery actions include conservation and recovery efforts such as legislation, decision-making, coordination, planning, policies, and programs. There are several provincial and federal acts that contribute to the conservation and recovery of ACPF (Section 2.7.1 and 2.7.2 provides an overview of these acts). Since the formation of the ACPF Recovery Team in 1996 the NS *Endangered Species Act* (1998) and the federal *Species at Risk Act* (2002) were passed, affording protection to 13 ACPF species.

The provincial Integrated Resources Management (IRM) planning process highlights key ACPF conservation and recovery areas. This means any proposed development in these areas is closely scrutinized for potential impacts on ACPF. Programs such as the Government of Canada Habitat Stewardship Program for Species at Risk, which has been in place since 2000, has enabled conservation and recovery work on several ACPF initiatives.

The Nova Scotia Department of Natural Resources can issue Special Management Practices (SMPs) that apply to activities carried out on Crown Land. Currently SMPs exist for other at risk species such as Boreal Felt Lichen, Mainland Moose, Canada Lynx and Wood Turtles. No Special Management Practices are currently in place for ACPF.

ACPF conservation and recovery has involved coordination and collaboration between all three levels of government (federal, provincial, and municipal). Eaton and Boates (2005) identified municipalities as key partners in the recovery of ACPF, particularly because lakeshore development is one of the primary threats to ACPF and municipalities are responsible for much of the regulation regarding development planning and permitting. Also municipalities had been engaged successfully in 2002 when NS DNR and NS DEL staff met with a local developer and municipal officials to create guidelines for development that eliminate lakeshore threats to ACPF and have resulted in a new process to improve lakeshore alteration permitting processed under the Environment Act. Some municipalities have developed municipal planning strategies that account for wildlife and habitat (e.g. Municipality of the County of Queens).

Progress towards the on the ground protection of ACPF has been made with the creation of protected areas including; Kejimkujik National Park in 1976, the Tusket River Nature Reserve on Wilsons and Gillfillan Lakes established in 1987, followed by Ponhook Lake Nature Reserve, Quinns Meadow Nature Reserve (land surrounding the bog/fen location), and the Tobeatic Wilderness Area. Bowers Meadows and Tidney River Wilderness Areas may also prove to have some value for ACPF conservation.

The Nature Conservancy of Canada (NCC) has been involved in the purchasing and protection of the land on Wilsons Lake which became the site of a Nature Reserve. NCC owns additional properties with high priority ACPF on Pearl, Third, Kegeshook and Bennets Lakes as well as Quinns Meadow. Bowater Mersey Paper Company Incorporated worked with the NCC to donate a piece of land to TREPA that became the private C.R.K. Allen Nature Reserve on Gillfillan Lake. Nova Scotia Nature Trust (NSNT) has reserves with ACPF on Gillfillan, Bennets, Wilsons and Ponhook Lakes, as well as Riversdale on the Medway river.

In 2012 Nova Scotia started the process to identify new protected areas to reach the goal of 12% protected areas in the province. Inevitibly, some new wilderness areas and nature reserves will be established because of the presence of high priority ACPF species. Candidate areas include expansion of nature reserves at Ponhook Lake, Eighteen Mile Brook and Gillfillan Lake. New candidate nature reserves and wilderness areas will protect ACPF at Ten Mile and Little Ten Mile Lakes, Shingle Lake, Seven Mile Lake, Smith Lake, Harpers Lake, Western Lake, Gold Lake, Raynards Lake, Shingle Lake, Canoe Lake, Dunraven Bog, Kegeshook Lake and the Tusket River. Forchu Coast wilderness area as well as Point Michaud and Mulcuish Lake Nature reserves will protect New Jersey Rush in Cape Breton

1.6.3 Stewardship

Groups undertaking stewardship initiatives have worked closely with the ACPF Recovery Team. Since 2000 the Nova Scotia Nature Trust (NSNT) has focused on promoting the role and

importance of private land stewardship in the conservation of ACPF through its *Coastal Plain Stewards* and *Plants on the Edge* projects.

The NSNT has collected detailed information on private land holdings at key ACPF locations, produced signage for use on private land, compiled landownership records, met with landowners to discuss ACPF protection on their land, and documented interactions with individual landowners. Stewardship agreements have been established with landowners at 45 properties. The landowners agree to three things: to be good stewards of their ecologically significant property; to contact the NSNT if they are interested in altering the habitat, and to notify the NSNT if they decide to sell the property.

The success of the NSNT landowner contact program provides a foundation for the formal securement (purchase, donation, or the establishment of conservation easements) of key ACPF habitats identified in collaboration with the ACPF Recovery Team. Four properties have been permanently secured, two on Molega Lake and two on Gillfillan Lake; over 5 km of ACPF lakeshore habitat (for more information http://www.nsnt.ca/).

The NSNT and NS DEL have increased stewardship and support for the recovery of ACPF through public education initiatives such as presentations and guided walks. They have lead guided walks for private landowners and the general public, with local experts, biologists, and researchers promoting ACPF conservation and recovery.

Effective educational communications materials have also been produced and distributed including: a poster illustrating high priority ACPF species, brochures and fact sheets regarding NSNT stewardship and volunteer monitoring programs, support materials for a volunteer plant monitoring program, brochures on water quality and alien invasive species. The NSNT has produced a Guide to the ACPF in NS (NSNT 2005), and the Recovery Team has produced a website (http://www.speciesatrisk.ca/coastalplainflora/). The Tusket River Environmental Protection Association (TREPA) has been involved in communicating and educating local landowners in the Tusket River area. Also, KNP continues to promote the suite of ACPF species, placing particular emphasis on the Water Pennywort.

In 2010 the Mersey Tobeatic Research Institute (MTRI) began a multi partner 5 year project to increase awareness of ACPF by involving the public in monitoring and by conducting targeted outreach at 36 high priority lakes. A field guide "*Atlantic Coastal Plain Flora in Nova Scotia: Identification and Information Guide*" was produced by Parks Canada and MTRI (MTRI, 2011). The guide, along with "*Healthy Lakes and Wetlands for Tomorrow*" (MTRI, 2009), was distributed door to door to landowners on the 36 high priority lakes. Social events, BBQ's and plant walks were held with partner organizations in communities near the high priority lakes. From 2010-2012 volunteers contributed over 1700 hours to the various aspects of the project.

1.7 Knowledge Gaps Common to All or Most Species

Conservation and recovery of ACPF species at risk has been underway for over a decade, with some protected areas in place for over three decades. As a result the information base for

recovery efforts is sufficient for directing objectives and strategic approaches. However, knowledge gaps still exist and further monitoring and research of species, their habitats, and threats are required to further advance recovery efforts. Although knowledge gaps are common across all high priority species, the legally listed priority species will be the primary focus. The following actions are required:

Survey and Monitoring Requirements:

- Regular surveys of known sites as part of a long-term monitoring program to determine accurate population abundance and distribution, population trends, and habitat conditions
- Identification of potential sites and inventories to determine species presence or absence at additional locations

Threat Clarification Research Requirements:

- Determine the extent of threats and the pathways through which they are impacting species and habitats, particularly for high priority threats and threats where severity is unknown or causal certainty is low (Table 8)

Biological and Ecological Research Requirements:

- Examination of population biology such as reproductive, demographic, genetic and dispersal information (i.e. seed production, seed bank longevity, dispersal, recruitment, survivorship)
- Understanding of key habitat characteristics required to comprehensively identify critical habitat for Endangered and Threatened species
- Understanding of ecological processes such as habitat requirements of pollinators and watershed level processes such as dispersal between lakes
- Determination of whether there are barriers to restoration of specific populations of some species, or to reintroduction of new populations
- Examination of the genetic differences between US and NS populations to determine if the NS populations are distinct, whether they are irreplaceable global populations, or if they are similar to the US populations and therefore may serve as a source population for the highly threatened US locations.

2. Recovery

2.1 Recovery Feasibility

Based on the application of the criteria outlined in the *Species at Risk Act* Policies (Government of Canada 2009) to each of the 13 legally listed ACPF species, recovery is considered feasible for all 13 legally listed ACPF species.

The desirability, efficacy and probability of successfully implementing recovery actions for these species are greatly enhanced through their occurrence in similar habitats and locations, as well as commonalities in their threats. Examples already exist which demonstrate that reduction and mitigation of threats is possible and that the necessary techniques exist and are effective. Formal and informal partnerships with industry, scientists, municipal governments, federal/provincial governments, conservation organizations, property owners, and the public all work positively towards the long-term conservation and recovery of ACPF species.

The following four criteria have been considered:

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. All species show some capacity for asexual and sexual reproduction however some of the constraints on sexual reproduction are not well understood. It is uncertain if these are genetic or environmental constraints and thus it is uncertain how these may impact the feasibility of recovery. Whether through asexual or sexual means there is enough capacity to improve the population growth rate and abundance.

2. *Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.*
   Yes. There is no evidence that suitable habitat is not available or could not be made available for all 11 species. However, there have been declines in habitat quality and extent, particularly for the seven lakeshore species due to human activities and these threats continue to have an adverse effect on habitat.

3. *The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.*
   Yes. None of the threats that are currently known could not be avoided or mitigated. Some additional work may be needed to fully understand the impacts of some threats and what recovery approaches will be most effective in terms of the removal or mitigation of threats. For example halting all development around lakeshores may not be possible, however threat mitigation measures may be able to be implemented which would make development more compatible with ACPF populations and their required habitat.

4. *Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.*
   Yes. Recovery and conservation actions have been underway since the early 1990's and recovery techniques have already been employed successfully for species. Several examples already exist which indicate that recovery is technically feasible (see Section 1.6).

2.2 Recovery Goals

2.2.1 Vision

A vision for all ACPF species and habitats was developed for the conservation and recovery of this very important suite of species. Recognizing that in Canada these species are only located in NS and that globally NS has some of the best remaining habitat for these species, the vision is *to maintain persistent populations of ACPF species and their habitat in NS and Canada.*

This will be achieved by maintaining an ecosystem perspective in ACPF recovery planning, protecting and maintaining species and their habitats, including the broader context of the conservation of ACPF species that are potentially at risk in all recovery approaches, and addressing the prevention of additional ACPF species from becoming at risk.

2.2.2 Recovery Goals

Recovery goals are presented for all high priority ACPF species in this document, including the 13 legally listed ACPF species, the 13 non-legally listed, Red (May Be At Risk) ranked species, and the two Undetermined rank (data deficient) species (Table 10).

Table 10: Recovery goals for the high priority ACPF species.

Goal No.	Species Common Name (Status*)	Recovery Goal
1	Pink Coreopsis **(E)** Water Pennywort **(T)** Plymouth Gentian **(T)**	• Maintain extant populations at present levels of abundance or greater at current locations. • Maintain extent and quality of habitats for all three species. • Restore habitats to re-establish populations to areas of former habitat.
2	Eastern Baccharis **(T)** Thread-leaved Sundew **(E)** Goldencrest **(T)** Sweet Pepperbush **(SC)** Tubercled Spikerush **(SC)** New Jersey Rush **(SC)** Redroot **(SC)** Eastern Lilaeopsis **(SC)** Long's Bulrush **(SC)** Spotted Pondweed **(V)** Nantucket Shadbush **(Red** (May Be At Risk)**)** Coastal Plain Joe-pye-weed **(Red** (May Be At Risk)**)** Slender Blue Flag **(Red** (May Be At Risk)**)** Spreading Panic-grass **(Red** (May Be At Risk)**)** Intermediate Mermaid-Weed **(Red** (May Be At Risk)**)** Marsh Mermaid-Weed **(Red** (May Be At Risk)**)** Tall Beakrush **(Red** (May Be At Risk)**)** Silky Willow **(Red** (May Be At Risk)**)** Coastal-Plain Blue-Eyed Grass **(Red** (May Be At Risk)**)** Poison Sumac **(Red** (May Be At Risk)**)** Maleberry **(Red** (May Be At Risk)**)** Torrey's Bulrush **(Red** (May Be At Risk)**)** Forked Bluecurls **(Red** (May Be At Risk)**)**	• Maintain extant populations at present levels of abundance or greater at current locations. • Maintain extent and quality of habitats for all 23 species.
3	Terrell Grass **(Undetermined)** Rich's Sea-blite **(Undetermined)**	• Improve information for both species and ensure persistence of existing populations at present levels.

* Status: Legally listed (SARA): Endangered (E), Threatened (T), Special Concern (SC), Provincially Vulnerable (V) or General Status: Red (May Be At Risk) or Undetermined

More quantitative recovery goals and objectives are not possible at this time as a result of a lack of data pertaining to population numbers and trends and historical distribution within a given location. Also it is important to consider that recovery potential may be influenced by biologically limiting factors such as scarcity of suitable habitat, slow growth, limited distribution, and low reproductive rates.

The three species addressed by the first goal require additional attention because they have experienced significant historical losses and are under imminent threats from development at remaining known sites. Thus habitat restoration is one of the goals for these species. Restoration applies only to areas of known loss of habitat or areas where opportunities for stewardship

activities could enable restoration. Other ACPF species might benefit from restoration actions; however, these three species should be the primary focus of these efforts.

For species addressed by the second goal, objectives and approaches required to achieve this goal for each species will vary primarily because of differences in the number and degree of threats. Endangered and Threatened species will require threat reduction in order to achieve the goal, whereas Special Concern (SARA), Vulnerable (NS ESA) and Red (May Be At Risk) ranked species, which face fewer threats, will require the prevention of additional threats to achieve the goal.

2.3 Recovery Objectives

The following objectives (Table 11) are presented for all high priority ACPF species in this document and are necessary and sufficient to meet the recovery goals in Table 10. The time-frame for each objective is presented according to the different species addressed in the recovery goals (Table 10). Priorities referred to in the recovery objectives table are based on the characterization and prioritization process outlined in Section 1.4. Each objective addresses a single concept or issue, identifies changes that are needed, and describes a desired end state or accomplishment. The means for achieving the recovery objectives are described in the Strategic Recovery Approaches Section (2.4).

Table 11: Recovery objectives and a proposed time-frame for completion according to each of the high priority species categories.

Objective No.	Objective	Time-frame (years)		
		Legally listed ACPF Species	Red (May Be At Risk)	Undetermined
1	**Protect all populations and their habitats** at the 53 high priority lakeshores, 56 high priority bogs/fens, all medium priority lakeshores, 6 high priority estuaries and 7 high priority saltmarshes.	5-10	>10	>10
2	**Prevent, remove, and/or reduce threats** to species and habitats, including all high priority threats on lakeshores, at bogs/fens, and at estuaries/coastal habitats.	5-10	>10	-
3	Determine and update **information on population** abundance and distribution, **habitat** availability and suitability, and **threats**.	5	>10	5
4	Attain **information on population biology, diversity and ecological requirements** needed to support conservation and recovery.	5-10	>10	>10
5	Continue and/or implement **stewardship activities** at the 53 high priority lakeshores and 56 high priority bogs/fens and the medium priority lakeshores.	5	>10	-
6	Increase **public awareness and education** pertaining to the existence, threats, and conservation value of all high priority species and their habitats.	5	5-10	5-10
7	Define needs and methods for implementing **restoration** for Pink Coreopsis, Water Pennywort, and Plymouth Gentian.	5-10	-	-

2.4 Approaches Recommended to Meet Recovery Objectives

2.4.1 Recovery planning

The similar goals and objectives for the high priority species included in this document can be addressed through three broad, interrelated strategies: Management, Stewardship, and Information Acquisition. These broad strategies provide a framework for the future development of specific recovery actions, help participants identify their role in the recovery process, and can increase efficiency and cost-effectiveness of recovery actions. Priorities referred to in the recovery approaches table are based on the characterization and prioritization process outlined in Section 1.4. Table 12 provides a summary of the recommended approaches and specific steps necessary to meet recovery objectives and address threats with the approaches organized according to each of the three strategies. Section 2.4.2 provides a general description of each broad strategy with a discussion of its relevance to the recovery of ACPF.

Table 12: Recommended approaches required to achieve recovery goals and objectives and address threats for all high priority species.

Recommended approaches necessary to meet recovery objectives	Priority[+]	Objv. No.	Threat Addressed (Category & General Threat)*
Broad Strategy: Management			
1. Protect all suitable habitat at all High priority locations ► Develop a comprehensive habitat conservation and protection plan and conduct a detailed assessment and review of land ownership and tenure in order to apply the following approaches ► Employ a variety of approaches to protect habitat including: legal (*i.e.* SARA critical habitat, NS ESA core habitat, protected areas designation: Special Places Protection Act, Wilderness Areas Protection Act, conservation easements, acquisition by non-governmental conservation land trusts or government protection/conservation agencies), policy (*i.e.* provincial Integrated Resource Management (IRM) zoning) or stewardship (*i.e.* agreements, community administered conservation areas) ► Apply these approaches at all lakes and bogs/fens with critical habitat identified. ► Apply these approaches at the additional High priority lakes and bogs/fens at which critical habitat does not occur ► Identify specific government agencies and departments, industries, and other groups that are making decisions and conducting planning that could impact ACPF, enhance understanding of legal responsibilities regarding ACPF, about recovery and conservation efforts, and how they could become involved ► Identify high priority ACPF sites that are considered to be irreplaceable and work towards their formal acquisition, while also continuing to act opportunistically to acquire ACPF sites ► Work with land trusts and other non-government, conservation organizations to identify sites where formal acquisition may be the preferred method of protection over conservation easements or stewardship agreements ► Work with NS DEL to identify priority locations for protected areas designation and move towards establishing protected areas ► Ensure key ACPF sites are recognized as priorities for protection under the Nova Scotia government's protected areas systems planning process which targets the protection of 12% of the province ► Develop specific targets regarding the number of ACPF sites to be protected within a specific timeframe (*i.e.* at least one high priority site on each lake, bog/fen or estuary by 2012)	High	1, 2, 5, 6	All current threats (except D. 2 & F. 1)

2. Recommend enforcement of laws, regulations, and policies for species and habitat protection ► Ensure appropriate training with regards to relevant species at risk legislation and regulations for all provincial and federal enforcement staff ► Review and assess effectiveness of legislation, regulations and policies by tracking violations and infractions of laws, and seek amendments where appropriate ► Raise awareness amongst all departments and levels of government regarding threats to ACPF and how their jurisdiction over laws, regulations and policies may impact on ACPF ► Strengten implementation of law, regulation and policies on the ACFP species and their habitat	High	1, 2	All current threats (except D. 2 & E. 1 & F. 1)
3. Involve federal, provincial and municipal government land use decision bodies in conservation and recovery of ACPF species and habitats and encourage enhanced communication among levels of government and between government departments ► Provide an overview and briefing of the status of ACPF and this recovery planning document to all relevant federal and provincial government departments and all 12 of the regional and rural municipalities that contain the legally listed High priority ACPF species. ► Expand on initial contact and communication with municipal planners with regards to municipal tools that can be used to reduce impacts of cottage and residential development on ACPF species at risk ► Encourage the development and implementation of a simple and streamlined process for jurisdictional decisions, approvals, and denials particularly regarding permitting, licensing, and regulation of human activities that pose a threat to ACPF ► Along with legally binding forms of protection, continue to work with the provincial Integrated Resources Management (IRM) planning process to further the conservation and recovery of ACPF ► Continue to provide support and rationale for the expansion and designation of additional provincial protected areas ► Evaluate the effectiveness of development restrictions created in 2004 that apply to 13 High priority lakes in the Tusket River watershed, regulated through NS DEL (but developed in collaboration with NS DEL, NS DNR, and the municipalities)	Medium	1, 2	All current threats (except D. 2 & E. 1 & F. 1)

4. Engage and work with landowners, industry, non-government organizations, and regulatory authorities in management programs that target reduction and mitigation of High priority threats ► Identify and communicate with all development companies that own property on High priority locations ► Identify and work with all cottage associations and OHV clubs in high priority locations ► Identify all companies (*i.e.* NS Power Incorporated, Bowater Mersey Paper Company Limited, JD Irving Limited, etc…) with land immediately adjacent to High priority locations ► Indentify and work with mink farmer associations regarding nutrient runoff and support water quality monitoring (volunteer or industry). ► Work with those identified to reduce and mitigate High priority threats including; OHV use, cottage development and shoreline alterations, water level alterations, and nutrient loading	Medium	2, 5, 6	All current High priority threats: ***A.*** *Habitat Loss or Degradation* (General Threats 1-4, 7&8) ***B.*** *Changes in Ecological Dynamics & Natural Processes* (General Threats 1&2, 5&6) ***D.*** *Disturbance or Persecution* (General Threat 1)
5. Increase public awareness and education regarding management approaches to ACPF conservation and recovery ► Include explanation of management approaches (OHV reduction, cottage/residential development restrictions and guidance, inter-departmental involvement, etc…) in communication and outreach materials and website ► As ACPF protected areas expand, expand educational signage onsite, so that more people are made aware of the significance of ACPF and the efforts being made to protect them	Medium	6	***A.*** *Habitat Loss or Degradation* (General Threats 1-6) ***B.*** *Changes in Ecological Dynamics & Natural Processes* (General Threats 1&2, 4) ***C.*** *Pollution* (General Threats 1-3) ***D.*** *Disturbance or Persecution* (General Threat 1&2) ***E.*** *Exotic or Invasive Species* (General Threat 1)
6. Coordinate ACPF recovery and conservation with recovery efforts for other species at risk to create efficiencies and ensure effective implementation ► Meet, collaborate, and coordinate efforts with other species at risk Recovery Teams, including: Eastern Ribbonsnake, Blanding's Turtle, and Atlantic Whitefish	Medium	1, 2, 3, 5, 6	All current threats (except D. 2)
7. Integrate species at risk conservation and recovery into ecosystem and landscape management tools that are not specific to conservation and recovery but that have an effect on species at risk (i.e. agriculture, forestry, municipal planning) ► Assess all other ecosystem and landscape management tools which could include more species at risk elements ► Conduct an analysis of these management tools and offer suggestions for how they could be expanded to include more species at risk components ► Continue to work with municipal planners on approaches and municipal tools that can play a role in ACPF conservation and recovery	Low	1, 2, 6	All current threats (except D. 2)
Broad Strategy: Stewardship			
8. Align stewardship activities with High priority species, habitats, locations, and threats ► Ensure all organizations engaged in stewardship activities have the Recovery Strategy	High	5	All current threats

and Management Plan and are coordinating their recovery activities with the ACPF Recovery Team			
9. Initiate stewardship programs with landowners for High priority species and locations which have not yet been targeted ► Work with the NSNT to expand their stewardship programs, particularly initial landowner contact, to include all High priority locations ► Engage other non-government organization interested in the stewardship of ACPF, including local environmental and conservation groups such as the Tusket River Environmental Protection Association (TREPA) to help achieve this step	High	5	***A.*** *Habitat Loss or Degradation* (General Threats 1-4) ***B.*** *Changes in Ecological Dynamics & Natural Processes* (General Threats 1&2) ***C.*** *Pollution* (General Threats 1-3) ***D.*** *Disturbance or Persecution* (General Threat 1&2) ***E.*** *Exotic or Invasive Species* (General Threat 1)
10. Continue and improve stewardship initiatives with landowners where they already exist, including landowner contact programs, formal stewardship agreements, conservation easements, and volunteer monitoring programs ► Continue to build relationships with landowners already contacted ► Increase the number of formal stewardship agreements in place and evaluate their effectiveness in terms of long-term protection of species and habitats ► Continue to use conservation easements, protected areas designations on private land, and land trust securement as means to protect High priority locations in perpetuity and coordinate/target conservation easements in locations and at sites that coincide with existing protection to ensure a greater contiguous area of habitat is protected ► Encourage volunteer monitoring programs follow protocols developed by the Recovery Team, are coordinated with other monitoring initiatives, and population, habitat and threats components are monitored	High	1, 3, 5, 6	***A.*** *Habitat Loss or Degradation* (General Threats 1-4) ***B.*** *Changes in Ecological Dynamics & Natural Processes* (General Threats 1&2) ***C.*** *Pollution* (General Threats 1-3) ***D.*** *Disturbance or Persecution* (General Threat 1&2) ***E.*** *Exotic or Invasive Species* (General Threat 1)
11. Explore ideas for incentives for private land conservation, such as tax breaks, elimination of tax disincentives, and creation of an efficient process that minimizes time and energy required by landowner ► Work with the Recovery Team, NSNT, Nature Conservancy of Canada, other land trusts, and relevant provincial and federal agencies to implement the recommendations of the PLaCEs (Private Land Conservation Enhancements) Committee regarding enhancing private land conservation ► Work with existing government based programs, such as EcoGifts, to align their approaches with the strategy developed to create incentives ► Promote the expansion and enhancement of the cost-shared conservation land securement agreements that the Province has entered into with the NCC and NSNT ► Work with the NCC to ensure money for private land securement in NS targets priority ACPF habitats and sites and encourage the use of this money to leverage additional land securement funds	High	1	***A.*** *Habitat Loss or Degradation* (General Threats 1-4) ***B.*** *Changes in Ecological Dynamics & Natural Processes* (General Threats 1&2)

12. Continue to develop and strengthen education initiatives such as public talks and production and distribution of printed and online information ► Increase the number of pubic talks and ensure a diversity of audiences including, residents, schools, naturalist groups, developers, municipal officials and staff, provincial and federal government staff, other non-government organizations ► Work with Kejimkujik National Park and National Historic Site staff when they are developing educational materials for parks visitors and ensure their utility both within and outside of park boundaries ► Work with non-government and conservation organizations on the development of additional brochures and signage for cottage owners and residents ► Work with the NSNT and Parks Canada to evaluate the effectiveness of ACPF field guides ► Maintain and enhance ACPF Conservation and Recovery website and promote it	Medium	5, 6	All current threats
13. Develop stewardship initiatives that engage industry, other organizations, and all three levels of government ► Identify all development companies, cottage associations, OHV clubs, mink farm associations, companies and industries with land immediately adjacent to High priority locations ► Work with these audiences to develop stewardship initiatives that reduce or mitigate High priority threats to ACPF	Low	2, 5	***A.*** *Habitat Loss or Degradation* (General Threats 4-9) ***B.*** *Changes in Ecological Dynamics & Natural Processes* (General Threats 3-6) ***C.*** *Pollution* (General Threats 1&2) ***D.*** *Disturbance or Persecution* (General Threat 1) ***E.*** *Exotic or Invasive Species* (General Threat 1) ***F.*** *Climate & Natural Disasters* (General Threat 1)
14. Establish an international network to foster cooperation and coordination of conservation and recovery efforts for ACPF throughout their range ► Organize and host the second International Conference on ACPF ► Formalize and expand communication networks already established between ACPF researchers on a project-by-project, species-by-species basis	Low	4, 5, 6	All current threats
Broad Strategy: Information Acquisition			
15. Develop protocols and species-specific methods of counting for surveying, monitoring, and inventories ► Work with Atlantic Canada Conservation Data Centre (AC CDC) and botanists on the Recovery Team to develop protocols for assessing abundance, conducting surveys, and monitoring ► Re-design and enhance existing databases to ensure that all surveys, monitoring and inventories are up to date, well documented, and readily accessible ► Coordinate the application of protocols for all ongoing research including academic, community-based, NSNT volunteer monitoring program, industry, and government	High	3	All current threats

16. Conduct surveys to assess population abundance and distribution as well as existing and potential habitat availability and suitability ► Use newly developed ACPF database to determine High priority locations that require immediate surveying (selection of locations to be based on ACPF Recovery Team assessment of such factors as time since last survey and/or incomplete data) ► Ensure adequate population abundance and distribution baseline data are collected at all High priority locations ► Map sites for populations and individuals, as well as suitable habitat at all High priority locations ► Conduct targeted surveys of areas with suitable habitat for the Undetermined ranked (or data-deficient) species ► Conduct targeted surveys for High priority species that the ACPF Recovery Team has identified as likely to be more widely present than currently documented (*i.e.* Long's Bulrush, Thread-leaved Sundew, Tubercled Spikerush, Sweet Pepperbush) ► Conduct targeted surveys of rivers and streams flowing into and out of High priority lakes	High	3	All current threats
17. Monitor populations and habitat regularly to determine trends in status ► Apply monitoring protocols, implement a regular monitoring schedule for all High priority locations and ensure that a long-term monitoring program is in place ► Coordinate efforts with volunteer monitoring programs and academic, industry and government research	High	3, 5	All current threats
18. Monitor threats to populations and habitats and evaluate mitigation and reduction efforts ► Ensure adequate baseline data on threats exists for all High priority locations ► Coordinate the monitoring of threats with the monitoring of populations and habitats to enhance efficiency	High	3	All current threats

19. Conduct biological and ecological research required to address knowledge gaps ► Examine the role of sexual and asexual reproduction in species population viability ► Evaluate pollination and how lack of it might limit persistence and growth and determine what the habitat requirements are for pollinators ► Determine the importance of watershed-level processes with respect to seed dispersal ► Examine genetic diversity, particularly differences between US and NS populations	Medium	4	All current threats
20. Conduct surveys and research to examine the role of key ecological processes and factors in regards to habitat characterization ► Evaluate ecological processes and factors such as natural disturbance regimes, pollination, seed dispersal, and cumulative effects of threats to determine their impact on how habitat is characterized.	Medium	1,3,4	All current threats
21. Assess habitat restoration methods and determine potential sites for implementation ► Evaluate options for habitat restoration methods particularly for Pink Coreopsis, Water Pennywort, and Plymouth Gentian	Medium	7	***A.*** *Habitat Loss or Degradation* (General Threats 1-4) ***B.*** *Changes in Ecological Dynamics & Natural Processes* (General Threats 1&2) ***C.*** *Pollution* (General Threats 1-3) ***D.*** *Disturbance or Persecution* (General Threat 1&2) ***E.*** *Exotic or Invasive Species* (General Threat 1)
22. Work with Mi'kmaq community to identify Traditional Ecological Knowledge (TEK) pertinent to conservation and recovery ► Align communication and engagement opportunities for the Mi'kmaq community with other species at risk initiatives in southwestern NS (*i.e.* Eastern Ribbonsnake and Blanding's Turtle) ► Extend the offer to the Mi'kmaq community to have a representative on the ACPF Recovery Team	Medium	4, 5	***A.*** *Habitat Loss or Degradation* (General Threats 1-4) ***B.*** *Changes in Ecological Dynamics & Natural Processes* (General Threats 1&2) ***C.*** *Pollution* (General Threats 1-3) ***D.*** *Disturbance or Persecution* (General Threat 1&2) ***E.*** *Exotic or Invasive Species* (General Threat 1)
23. Coordinate scientific studies, approaches to recovery and encourage collaboration ► Ensure academics have the Recovery Strategy and Management Plan and are aware of the High priority approaches and steps identified therein ► Work with other research-based organizations such as the Mersey Tobeatic Research Institute (MTRI) to ensure coordination and facilitate efficient use of resources ► As with the management approach and steps identified above: Communicate and coordinate recovery efforts with other species at risk Recovery Teams	Medium	3, 4	All current threats

24. Develop tools in support of contingency planning ► Develop a contingency plan in order to adapt conservation and recovery steps and modify priorities as new information becomes available, threat priorities change, or new threats arise ► Explore and apply propagation techniques as a potential tool for recovery ► Develop a gene and seed bank	Low	4	All current threats

[+] Priority corresponds to: High = Urgent, Medium = Necessary, Low = Beneficial / * Refer to Table 8 to interpret alpha-numeric threat codes

2.4.2 Narrative to support Recovery Planning Table

Although priorities are established for all recovery approaches outlined in Table 12 it is important to recognize the need for flexibility when implementing this document. As new information arises or changes in threats occur it is important to be able to respond to these events and be able to adapt and shift priorities accordingly.

Broad Strategy: *Management*

As a broad strategy, management offers several tools to affect recovery, including: legislation, decision-making, coordination, planning, policies, programs, and protected areas. It is important that ACPF species and habitats receive early attention and priority during broad management planning and decision-making. Management efforts must occur in a timely fashion, target priorities outlined in this document, be based on sound information, be adaptive, and be evaluated frequently. Approaches that do not incorporate these aspects may waste precious resources or could actually result in negative impacts to the species.

The first and most urgent management priority identified in Table 12 is the protection of habitat which will only be achieved through the development and then implementation of a comprehensive habitat conservation and protection plan. This would require a review of all land tenure at high priority locations in order to determine which of the identified approaches to habitat protection (legal, policy, zoning, stewardship, acquisition, etc.) would best be applied at each location. Many of the subsequent approaches and specific steps outlined under the broad management strategy will be dependent upon the development of this habitat conservation and protection plan.

Broad Strategy: *Stewardship*

Stewardship is an important broad strategy for recovery because it builds local capacity for conservation. It encompasses an assortment of “less formal”, often voluntary approaches associated with the care and responsibility for species and habitats and it can include a range of conservation approaches. Stewardship efforts towards ACPF recovery to be undertaken by all citizens, non-government organizations, industries, and governments should be encouraged. Effective communication and education are integral components of this document as they promote and sustain stewardship initiatives.

Although identified as two separate broad strategies ‘management’ and ‘stewardship’ approaches and specific steps do overlap and integrate in several instances. This serves to reinforce the importance of adopting multiple approaches and steps in recovery efforts. There are several urgent stewardship priorities identified in Table 12 and one of fundamental importance aligning stewardship efforts with the priorities identified in this document. With such a high proportion of the land in NS being privately owned stewardship initiatives that engage landowners are considered key. This includes specific steps such as initial landowner contact as well as the building of a relationship with the landowners, development of formal stewardship agreements, conducting a volunteer monitoring program, promoting and achieving conservation easements, and creating incentives for private land conservation.

Broad Strategy: *Information Acquisition*

Reliable relevant information, derived from science-based research, Traditional Ecological Knowledge (TEK), and other cultural and non-scientific sources should form the basis of any recovery planning document. The existing information base for ACPF is sufficient for identifying many of the necessary strategic recovery approaches. However, there are still gaps in knowledge (Section 1.7); therefore the ongoing acquisition of information is essential. Also, ongoing monitoring and survey information are crucial for evaluating the status and trends for species, habitats, and threats.

2.5 Performance Measures

The ultimate purpose of setting performance measures is to determine whether the recovery approaches being used are having a positive or beneficial effect. The recovery planning document should take an adaptive management approach whereby new information feeds back into the document on a regular basis. Performance measures provide a means to evaluate whether the recovery objectives are being met, report on progress, and guide their improvement. Future evaluations of this recovery planning document will be based upon the performance measures listed in Table 13.

Table 13: Performance measures pertaining to each recovery objective

Objective No.	Objective	Performance Measures
1	**Protect all populations and their habitats** at the 53 high priority lakeshores, 56 high priority bogs/fens, medium priority lakeshores, 6 high priority estuaries and 7 high priority saltmarshes.	• Number of sites protected • No loss of populations or reduction in distribution
2	**Prevent, remove, and/or reduce threats** to species and habitats, including all high priority threats on lakeshores, at bogs/fens, and at estuaries/coastal habitats.	• Reduction in the number of threat occurrences • Reduction in the severity or impact of threats
3	Determine and update **information on population** abundance and distribution, **habitat** availability and suitability, and **threats**.	• Database developed and updated with comprehensive data on population abundance and distribution and habitat status • Monitoring protocols developed and regular monitoring program in place
4	Attain **information on population biology, diversity and ecological requirements** needed to support conservation and recovery.	• Important components of biology and ecology knowledge required for conservation and recovery understood
5	Continue and/or implement **stewardship activities** at the 53 high priority lakeshores and 56 high priority bogs/fens and the medium priority lakeshores.	• Stewardship agreements in place for all High priority species and locations • Number of sites protected through stewardship agreements with landowners • Number of people and groups engaged in stewardship
6	Increase **public awareness and education** pertaining to the existence, threats, and conservation value of all high priority species and their habitats.	• All landowners aware and educated regarding ACPF conservation and recovery • All audiences inventoried and a contact database developed and maintained • All relevant audiences receive education and awareness materials
7	Define needs and methods for implementing **restoration** for Pink Coreopsis, Water Pennywort, and Plymouth Gentian.	• Restoration plan and timelines in place • Number of sites successfully restored for each species

2.6 Critical Habitat

Critical habitat is defined in the *Species at Risk Act* as "*…the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species*" (subsection 2(1)).

In this multi-species recovery planning document, critical habitat is addressed for the five SARA listed species: the two Endangered species, Pink Coreopsis *(Coreopsis rosea*) and Thread-leaved Sundew *(Drosera filiformis*); and the three Threatened species, Water Pennywort *(Hydrocotyle umbellata*), Goldencrest *(Lophiola aurea*) and Plymouth Gentian *(Sabatia kennedyana*). All five of these species occur either in bog/fen habitat, lakeshore habitat, or rivershore habitat Table 7).

Critical habitat does not apply to species of Special Concern or species listed only under the NS ESA and is therefore not identified for Tubercled Spike-rush, New Jersey Rush, Redroot, Eastern Lilaeopsis, Sweet Pepperbush, Eastern Baccharis, Spotted Pondweed and Long's Bulrush. However, habitat management and protection is still an essential element for the long-term conservation of these species and thus detailed habitat descriptions are included in Section 1.5 (Table 4) and the locations where these species are known to occur are listed and prioritized in Section 1.5.

In this Amended Recovery Strategy, critical habitat is fully identified for all five Endangered and Threatened ACPF species using the best available information. Included below is a summary of the approach and rationale used for identifying critical habitat, followed by the identification of critical habitat for each of the five species. The 2010 Recovery Strategy included a schedule of studies (Section 2.6.4) and below, Table 23 summarizes the activities that were completed.

2.6.1 Approach and rationale for identifying species' critical habitat

For all five species, critical habitat will be evaluated at multiple spatial scales (

Table 14). The scale termed *Location* (entire lake waterbody, river, or bog/fen) is included as a means to assist in the identification of critical habitat, but is not identified as such. The two scales at which critical habitat is identified are: *Site* (specific occurrence within a *location*), and *Individual* (where the plant is growing). This multiple scale approach is useful and necessary to ensure all ecological and biological habitat requirements are considered and all management tools required for the protection of habitat are evaluated. These scales are interrelated but an evaluation of all three provides the most comprehensive approach to determine critical habitat.

Table 14 provides a description of each scale and outlines its importance from an ecological and management perspective and further explanation of the scales is provided below the table. There are no specific temporal scales that need to be addressed with regards to critical habitat for these ACPF species.

Table 14: Scales evaluated in the identification of critical habitat, including an explanation of the importance of the scale from both an ecological and management perspective.

Scale (Description)	**Importance of Scale: Ecological Perspective**	**Importance of Scale: Management Perspective**
Location (Lake, bog/fen, or river)	• Ecological, functional unit • Changes in hydrology (i.e. quality and integrity) can impact habitat at the *site* and *individual* scales	• **Critical Habitat is NOT identified at this scale** • Activities at this scale impact habitat at *site* and *individual* scales (e.g. eutrophication, draining of lake or bog/fen, stabilization of water levels) • Readily identifiable geographic unit (i.e. names and boundaries already defined) • Can trigger management decisions, regardless of level of habitat information at *site* or *individual* scale
Site (Specific occurrence within a *location*)	• Essential areas within a *location* where species specific habitat characteristics occur • Suitable habitat can be identified based on the species specific habitat characteristics	• **Critical Habitat is identified at this scale** • Majority of activities impact habitat at the *site* and *individual* scales • Detailed habitat descriptions allow identification of areas where habitat exists, enabling current management decisions based on a site visit and facilitating future mapping of areas
Individual (Where the plant is growing)	• Where individuals occur is the most basic, fundamental habitat scale • Plants can occur in areas that do not fit the description of the *site* scale habitat characteristics	• **Critical Habitat is identified at this scale** • Majority of activities impact habitat at the *individual* and *site* scales • Essential scale for management decisions when *site* scale critical habitat (i.e. habitat characteristics) is not described • Management decisions must be made for all areas where the species occurs or has occurred

Table 15 provides a summary of how many locations exist for each species and whether critical habitat will be identified for the species in this recovery planning document. As new information becomes available or new occupied areas are discovered (either at the site scale, individual scale, or both) the identified of critical habitat will be amended in the subsequent action plan or the updated recovery strategy and management plan.

Table 15: For each species, the total number of lake, bogs/fens, and rivershore locations where critical habitat will be identified at each scale.

	Critical Habitat Identified				
Scale (Description)	Pink Coreopsis	Thread-leaved Sundew	Water Pennywort	Goldencrest	Plymouth Gentian
# of Locations (Lake, bog/fen, or river)	8 lakes	5 bogs/ fens	3 lakes	8 lakes & 3 bogs/ fens	11 lakes & 1 river
Site (Specific occurrence within a *location*)	yes	yes	yes	yes	yes
Individual (Where the plant is growing)	yes	yes	yes	yes	yes

Location scale

For all five species the *location* scale will ***not*** be identified as critical habitat; however, it is important to consider and evaluate this scale because it is an ecologic unit within which the species specific habitat characteristics necessary for the survival and recovery of the species are found and activities likely to destroy critical habitat may be relevant at this scale. For each location, the NS Atlas Square Reference (Province of NS, 2011) is provided to identify the corresponding geographic area.

There are three species: Pink Coreopsis, Water Pennywort, and Plymouth Gentian, that occur along lakeshores, Thread-leaved sundew is a bog and fen species and Goldencrest is found both along lakes and in bog/fens. Plymouth Gentian is the only species for which critical habitat will be identified on rivershores.

Site Scale

At the *site* scale critical habitat is identified for five federally listed endangered and threatened species: Pink Coreopsis, Water Pennywort, Plymouth Gentian, Thread-leaved sundew and Goldencrest (Table 15). This scale represents the lakeshore areas, rivershore areas, or areas within a bog/fen that contain the key habitat characteristics required by the species. These sites are required for the survival and recovery.

Critical habitat at the *site* scale is defined as any area that contains species-specific key habitat characteristics. This includes the specific area of occurrence of occupied and unoccupied habitat within a given *location*. These species-specific habitat characteristics are elements or attributes of the habitat (*i.e.* shore slope and width, position on the shoreline, substrate composition, and soil quality) that are required for species survival and recovery and are well documented and

referenced in the literature. Not all of the specific habitat characteristics indicated have to be present for it to qualify as critical habitat. Identifying both occupied and unoccupied habitats at the *site* scale allows for the maintenance of extant populations at present levels and allows for population growth.

With only a few exceptions, detailed *site* scale mapping has not been conducted at *locations* where critical habitat is identified. However, the identification of *site* scale critical habitat based on specific and defined habitat characteristics is considered a valid and necessary approach to the identification of critical habitat because it provides the basis for habitat protection and management. The *location* and *site* level habitat characteristics (Tables 17-22) provide the information necessary to determine whether a proposed activity will impact critical habitat when visiting a site.

Individual Scale
At the *individual* scale, critical habitat identification is complete for all five species and includes habitat at the most basic level; where the plant is actually growing.

Critical habitat at the *individual* scale is defined as the area occupied by the individual and the extent of the habitat surrounding the plant(s) that contains the same key habitat characteristics as that in which the plant is growing. This includes areas where individuals occur and do not fit the *site* scale habitat descriptions provided in species-specific Tables 17-22. For all five species, the *individual* scale critical habitat pertains only to those areas where individuals occur that do not fit the *site* scale habitat descriptions. This definition of *individual* scale critical habitat is the minimum amount of adequate habitat necessary to safeguard persistence of the species in the habitat in which it is actually growing.

2.6.2 Identification of the species' critical habitat

2.6.2.1 Locations at which critical habitat is identified

There are 25 lakes, one rivershore, and 8 bogs/fens where the five federally-listed Endangered and Threatened species are known to occur and where critical habitat is identified at the *site* and *individual* scales. Table 16 identifies the lakes, bogs/fens and rivershore where critical habitat is found; see Figure 3 for the location of corresponding watersheds.

Table 16: Locations (lakes, rivershores, and bogs/fens) where critical habitat is identified at the site and individual scales.

Watershed	**Location**	**NS Atlas Square Reference** (2001)	Pink Coreopsis	Thread-leaved Sundew	Water Pennywort	Goldencrest	Plymouth Gentian
Tusket	Wilsons Lake	82W2	√		√		√
Tusket	Gillfillan Lake	82W1	√				√
Tusket	Bennetts Lake	82V2	√				√
Tusket	Agard Lake	81Z2	√				√
Tusket	Salmon Lake	81Z3	√				
Tusket	Sloans Lake	82V1	√				
Tusket	Pleasant Lake	81Z3	√				
Tusket	Raynards Lake	82V2	√				
Mersey	Kejimkujik Lake	72X3			√		
Tusket	Springhaven Duck Lake	82W2			√		
Tusket	Lac de l'Ecole	82W2					√
Tusket	Pearl Lake	77W5					√
Tusket	Travis Lake	77W4					√
Tusket	Kegeshook Lake	82X1					√
Tusket	Third Lake	82W1					√
Tusket	Lake Fanning	77V5					√
Tusket	Tusket River	82W1					√
Roseway	Quinns Meadow Bog	87V2		√			
Roseway	Port La Tour Bog	87V5		√			
Roseway	Swains Road Bog	86Z4		√			
Roseway	Villagedale Bog	86Z5		√			
Roseway	West Baccaro Bog	89V1		√			
Medway	Molega Lake	73W3				√	
Medway	Beartrap Lake	73V4				√	
Medway	Hog Lake	73V3				√	
Medway	Ponhook Lake	73V4				√	
Medway	Little Ponhook Lake	73W4				√	
Medway	Shingle Lake	73W2				√	
Lahave	Seven Mile Lake	73X1				√	

Watershed	**Location**	**NS Atlas Square Reference** (2001)	Pink Coreopsis	Thread-leaved Sundew	Water Pennywort	Goldencrest	Plymouth Gentian
Petit	Fancy Lake	73Z4				√	
Mersey	Dunraven Bog	78Y4				√	
Little River	Moores Lake Bog	70Y2				√	
Little River	Tiddville Bog	70Y2				√	
Total # of Locations	24 Lakes		8	0	3	8	11
	8 Bogs/Fens		0	5	0	3	0
	1 Rivershore		0	0	0	0	1

2.6.2.2 Critical habitat identification at the site and individual scales for each species

Critical habitat at the *site scale* is identified for all five Endangered and Threatened species. For the three lakeshore species, at the lake locations, critical habitat is identified as any portion of a lakeshore where the key habitat characteristics described in the species-specific Tables 17-21 occur. This includes both occupied and unoccupied habitat. Unoccupied habitat is important for Pink Coreopsis, and Plymouth Gentian because natural disturbance regimes, particularly ice scouring, can dislodge portions of the substrate or pieces of vegetative matter (including seeds, cultivars, and pieces of the plant that can disperse and propagate vegetatively) that can be transported to other sites on the lake. For Plymouth Gentian, critical habitat is identified at the *site* scale for one rivershore site along the Tusket River that contains the same key habitat characteristics as described for the lakeshore sites scale critical habitat (Table 19).

For Thread-leaved Sundew (Endangered), critical habitat is identified at the site scale. There are five bog/fen *locations* identified in Table 16 that contain *sites* where critical habitat is identified for the Thread-leaved Sundew. At the *site* scale, critical habitat is identified as any portion of a bog where the key habitat characteristics described in Table 20 occur and this includes both occupied and unoccupied habitat.

For Goldencrest (Threatened), critical habitat is identified at the site scale. There are three bog/fen *locations* identified in Table 16 that contain *sites* where critical habitat is identified for the Goldencrest and eight lakes. At the *site* scale, critical habitat is identified as any portion of a lakeshore or bog where the key habitat characteristics described in Table 21 and 22 occur and this includes both occupied and unoccupied habitat.

Critical habitat at the *individual* scale is identified for Pink Coreopsis, Water Pennywort, and Plymouth Gentian as the area of lakeshore occupied by the plants and the extent of the habitat surrounding the plant(s) that contains the same key habitat characteristics as that in which the plant is growing. This critical habitat pertains to those areas where individuals occur and do not fit the *site* scale habitat descriptions provided in species-specific Tables 17-22.

For Thread-leaved Sundew (Endangered) and Goldencrest (Threatened), critical habitat at the *individual* scale is identified as those areas of the bog/fen where individuals are known to occur and include the extent of the habitat immediately surrounding the plant(s) that contains the same biologically key habitat characteristics as that in which the plant is growing.

The 2010 Recovery Strategy described a schedule of studies necessary to complete the identification of critical habitat for Thread-leaved Sundew and Golden Crest as well as Plymouth Gentian. These activities have been completed and critical habitat is fully identified for these species in this Amended Recovery Strategy.

Table 17: Descriptions of the key habitat characteristics of critical habitat at the site scale for Pink Coreopsis.

Habitat Parameter	Description of Habitat Characteristic*
Shore Slope & Width	Low gradient, gently sloping; broad
Position on Shoreline	Areas below the shrub zone that are often flooded and where exposure to disturbance is greatest
Substrate Composition	Sandy, gravel, or cobblestone; associated with glacial deposits of 'red till' (made up of smooth sand or gravel and tend to be water-saturated and low in nutrients)
Soil Quality	Low nutrients
Natural Disturbances	Natural fluctuating water conditions, ice scour, wave action
Other Associated Species	Southern Rein-Orchid *(Platanthera flava),* Grass-Leaved Goldenrod (or Slender Fragrant Goldenrod) (*Euthamia caroliniana),* Twigrush *(Cladium mariscoides), Xyris caroliniana,* Redtop Panic Grass *(Panicum rigidulum var. pubescens),* Three-way Sedge *(Dulichium arundinaceum),* Golden-Pert *(Gratiola aurea),* Southern Bog Clubmoss (*Lycopodiella appressa*)

*Information obtained from: Maher et al. 1978, Isnor 1981, Keddy and Keddy 1983a, Keddy 1985a, Keddy and Wisheu 1989, Pronych and Wilson 1993, Wisheu and Keddy 1994, Newell 1998a, and Roland and Zinck 1998.

Table 18: Descriptions of the key habitat characteristics of critical habitat at the site scale for Water Pennywort.

Habitat Parameter	Description of Habitat Characteristic*
Shore Slope & Width	Low gradient, gently sloping; broad
Position on Shoreline	Narrow band above or below the waterline (where water level fluctuates)
Substrate Composition	Sandy or fine gravel
Soil Quality	Acidic; Low nutrients
Natural Disturbances	Natural fluctuating water conditions

Other Associated Species	Seven-angled Pipewort *(Eriocaulon septangulare)*, Redtop Panic Grass *(Panicum rigidulum var. pubescens)*, Brook-side Alder *(Alnus serrulata)*, Small Swollen Bladderwort *(Utricularia radiata)*, Northern Manna Grass *(Glyceria borealis)*, Shore Sedge *(Carex lenticularis)*, Grass-Leaved Goldenrod (or Slender Fragrant Goldenrod *(Euthamia caroliniana)*, Golden-Pert *(Gratiola aurea)*, Thread Rush *(Juncus filiformis)*, Plymouth Gentian *(Sabatia kennedyana)*, Bog Yellow-Eyed Grass *(Xyris difformis)*, Pale St John's-Wort *(Hypericum ellipticum)*, Lance-Leaved Violet *(Viola lanceolata)*, Lesser Spearwort *(Ranunculus flammula)*, Little Floating-Heart *(Nymphoides cordata)*, Zigzag Bladderwort *(Utricularia subulata)*

*Information obtained from Keddy 1985a, Wilson 1984, Keddy and Wisheu 1989, Wisheu and Keddy 1989a,b, Newell 1998b, Roland and Zinck 1998, Vasseur et al. 2002, Vasseur 2005.

Table 19: Descriptions of the key habitat characteristics of critical habitat at the site scale for Plymouth Gentian.

Habitat Parameter	Description of Habitat Characteristic*
Shore Slope & Width	Low gradient, gently sloping; broad
Position on Shoreline	Areas below the shrub zone that are often flooded and where exposure to disturbance is greatest
Substrate Composition	Sandy, gravel, or cobblestone; associated with glacial deposits of 'red till' (made up of smooth sand or gravel and tend to be water-saturated and low in nutrients)
Soil Quality	Low nutrients
Natural Disturbances	Natural fluctuating water conditions, ice scour, wave action
Other Associated Species	Southern Rein-Orchid *(Platanthera flava)*, Grass-Leaved Goldenrod (or Slender Fragrant Goldenrod) *(Euthamia graminifolia)*, Twigrush *(Cladium mariscoides)*, Golden-Pert *(Gratiola aurea)*, Zigzag Bladderwort *(Utricularia subulata)*, Three-way Sedge *(Dulichium arundinaceum)*, Southern Bog Clubmoss *(Lycopodiella appressa)*, Grass-Leaved Goldenrod (or Slender Fragrant Goldenrod) (*Euthamia caroliniana)*, Bog Yellow-eyed-grass *(Xyris difformis)*

*Information obtained from Keddy and Keddy 1983b, Keddy 1985a, Keddy and Wisheu 1989, Wisheu and Keddy 1989a, b, Wisheu and Keddy 1994, and Newell 1998d.

Table 20: Description of the key habitat characteristics of critical habitat at the site scale for Thread-leaved Sundew.

Habitat Parameter	Description of Habitat Characteristic*
Type of Bog	Ombrotrophic maritime plateau bogs with a hummock - hollow microtopography
Position in Bog	Moist peaty hollows and areas of exposed peaty substrate
Substrate Composition	Poorly drained and poorly humified sphagnum that overlies extensive peat deposits
Soil Quality	Highly infertile, pH of 3.1 to 3.5
Natural Disturbances	Natural fluctuating water conditions
Other Associated Species	Soft Peat Moss *(Sphagnum tenellum)*, Red Peat Moss *(Sphagnum rubellum)*, Tufted Clubrush (or Deergrass) *(Scirpus caespitosus)*, White Beakrush *(Rhynchospora alba)*, Coastal Sedge *(Carex exilis)*, Green Reindeer Lichen *(Cladina mitis)*, *C. terraenovae*, Cladonia lichen species *(Cladonia cervicornis)*, Liverworts *(Hepatics)*, Purple Chokeberry *(Photinia floribunda)*, Black Huckleberry *(Gaylussacia baccata)*, Dwarf Huckleberry *(Gaylussacia bigeloviana)*, Sheep Laurel *(Kalmia angustifolia)*

* Information obtained from: Zinck 1991, Freedman et al. 1992, Freedman and Jotcham 2001, and Landry and Cwynar 2005.

Table 21: Descriptions of the key habitat characteristics of critical habitat at the site scale for lakeshores for Goldencrest.

Habitat Parameter	Description of Habitat Characteristic*
Shore Slope & Width	Gently sloping; typically along shorelines wider than 2 m
Position on Shoreline	Middle of seasonally-exposed shoreline, often in wet, peat-dominated substrate among graminoids and/or ericaceous shrubs; upper of seasonally-exposed shoreline, often in moist, peat-dominated substrate among graminoids and/or Sweet Gale *(Myrica gale)*
Substrate Composition	Peat-dominated substrate or (most frequently) thin peat-dominated substrate layer over and/or between coarse mineral substrate including gravel, cobbles, stones, boulders, and bedrock
Soil Quality	Nutrient-poor peat often surrounded by nutrient poor mineral substrate
Natural Disturbances	Flooding, wave action, and ice scour associated with larger catchment area lake shorelines
Other Associated Species	Twigrush *(Cladium mariscoides);* Sweet *Gale (Myrica gale);* Old Switch Panic Grass (*Panicum virgatum var. spissum);*

*Information obtained from: Atlantic Canada Conservation Data Centre, 2014 and COSEWIC 2012.

Table 22: Descriptions of the key habitat characteristics of critical habitat at the site scale for bogs/fens for Goldencrest.

Habitat Parameter	Description of Habitat Characteristic*
Type of Bog	Floating bog; shore bog; shore fen; basin fen
Position in Bog	Open section of bog/fen or bog/fen edge usually near open water, and often dominated by graminoids and Sweet Gale *(Myrica gale)*
Substrate Composition	Peat-dominated
Soil Quality	Nutrient-poor peat, saturated for most or all of growing season
Natural Disturbances	Seasonal flooding from adjacent watercourse, depression, or other water body
Other Associated Species	Coastal Sedge *(Carex exilis);* Slender Sedge *(Carex lasiocarpa var. americana);* Pickering's Reed Grass *(Calamagrostis pickeringii);* White Beakrush *(Rhynchospora alba);* Sweet Gale *(Myrica gale)*;* Twigrush *(Cladium mariscoides);* Northern Pitcher Plant *(Sarracenia purpurea);* Bog Aster *(Oclemena nemoralis);* Sphagnum moss species*;* Leatherleaf *(Chamaedaphne calyculata)*;* Bog Rosemary *(Andromeda polifolia var. latifolia)*;* Dwarf Huckleberry *(Gaylussacia bigeloviana)*;* Large Cranberry *(Vaccinium macrocarpon)* (*generally very low-statured examples of these shrub spp.)

*Information obtained from: Atlantic Canada Conservation Data Centre, 2014; COSEWIC, 2012; Canada Committee on Ecological (Biophysical) Land Classification: National Wetlands Working Group, 1997

2.6.3 Schedule of Studies

All three of the studies necessary to complete the identification of critical habitat have been completed and critical habitat is fully identified for the five Endangered and Threatened Atlantic Coastal Plain Flora (Table 23).

Table 23: Schedule of studies necessary to complete the identification of critical habitat. A check mark means the study has been completed.

Description of Activity	Outcome/Rationale	Completion Date	Thread-leaved Sundew	Goldencrest	Plymouth Gentian
Complete research on *site* level habitat characteristics and requirements	Comprehensive description of key habitat characteristics will be completed	2011	√	√	√

2.6.4 Examples of activities likely to result in the destruction 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 when needed by 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 (Government of Canada 2009).

It is important to indicate the scale (according to

Table 14) at which activities may have to be managed to ensure that critical habitat is not destroyed. Critical habitat can be negatively affected by activities that occur at a different scale than that at which it has been identified. For example, cottage development anywhere around an entire lake, not just immediately adjacent to identified critical habitat at the *site* or *individual* scale, may have to be managed to ensure critical habitat is not destroyed.

Examples of activities which, without proper mitigation, may result in the destruction of critical habitat include, but are not limited to, the activities outlined in Table 24. The scales at which activities may have to be managed in order to ensure critical habitat is not destroyed are indicated.

Table 24: Examples of activities likely to result in the destruction of critical habitat and the habitat type which these activities may impact.

Description of Activity	Description of effect in relation to function loss of critical habitat	Habitat Type*	Scale (as per Table 14)		
			Location	Site	Individual
Infilling and road building	Permenant habitat loss; Habitat conversion; fragmentation of habitat; Alteration of natural disturbance regime in existing habitat	L & B/F	√	√	
Off-highway vehicle use	Alteration of habitat characteristics (species composition, substrate compaction); Reduction of microhabitat	L & B/F		√	√
Cottage and residential development resulting in nutrient runoff from land clearing, septic system, landscaping	Habitat conversion & fragmentation; Alteration of habitat characteristics (increased siltation and nutrients) leading to changes in species composition	L & B/F	√	√	
Shoreline alterations including mowing and raking, construction of boat docks and launches, wharves, and breakwaters	Alteration of natural disturbance regime; Alteration of habitat characteristics (substrate composition)	L		√	√
Crop and animal husbandry/production resulting in nutrient runoff or alteration of the hydrologic regime	Change in hydrological processes; Alteration of habitat characteristics (Increased siltation and nutrients; changes in species composition)	L	√		
Forest harvesting practices resulting in nutrient runoff or alteration of the hydrologic regime	Change in hydrological processes; Alteration of habitat characteristics (Increased siltation and nutrients; changes in species composition)	L	√		
Hydroelectric dam operation: stabilization of water levels and draining of lake	Habitat conversion; Alteration of natural disturbance regime (stabilization of water levels)	L	√		
Peat mining	Habitat conversion; Removal of substrate; Hydrologic regime changes (water table changes)	B/F	√		
Cranberry growing	Habitat conversion; Removal of substrate; Hydrologic regime changes (flooding)	B/F	√		

*Habitat Type: L: Lake, B/F: Bog/Fen

2.7 Recommended Approach for Recovery Implementation

A multiple species approach to recovery implementation is being proposed because the species addressed in this recovery strategy and management plan share similar distributions, habitat requirements, threats, and recovery approaches (see Section 1.3). Implementation will be overseen by the three jurisdictions responsible for the development of this document (Environment Canada, Parks Canada, and the Province of NS). This approach to recovery implementation should be applied particularly because some other species at risk, such as Blanding's Turtle, Eastern Ribbonsnake, and Atlantic Whitefish occur in the same locations as ACPF. Where these species co-exist opportunities for collaboration and coordination of recovery actions should be explored. For Water Pennywort it is recommended that these goals, objectives, and approaches be integrated into vegetation or ecosystem management plans for KNP.

2.8 Statement on Action Plans

The federal SARA-specific requirements for an action plan will be met in one or more action plans for the ACPF that will be completed within two years of the final posting of this recovery planning document on the Species at Risk Public Registry. For broader conservation reasons, other action plans in support of recovery may be developed outside of the SARA process by jurisdictions and other partners in cooperation with the Recovery Team. Some activities detailed in the broad strategies and recommended approaches (Table 12) will be undertaken concurrently with the creation of the action plan. The recovery action plan included in the 2005 ACPF Multi-species Recovery Strategy and Action Plan will serve as a starting point for action planning however; it does not contain sufficient detail to serve as the action plan for ACPF recovery.

3. Species Background

3.1 Pink Coreopsis

3.1.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2000, November 2012

Common Name (population): Pink Coreopsis

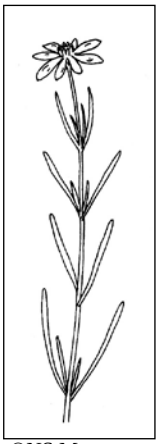
Scientific Name: *Coreopsis rosea*

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 in November 2012.



3.1.2 Description

Pink Coreopsis is a perennial herb with flowers that grow at the ends of stalks 20-60 cm high (Gleason 1952, Roland and Zinck 1998). It flowers from mid to late summer and the daisy-like, composite flowers are made up of yellow inner flowers and outer flowers that range from pink to white. The leaves are 2 to 5 cm long, entire, opposite, smooth and linear (Gleason 1952, Roland and Zinck 1998). The achenes (fruit) are 2 mm long, narrow and wingless (Gleason 1952). *Coreopsis* comes from the Greek word *koris*, which means bedbug and refers to the similarity of the dark seeds to bedbugs. *Rosea* means rose-coloured, and refers to the pink coloured petals of the flower.

3.1.3 Populations and Distribution

Pink Coreopsis occurs in ten eastern seaboard states and in southwestern NS (Roland and Zinck 1998). In NS it is found on the shores of eight lakes in the Tusket, Carelton, and Annis river systems in Yarmouth County, Salmon, Wilsons, Bennetts, Raynards, Gillfillan, Agard, Sloans, and Pleasant Lakes. The estimated population size is approximately 276,600 to 328,000 stems. Wilsons Lake and Sloans Lake each are home to over 100,000 stems, with all other lakes having significantly fewer stems. Pink coreopsis has been extirpated from Gavels Lake and Lake Vaughan as a result of alterations to water levels with the construction of a hydroelectric dam in 1929.

Pink Coreopsis has a Global Rank of G3 and a Sub-National Rank (S-Rank) of S1 in NS. See the table below for the S-Rank in US states where it occurs. It is legally protected under the NS ESA, and under Schedule 1 of SARA, where it is listed as Endangered.

US & Canada State/Province Status: S-Ranks (Source, 2006: http://www.natureserve.org)	
United States	Delaware (S1), Georgia (SNR), Maryland (S1), Massachusetts (S3), Mississippi (SNR), New Jersey (S2), New York (S3), Pennsylvania (SX), Rhode Island (S2), South Carolina (S2)
Canada	Nova Scotia (S1)

3.1.4 Habitat and Biological Needs of Pink Coreopsis

Pink Coreopsis is found on infertile, gently sloping sandy, gravel, peat, or cobblestone lake shorelines (Isnor 1981, Maher et al. 1978, Pronych and Wilson 1993, Roland and Zinck 1998). It is associated with deposits of red till (Keddy 1984, Keddy 1985a). It prefers shorelines with naturally occurring environmental stresses and disturbances such as periodic water level fluctuations, wave action and/or ice scour which maintains a sparsely vegetated open habitat and prevents the establishment of more aggressive plants. It is frequently found with other rare species such as Plymouth Gentian, Water Pennywort and Tubercled Orchid..It is also associated with Grass-Leaved Goldenrod (or Slender Fragrant Goldenrod), Twigrush, Bog Yellow-eyed Grass, Redtop Panic Grass, Three-Way Sedge, and Golden-Pert (Keddy and Keddy 1983a).

Pink Coreopsis reproduces mainly asexually, through well-developed creeping subterranean rhizomes (Gleason 1952). Sexual reproduction in NS is sporadic. Flowering occurs between mid-July and mid-September and seed maturation takes place in late August and September. Fluctuating water levels influence flowering success and flowering mainly occurs during years when the water level is low (Keddy and Keddy 1983a). It is most likely insect pollinated (Keddy and Keddy 1983a). The production of a relatively small number of seeds limits the ability of the species to recover from severe habitat disturbance (Newell 1998a).

3.2 Thread-leaved Sundew

3.2.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2001

Common Name (population): Thread-leaved Sundew

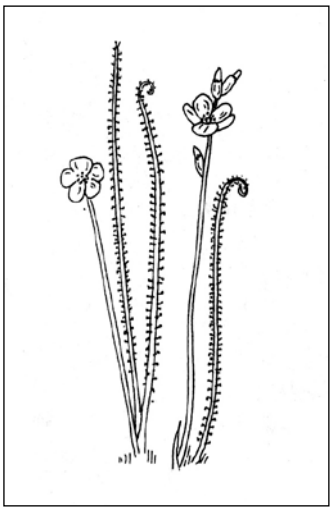
Scientific Name: *Drosera filiformis*

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 on-going risks of peat extraction.

Canadian Occurrence: NS

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



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3.2.2 Description

The Thread-leaved Sundew is a perennial, carnivorous herb that grows to a height of 15 to 25 cm. Its leaves are long, erect, and threadlike and rise from a spherical, whitish tuber that grows at or just under the surface (Freedman and Jotcham 2001). Reddish-purple, sticky, hair-like glands cover the leaves (Gleason 1952, Roland and Zinck 1998). Each plant produces 6-15 violet flowers with five petals and yellow centers that grow on peduncles (Zinck 1991).

This is one of three species of the Droseraceae carnivorous plant family found in NS. It has adapted to its nutrient poor, acidic habitat by trapping insects as a source of digestible nitrogen (Zinck 1991). Insects are attracted to the sticky liquid on the hairs of the leaf surface and once trapped, additional fluid and digestive enzymes are secreted to digest and absorb the prey (Zinck 1991).

3.2.3 Populations and Distribution

Thread-leaved Sundew is found along the eastern US from Massachusetts to southern New Jersey and from South Carolina to northern Florida (Isnor 1981, Zinck 1991). In Canada, the Thread-leaved Sundew is found in five bogs in a small area of southwestern NS. The five bogs

are in Shelburne County and include Swaines Road Bog, Quinns Meadow Bog, Port La Tour, Villagedale, and West Baccaro Bog. The total population of the Thread-leaved Sundew is tens of thousands of plants, and the five known locations occur within 10 km of one another. Its extent of occurrence is approximately 77 km^2, while its area of occupancy is approximately 11.5 km^2. It has a low rescue effect, as immigration is unlikely from the closest population in the US.

Thread-leaved Sundew has a Global Rank of G4 and a Sub-National Rank (S-Rank) of S1 in NS. See the table below for the S-Rank in US states where it occurs. It is legally protected under the NS ESA, and under Schedule 1 of SARA, where it is listed as Endangered.

US & Canada State/Province Status: S-Ranks (Source, 2006: http://www.natureserve.org)	
United States	Connecticut (SH), Delaware (SX), Florida (S1), Maryland (SNA), Massachusetts (S4), New Jersey (S4), New York (S3), North Carolina (S1), Pennsylvania (SNR), Rhode Island (SH), West Virginia (SNA)
Canada	Nova Scotia (S1)

3.2.4 Habitat and Biological Needs of Thread-leaved Sundew

In NS the Thread-leaved Sundew occurs in raised (or plateau) bogs which are infertile, acidic, open wetlands dominated by peat mosses, heath shrubs, short sedges and grasses. It requires open conditions and is typically found in peaty hollows where competition from other vegetation is limited (Zinck 1991). It is most often associated with Tufted Clubrush (*Trichophorum caespitosum*) (Freedman and Jotcham 2001) and Horned Bladderwort *(Utricularia cornuta)* (Dave MacKinnon pers.com. 2007). The carnivorous supplementation of nutrients is important because these bog habitats are typically characterized by slow decomposition rates and thus a limited availability of nutrients (Zinck 1991). Associated species include Tufted Clubrush, Coastal Sedge, White Beakrush, Northern Pitcher Plant, Bog Goldenrod *(Solidago uliginosa),* Curly-Grass Fern *(Schizaea pusilla),* Round-leaved Sundew *(Drosera rotundifolia),* Horned Bladderwort, Bog Aster, Leatherleaf, Sheep Laurel, Pale Bog Laurel *(Kalmia polifolia),* Bog Rosemary, *polifolia spp.* Chokeberry species., Bog Huckleberry, Common Juniper *(Juniperus communis),* Small Cranberry *(Vaccinium oxycoccos),* and Large Cranberry.

Reproduction occurs sexually through seed production. Flowering occurs from mid to late July into August (Roland and Zinck 1998). The flowers mature sequentially with the flowers lower on the stem maturing before the flowers higher on the stem (Zinck 1991). Pollination is thought to occur by insects (Zinck 1991). Each plant produces an average of eight seed capsules, with 70 seeds in each capsule (Zinck 1991). Seed dispersal is thought to occur locally through flowing water (Freedman and Jotcham 2001) although there are possibly other modes as well. Thread-leaved Sundew can be successfully propagated from cuttings (Freedman and Jotcham 2001). There is no genetic variation within or between populations of Thread-leaved Sundew in NS and Massachusetts, nor any signs of inbreeding depression (Cody 2002).

3.3 Tubercled Spike-rush

3.3.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2000, April 2010

Common Name (population): Tubercled Spike-rush

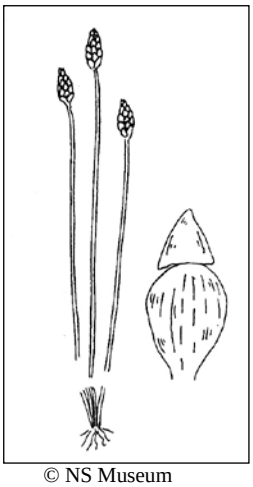
Scientific Name: *Eleocharis tuberculosa*

COSEWIC Status: Special Concern

Reason for Designation: Highly localized Atlantic Coastal Plain species widely disjunct in Nova Scotia from its main range along the American coastal states. Occurs at only a few sites covering very small areas of lakeshore habitats. Populations are threatened by recreational activities, cottage development and water pollution.

Canadian Occurrence: NS

COSEWIC Status History: Designated Threatened in May 2000. Designated Special Concern April 2010.



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3.3.2 Description

Tubercled Spike-rush is a grass-like plant, reaching a height of 10-40 cm. Its leaves are reduced to basal sheathes and its stiffly erect, flattened stems grow in dense clumps (Roland and Zinck 1998). 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 by its unusually large knob-like tubercle, which is nearly as long and wide as the honeycombed achene (fruit) that it grows upon (Gleason 1952, Roland and Zinck 1998). 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 (Newell and Zinck 1999). The name refers to its tubercle, which is often large as a result of a symbiotic relationship with microorganisms (Roland and Zinck 1998).

3.3.3 Populations and Distribution

Tubercled Spike-rush primarily ranges along the eastern seaboard to Florida and Texas, inland to northern Alabama and Tennessee, and west along the coast of the Gulf of Mexico to Texas (Roland and Zinck 1998). In NS it occurs on the shores of seven lakes: Harper, Gold, Western,

and Barrington Lakes in Shelburne County, Great Pubnico Lake and Mill Lake in Yarmouth County and Little Ten Mile Lake in Queens County (COSEWIC 2010). Total population is likely in the hundreds of thousands of stems, with large populations on Barrington Lake, Great Pubnico Lake, a small cove on Hapers Lake, and much smaller populations elsewhere. Evidence suggests that the population size fluctuates dramatically on a yearly basis and the species' detectability and possibly presence at sites varies from year to year with water levels. Long-term population trends are unknown.

Tubercled Spike-rush has a Global Rank of G5 and a Sub-National Rank (S-Rank) of S2 in NS. See the table below for the S-Rank in US states where it occurs. It is legally protected under the NS ESA, and under Schedule 1 of SARA, where it is listed as Special Concern.

US & Canada State/Province Status: S-Ranks (Source, 2006: http://www.natureserve.org)	
United States	Alabama (SNR), Arkansas (SNR), Connecticut (SNR), Delaware (S4), District of Columbia (SNR), Florida (SNR), Georgia (S4), Louisiana (SNR), Maine (S1), Maryland (SNR), Massachusetts (SNR), Mississippi (S5), New Hampshire (SH), New Jersey (S4), New York (S2), North Carolina (S5), Pennsylvania (SX), Rhode Island (SNR), South Carolina (SNR), Tennessee (SNR), Texas (SNR), Virginia (S5)
Canada	Nova Scotia (S2)

3.3.4 Habitat and Biological Needs of Tubercled Spike-rush

Tubercled Spike-rush occurs on 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). It is also found on vegetative mats that are either floating or pushed onto shorelines in storms or by ice. In NS, all populations grow in full sun, suggesting intolerance of shade (Zinck 1997). When found on floating mats, beavers may assist this species by reducing competing plant species by grazing and trampling the mats (Newell and Zinck 1999). Associated species include but are not limited to, Grass-Leaved Goldenrod (or Slender Fragrant Goldenrod), Bog Aster, Screw-Stem *(Bartonia paniculata* ssp. *iodandra),* Zigzag Bladderwort, Jointed Rush *(Juncus articulates),* and Virginia Meadow-Beauty (*Rhexia virginica)* (Zinck 1997).

Little is known about the biology of this species; some sources describe it as an annual whereas others list it as a perennial. It can reproduce vegetatively and form clumps. Flowering takes place in August and pollination occurs by wind. Seeds mature in September and October and are dispersed by wind or water. The floating vegetative mats may provide a means of dispersal and assist in the establishment of new sites around the lake if clumps of the mat break off and wash ashore in a new location (Zinck 1997).

3.4 Water Pennywort

3.4.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2000, May 2014

Common Name (population): Water Pennywort

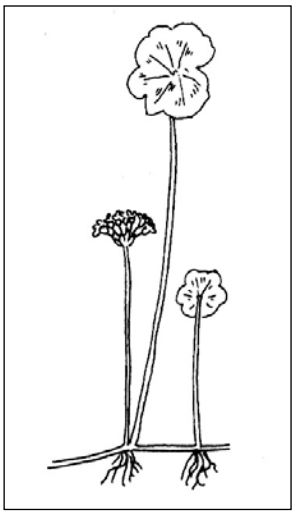
Scientific Name: *Hydrocotyle umbellata*

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.



3.4.2 Description

Water Pennywort is a small herbaceous perennial plant with the leaf petiole growing to a height of 10 to 30 cm. The slender stem of this clonal plant creeps on sand or gravel (Gleason 1952). The small round leaves have shallow lobes that are erect or floating. Leaves occurring above the water measure 1 cm in diameter while those occurring below the water measure 3 cm in diameter (Wilson 1984). Small clusters of white flowers are located on short rays on a long, thin peduncle (Roland and Zinck 1998). Typically, 12 small hermaphroditic flowers are found on each plant (Vasseur et al. 2002). In the NS population, seeds are not produced, possibly due to low genetic diversity or the short northern season (Vasseur et al. 2002). *Umbellata* signifies parasol-shaped (Roland and Zinck 1998) and *Hydrocotyle* comes from the Greek work *hydor*, meaning water, and *kotyle* meaning a shallow cup (Roland and Zinck 1998).

3.4.3 Populations and Distribution

Water Pennywort originated in the tropics and has spread north along the Atlantic and Pacific coasts (Roland 1976). It is considered a weed in many parts of the US where it grows abundantly. NS represents the northern limit of its range (Roland 1976, Wilson 1984). It is found on the shores of three lakes in southwestern NS; Kejimkujik Lake, located in Kejimkujik National Park and National Historic Site, Queens County, Wilsons Lake and Springhaven Duck Lake, Yarmouth County. Wilsons Lake is approximately 70 km southwest of Kejimkujik Lake. There are two known stands on Wilsons Lake and eight known stands on Kejimkujik Lake. At Wilsons Lake, one stand is 800 m long and the other is 100 m long, while both are several meters wide. These stands have remained relatively stable in size since 1985. Springhaven Duck Lake is less than 1km south of Wilsons Lake and drains into the Kiack Brook watershed. The population on Springhaven Duck Lake is mostly concentrated in the shallow southern cove and the eastern shoreline. At Kejimkujik Lake, most of the stands are relatively small in size. The unusually high number of dry summers in the park during the last decade has been beneficial to the plant. Therefore, at present, Water Pennywort populations within the park are doing well and have generally been expanding in size. Water Pennywort populations in Kejimkujik have been monitored annually since 2004 and have been stable over this period

Water Pennywort has a Global Rank of G5 and a Sub-National Rank (S-Rank) of S1 in NS. See the table below for the S-Rank in US states where it occurs. It is legally protected under the NS ESA, where it is listed as Endangered and under Schedule 1 of SARA as Threatened.

US & Canada State/Province Status: S-Ranks (Source, 2006: http://www.natureserve.org)	
United States	Alabama (SNR), Arkansas (SNR), California (SNR), Connecticut (S1), Delaware (S5), Florida (SNR), Georgia (SNR), Indiana (SNR), Louisiana (SNR), Maryland (SNR), Massachusetts (SNR), Michigan (SNR), Minnesota (SNR), Mississippi (SNR), New Jersey (S4), New Mexico (SNR), New York (S3), North Carolina (S5), Ohio (S1), Oklahoma (SNR), Oregon (SNR), Pennsylvania (SH), Rhode Island (SNR), South Carolina (SNR), Tennessee (SNR), Texas (SNR), Virginia (S5)
Canada	Nova Scotia (S1)

3.4.4 Habitat and Biological Needs of Water Pennywort

Water Pennywort is found primarily on sand or gravel lake shorelines in a narrow band above or below the waterline (Roland and Zinck 1998). It is generally found on lakeshores with soils that are acidic and nutrient poor. This species is often exposed to disturbances by wind, ice scour, and water fluctuations (Vasseur et al. 2002). Natural fluctuations of water levels from year to year and within a single growing season are instrumental by minimizing competition from other species. Water Pennywort is typically found growing in monocultures or with a low number of species (Vasseur et al. 2002). Rare associated species include Pink Coreopsis and Plymouth Gentian at Wilsons Lake, and Redtop Panic Grass, -+-+at Kejimkujik Lake (Wilson 1984).

Reproduction occurs asexually through stolons or runners, and through fragmentation. The stolon connection between leaves is maintained for a few months to 1.5 years, and can increase

survivorship by allowing resources to be shared (Vasseur et al. 2002). In NS, flowering is sporadic and occurs between July and September (Roland and Zinck 1998). Observations indicate that flowering generally occurs in the drier sections of suitable habitat (Vasseur et al. 2002). Recent studies in NS have discovered that seed production is absent and there is low genetic diversity in the NS populations of Water Pennywort (Vasseur et al. 2002). Seed production before the first frost may not be possible because of the short growing season and late flowering date (Vasseur ete al. 2002). Low genetic diversity could also play a role in the absence of seed production and could impact this species' long-term ability to adapt and conform to changing environmental conditions (Newell 1998b).

3.5 Redroot

3.5.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2000, November 2009

Common Name (population): Redroot

Scientific Name: *Lachnanthes caroliniana*

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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3.5.2 Description

Redroot is a perennial herb with yellow-green foliage, a pale green stem and a flowering stalk 20 to 40 cm tall. The vegetative plants have long, narrow leaves that are oriented vertically and those at the base of the flowering stalk are bright yellow-green and are folded in half lengthwise (Keddy 1994). The leaves are up to 40 cm long and 1 cm wide and most occur close to the base of the stem (Scoggan 1978). A very low proportion of rosettes flowers in any given year in Nova Scotia, with inflorescences consisting of a cluster of 10 to 30 dull light-yellow flowers may be observed 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 (Scoggan 1978, Gleason 1952). The name Redroot refers to the slender, blood-red underground roots. *Lachnanthes* comes from the Greek words *lachne* and *anthos*, meaning wooly-flower (Roland and Zinck 1998). *Caroliniana* means of the Carolinas (Roland and Zinck 1998).

3.5.3 Populations and Distribution

Redroot ranges from NS and Massachusetts, south along the coast to Florida, and Louisiana (Roland and Zinck 1998). It is also found in Cuba (Roland and Zinck 1998). In NS, it occurs in a small area along the shorelines of seven lakes: Ponhook, Little Ponhook, Molega, Cameron, Hog, First Christopher, and Beartrap Lakes in Queens County (Roland and Zinck 1998).). It was first discovered in NS in the early 1940s, but has only been relatively comprehensively surveyed in the past decade, with several hundred thousand rosettes now documented. Its flowering population is estimated at fewer than 1,200 plants.

Redroot has a Global Rank of G4 and a Sub-National Rank (S-Rank) of S2 in NS. See the table below for the S-Rank US states where it occurs. It is legally protected under the NS ESA, and under Schedule 1 of SARA, where it is listed as Special Concern.

US & Canada State/Province Status: S-Ranks (Source, 2006: http://www.natureserve.org)	
United States	Alabama (SNR), Connecticut (S1), Delaware (S1), Florida (SNR), Georgia (SNR), Louisiana (S2), Maryland (S1), Massachusetts (S3), Mississippi (SNR), New Jersey (S5), New York (S1), North Carolina (S4), Rhode Island (S1), South Carolina (SNR), Tennessee (S1), Virginia (SH)
Canada	Nova Scotia (S2)

3.5.4 Habitat and Biological Needs of Redroot

Redroot grows on the shorelines of lakes on substrates such as peat, sand and gravel (Keddy 1994). Abundance is highest on windward cobble beaches of peat or gravel that face to the southwest, often in shoreline stands of Twigrush (Keddy 1994, Wisheu et al. 1994). Fluctuations

in water levels control its distribution and abundance. Meadows of Twigrush are often associated with the presence of Redroot (Keddy 1994). Redroot is also sometimes associated with Goldencrest.

Plant reproduction occurs asexually and sexually through rhizomes, seeds and fragmentation. In NS, reproduction typically occurs asexually through the growth of vegetative plants from the rhizomes (Keddy 1994). Redroot flowers from August to September (Keddy 1994). Flowering individuals are rare and are typically located away from the water on the upper shoreline (Keddy 1994). Phenology and the type of reproduction are influenced by water levels. High water levels can inhibit flowering, seedling establishment and vegetative growth, whereas low levels can expose the buried seed bank, likely stimulating sexual reproduction. Fluctuating water levels are ideal because competitors would be removed during high water periods.

3.6 Goldencrest

3.6.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2000, May 2012

Common Name (population): Goldencrest

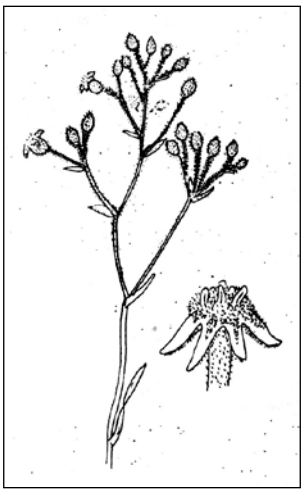
Scientific Name: *Lophiola aurea*

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. In May 2012 the status was changed to Special Concern.



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3.6.2 Description

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 located along the flowering stalks. The leaves at the base of the flowering stalk are grass-like, green with red at the base, and grow up to 30 cm in length (Keddy 1987b, Roland and Zinck 1998). The seeds are straw-coloured and are about 1 mm long (Gleason 1952). In the spring, it can be distinguished by the presence of persistent dried fruiting stalks from the previous season (Newell and Proulx 1998). *Lophiola* comes from the Greek, mane, and refers to the wooly inflorescence, and *aurea* signifies golden-yellow, and refers to the yellow flowers (Roland and Zinck 1998).

3.6.3 Populations and Distribution

In the US, Goldencrest ranges from New Jersey south to Florida and Mississippi (Roland and Zinck 1998). In Canada, it is found in NS on the shorelines of eight lakes: Beartrap, Hog, Ponhook and Little Ponhook and Molega Lakes in Queens County and Seven Mile, Fancy and Shingle Lakes in Lunenburg County. It is also found in four bogs: Dunraven Bog in Queens County, and Moores Lake Bog and Tiddville Bog in Digby County and Demones Run Bog in Lunenburg County. Two populations of Goldencrest have been extirpated in NS, including a small population on Brier Island and an extensive population on Digby neck. A third population recorded from "Sandy Cove" in 1949 has never been relocated. The Digby Neck population was extirpated due to diatomaceous earth mining and damming of the river that flowed through the wetland habitat (Newell 1998c). The total number of rosettes is very high, with many thousands at some sites, especially in the extensive occurrence around the shorelines of Ponhook Lake and Shingle Lake (east)

Goldencrest has a Global Rank of G4 and a Sub-National Rank (S-Rank) of S2 in NS. See the table below for the S-Rank in US states where it occurs. It is legally protected under the NS ESA, and under Schedule 1 of SARA, where it is listed as Threatened.

US & Canada State/Province Status: S-Ranks (Source, 2006: http://www.natureserve.org)	
United States	Alabama (S3S4), Delaware (SX), Florida (SNR), Georgia (S1?), Louisiana (S2S3), Mississippi (S4?), New Jersey (S4), North Carolina (S1)
Canada	Nova Scotia (S2)

3.6.4 Habitat and Biological Needs of Goldencrest

Goldencrest occurs on a number of substrates from sand to peat to floating bog mats, and is consequently found in three habitats; cobble lakeshores, bay bogs and fens (Keddy 1987b). These habitat types have naturally occurring stresses and disturbances such as wave action, periodic flooding, infertile substrate and waterlogged conditions which prevent more aggressive, common plant species from invading. Lake populations often occur along cobble shorelines in locations where peat accumulates from stands of Twigrush (Newell 1998c). It is often associated with rare species such as Redroot, Buttonbush, and Long's Bulrush (Newell 1998c).

Reproduction is primarily vegetative with shoots developing from the rhizomes (Keddy 1987b). The production of seeds appears to be sporadic, and suggests that seed bank stores for this species are low (Newell 1998c). Fluctuating water conditions allow for flowering and seedling establishment when water levels are low, and the reduction of competition when water levels are high (Keddy 1987b). Flowering occurs in August and September and swollen capsules are formed around mid-September (Keddy 1987b, Roland and Zinck 1998). Goldencrest is insect pollinated (Newell and Proulx 1998).

3.7 Plymouth Gentian

3.7.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2000, 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 in May 2000. In November 2012 it was reassessed as Endangered.

3.7.2 Description

Plymouth Gentian is a showy herbaceous perennial with 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 that grow at the end of long stalks (Keddy and Keddy 1983b). The plant has a single stem with opposite, sessile, lance-shaped leaves (Roland and Zinck 1998). The plants are stoloniferous, and the stolons terminate in leafy yellow-green rosettes. The seed capsules are cylindrical and measure 7 to 11 mm in length. The plant is named *kennedyana* in honour of George Golding Kennedy, a New England botanist (1841-1918) (Roland and Zinck 1998).

3.7.3 Populations and Distribution

Plymouth Gentian occurs in Massachusetts, North and South Carolina, Rhode Island, and southwestern NS (Zinck and Jensen 1998). In NS, it is located on the shores of 11 lakes in the Tusket River watershed including Wilsons, Gillfillan, Bennetts, Lac de l'École, Kegeshook, Pearl, Third, Lake Fanning, Agard, and Travis Lakes. It has been extirpated from Gavels Lake and Lake Vaughan as a result of alterations to water levels with the construction of a hydroelectric dam in 1929. It has also been extirpated from Canoe Lake for unknown reasons. Previous drafts of this recovery strategy referred to it being on Kempt Snare Lake. The original report for this was mislabelled and the lake has been searched extensively and no plants were found (ACCDC 2010 and 2013a).

The largest population is located on the shores of Wilsons Lake with an estimated population of several hundred thousand rosettes (COSEWIC 2012). The other lakes have significantly fewer plants; Gillfillan Lake has thousands of rosettes but most are vegetative in any one season. The NS population represents a significant proportion of the total global population (Keddy and Keddy 1983b; COSEWIC 2012). A small number of plants occur along the Tusket River between Pearl and Third Lakes (COSEWIC 2012).

Plymouth Gentian has a Global Rank of G3 and a Sub-National Rank (S-Rank) of S1 in NS. See the table below for the S rank in US states where it occurs. It is legally protected under the NS ESA, where it is listed as Endangered, and under Schedule 1 of SARA where it is listed as Threatened.

US & Canada State/Province Status: S-Ranks (Source, 2006: http://www.natureserve.org)	
United States	Massachusetts (S3), North Carolina (S1), Rhode Island (S1), South Carolina (S1), Virginia (SNA - introduced)
Canada	Nova Scotia (S1)

3.7.4 Habitat and Biological Needs of Plymouth Gentian

The Plymouth Gentian is found on broad, infertile, gently sloping lakeshores of sand, cobblestone, gravel, or peat, in areas typically associated with glacial deposits of red till (Keddy 1984, Keddy 1985a). Seedlings typically occur on peat lenses kept together by Twigrush (Hill et al. 2006). Periodic water level fluctuations are necessary to exclude more aggressive, competitively superior native shrubs and plants. Ice scour and wave action also help to prevent the establishment of more invasive plants. It is commonly associated with species such as Grass-Leaved Goldenrod (or Slender Fragrant Goldenrod), Twigrush, and Golden-Pert, as well as rare species such as Pink Coreopsis, Water Pennywort, Redtop Panic Grass, Southern-Rein Orchid, and Zigzag Bladderwort (Keddy and Keddy 1983b).

The main form of reproduction is vegetative through shoots called stolons. Each stolon terminates in a small leafy rosette, with flowering stems arising from the center of a small proportion of rosettes (Keddy and Keddy 1983b). Seed production is irregular and there is indication that this species has a small seed bank (Newell 1998d, Trant 2005). Seed production

may be key to the persistence of Plymouth Gentian populations as the buoyant seeds act as a dispersal mechanism in the connected Tusket river system (Hill et al. 2006). Flowering takes place between mid-July and mid-September and is highest in years when water levels are low (Keddy and Keddy 1983b). The fruit capsules mature in late August following a 6-10 day anthesis. This species is pollinated by syrphid flies and solitary bees (Perry 1971, Trant 2005).

3.8 Sweet Pepperbush

3.8.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2001, 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.


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3.8.2 Description

Sweet Pepperbush is a long-lived perennial, deciduous woody shrub that commonly grows in dense thickets and reaches a height of 1 to 2 m (Roland and Zinck 1998, Silberhorn 1999). It has shiny, alternate, serrated leaves that are 7 to 15 cm long and oval or oblong (Roland and Zinck 1998, Silberhorn 1999). Its flowers are small, white, and fragrant, with five petals that are approximately 8 mm in length. The flower are in a raceme, meaning they are on short stalks clustered together along a central elongated axis (Roland and Zinck 1998, Silberhorn 1999). It flowers from mid-August to mid-October, and produces green, globular, pubescent capsular fruit (approximately 0.5 cm wide) that becomes grey and peppercorn shaped by late autumn or early winter (Gleason 1952, Silberhorn 1999). Seed production may be limited in Nova Scotia. Its name is derived from its fragrant sweet flowers and grey peppercorn-shaped capsules (Silberhorn 1999).

3.8.3 Populations and Distribution

Sweet Pepperbush ranges from Texas and Florida, north to Maine, with a disjunct population in southwestern NS. In NS, this species is located along the shores of six lakes: Belliveau Lake in Digby County, Louis and Canoe Lakes in Yarmouth County, and a single connected population on Mill, Mudflat, and Pretty Mary Lakes in Annapolis County. Populations are large on Belliveau Lake (16,000 stems estimated) and at the Mill-Mudflat-Pretty Mary Lake population (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.

Sweet Pepperbush has a Global Rank of G5 and a Sub-National Rank (S-Rank) of S1 in NS. See the table below for the S-Rank in US states where it occurs. It is legally protected under the NS ESA, where it is listed as Vulnerable and under Schedule 1 of SARA as a species of Special Concern.

US & Canada State/Province Status: S-Ranks (Source, 2006: http://www.natureserve.org)	
United States	Alabama (S5), Connecticut (SNR), Delaware (S5), District of Columbia (SNR), Florida (SNR), Georgia (SNR), Louisiana (S4), Maine (S2), Maryland (SNR), Massachusetts (SNR), Mississippi (SNR), New Hampshire (SNR), New Jersey (S5), New York (S5), North Carolina (S5), Pennsylvania (SNR), Rhode Island (SNR), South Carolina (SNR), Tennessee (S1), Texas (SNR), Virginia (SNR)
Canada	Nova Scotia (S1)

3.8.4 Habitat and Biological Needs of Sweet Pepperbush

Sweet Pepperbush is found on unshaded shorelines that are often granite bouldered (Taschereau 1986). In contrast to other ACPF species, it occurs in areas that are protected from disturbances from wave and ice scour and is found in low catchment area lakes (Hill et al. 2000). Species frequently associated with Sweet Pepperbush include Sweet Gale and Black Huckleberry. At lower frequencies, Northern Bayberry *(Myrica pensylvanica), Photinia* spp. Chokeberry species, Winterberry Holly (*Ilex verticillata)* and Red Maple (*Acer rubrum)* are also associated with Sweet Pepperbush (Taschereau 1986).

In NS, reproduction is almost entirely vegetative by growth of suckers (Newell 2001). Flowering takes place between mid-August and mid-October, however, the ovules are typically not maturing to seed despite an abundance of pollinators during flowering. The reasons for limited sexual reproduction are not yet understood (Roland and Zinck 1998), and recent evidence indicates that some seedling production may occur occasionally (Hill et al. 2000).

3.9 New Jersey Rush

3.9.1 Species Assessment Information from COSEWIC

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 5000 -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.

*As of 2007 New Jersey Rush is located in 30 bogs and fens.

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3.9.2 Description

New Jersey Rush is a perennial rhizomatous herb reaching a height of 40-70 cm (Gleason 1952). The leaves are elongated, rough to the touch, and cylindrical, with regularly spaced divided walls or septa. The small green inconspicuous flowers are found in scattered clusters. The dark brown fruit capsules are sharply pointed and extend beyond the surrounding floral parts, holding seeds with well-developed tails that are 2-2.3 mm long (Gleason 1952, Roland and Zinck 1998). The long period of isolation of this population from other world populations is believed to have led to genetic variation between the two groups (Newell and Newell 1992).

3.9.3 Populations and Distribution

New Jersey Rush ranges from southern New Jersey and Maryland to northeastern Virginia (Roland and Zinck 1998). In Canada it is found in NS on Cape Breton Island, from Lower L'Ardoise to Fourchu, Cape Breton County and inland west to Loch Lomond (Roland and Zinck 1998). This species deviates from the typical distribution of ACPF, which are generally located in southwestern NS. It is found in 30 bogs and fens (Table 7) and its population was estimated in

the last status report (Newell 2004) at of 5000 to 10,000 mature individuals. Many new sites have been found since then and additional wetland surveys could find more individuals. There is a low rescue effect as immigration is unlikely from the closest nearby population in New Jersey (Newell 2004). This species is globally rare and consequently the NS population represents a significant proportion of the total global population (Newell 2004).

New Jersey Rush has a Global Rank of G2 and a Sub-National Rank (S-Rank) of S1S2 in NS. See the table below for the S-Rank in US states where it occurs. It is legally protected under the NS ESA, where it is listed as Vulnerable and under Schedule 1 of SARA as a species of Special Concern.

US & Canada State/Province Status: S-Ranks (Source, 2006: http://www.natureserve.org)	
United States	Maryland (S1), New Jersey (S2), North Carolina (S1), Virginia (S2)
Canada	Nova Scotia (S2)

3.9.4 Habitat and Biological Needs of New Jersey Rush

New Jersey Rush is found on the edges of small bays or coves of bogs and fens, and in small boggy openings in coniferous woods (Newell and Newell 1992). It requires early successional or open conditions because it cannot compete with woody species. It is found in wet areas but does not tolerate prolonged standing water conditions (Newell 2004). Moderate disturbance (as are found along animal trails through peatlands) are important as they enhance growth of New Jersey Rush by removing competing vegetation (Newell 2004). It is sensitive to hydrological changes and is negatively affected by events such as site drainage or flooding (Newell 2004). In July 1991, five sites in the Point Michaud region were sampled for pH levels and peat depth (Newell 2004). The pH ranged from 4.07-5.52 and peat depths ranged from 40 cm to >2 m (Newell 2004). Associated species include but are not limited to, Black Spruce *(Picea mariana),* Pickering's Reed Grass, Coastal Sedge, Three-leaved False Soloman's Seal *(Maianthemum trifolium),* Northern Pitcher Plant *(Sarracenia purpurea),* and Pale Bog Laurel (Newell and Newell 1992).

Reproduction is achieved mainly asexually through the division of the rhizome. Sexual reproduction is known to occur infrequently in the US. Seed production has not been observed in NS (Newell 2004), but it has not been studied intensively and must occur to some degree given the extent of the species' occurrence. Flowering occurs in July and August, and fruit is produced from August to October. Pollination occurs by wind. The relative level of self pollination compared to cross pollination is yet to be determined (Schuyler 1990).

3.10 Eastern Lilaeopsis

3.10.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2004

Common Name (population): Eastern Lilaeopsis

Scientific Name: *Lilaeopsis chinensis*

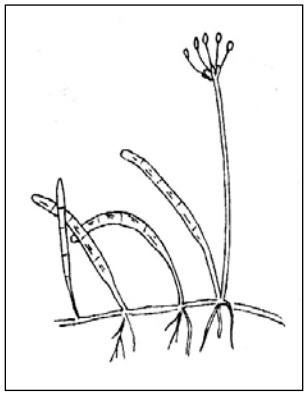
COSEWIC Status: Special Concern

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.

*As of 2007 Eastern Lilaeopsis is now known to occur in five estuaries.



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3.10.2 Description

Eastern Lilaeopsis is a small, semi-aquatic, perennial herb that grows close to the substrate on shorelines in the intertidal zone (Holder 2004). The short, dark green leaves are a few centimetres long and grow at irregular intervals along a slender horizontal rhizome (Keddy 1987a, Roland and Zinck 1998). The peduncle or flower stalks are up to 8 cm long (Scoggan 1978). At the top of the flowering stem, tiny white flowers with five petals occur in clusters of 5 to 7 (Keddy 1987a). The flowers are arranged in an umbel, meaning each pedicle (the stalk supporting the individual flower) originates from the same point. The fruit is ovoid and approximately 2 mm in length (Gleason 1952). It is named *chinensis* because the early botanist Carl Linnaeus erroneously believed it originated in China (Roland and Zinck 1998).

3.10.3 Populations and Distribution

Eastern Lilaeopsis ranges along the Atlantic Coast from NS to Florida, and west to Mississippi along the coast (Isnor 1981, Roland and Zinck 1998). In Canada, Eastern Lilaeopsis occurs in NS in six river estuaries: Tusket and Annis Rivers in Yarmouth County, La Have River in Lunenburg County, Medway River in Queens County, Roseway River in Shelburne County, and

River Philip in Cumberland County (Roland and Zinck 1998, Boates, pers. com. 2006, Klymko, pers. com. 2006). In 2010 it was found in the tidal lake of Pleasant Lake upriver from the previously known Annis River site. It is abundant at all known locations, with many thousands of plants. The area of occupancy is very small but the population is relatively large. The rescue effect is low as immigration is unlikely from the nearest populations in the US Atlantic states (Holder 2004).

Eastern Lilaeopsis has a Global Rank of G5 and in NS a Sub-National Rank (S-Rank) of S2. See the table below for the S-Rank in US states where it occurs. It is legally protected under the NS ESA, where it is listed as Vulnerable and is listed under Schedule 1 of SARA as a species of Special Concern.

US & Canada State/Province Status: S-Ranks (Source, 2006: http://www.natureserve.org)	
United States	Alabama (SNR), Connecticut (S3), Delaware (S5), Florida (SNR), Georgia (SNR), Louisiana (SNR), Maine (S2), Maryland (SNR), Massachusetts (SNR), Mississippi (SNR), New Hampshire (S2), New Jersey (S4), New York (S2), North Carolina (S3?), Rhode Island (S1), South Carolina (SNR), Virginia (S5)
Canada	Nova Scotia (S2)

3.10.4 Habitat and Biological Needs of Eastern Lilaeopsis

Eastern Lilaeopsis is found in the intertidal zone along the shorelines of estuaries, mainly on gentle, muddy slopes, and occasionally on gentle slopes of fine gravel (Environment Canada 2000, Roland and Zinck 1998). All five populations are near the mouth of large rivers in elongated, narrow estuaries cut off from the open ocean (Keddy 1987a). It grows well in the intertidal zone, and is submerged under up to 2 m of water for part of each day (Keddy 1987a). However, in controlled settings this species also does well in drier conditions and in freshwater (Affolter 1985). It is mainly found where Saltwater Cordgrass (*Spartina alterniflora)* dominates the intertidal river shore, and is sometimes associated with Sea Milkwort *(Glaux maritima)* and Seaside Plantain *(Plantago maritima).* The level of tolerance to competing vegetation is unclear (Holder 2004).

Reproduction is both vegetative through the elongation and branching of the rhizome and by seed. The main form of reproduction appears to be vegetative. Flowering occurs between August and mid-September, and specific pollination mechanisms are unknown (Holder 2004). Approximately 5-7 seeds are produced per umbel (Keddy 1987a). Seed dispersal is presumably through the water using tidal fluctuations and water currents (Holder 2004). Buoyancy is enhanced through the spongy tissue in the seed, which may allow the seed to float over considerable distances (Holder 2004).

3.11 Long's Bulrush

3.11.1 Species Assessment Information from COSEWIC

Date of Assessment: April 1994

Common Name (population): Long's Bulrush

Scientific Name: *Scirpus longii*

COSEWIC Status: Special Concern

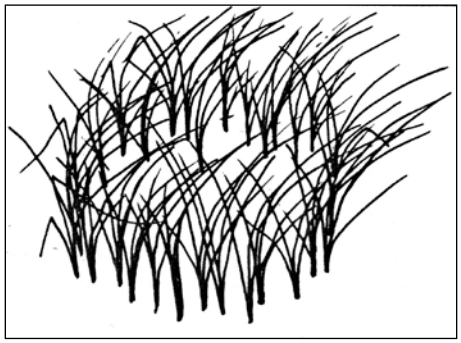
Reason for Designation: Restricted range and limited sexual reproduction with significant reduction of one site due to road development.

Canadian Occurrence: NS

COSEWIC Status History: Designated Special Concern in April 1994.

3.11.2 Description

Long's Bulrush is a slow growing perennial that grows in circular clusters, with flowering stems reaching a height of 1.5 m. Leafy shoots first appear at the growing ends of thick underground rhizomes just under the surface of the substrate (Hill 1992). These shoots create ring-shaped clusters, which can form large colonies. The largest clusters measure 5 to 10 m in diameter and were estimated to be 150 to 400 years old based on a colony with a 1 m width that was about 40 years old based on growth rings on the rhizome (Hill 1992). The tough, serrated leaves are most often bent over close to the top and are approximately 60 to 80 cm long and 5 to 10 mm wide (Gleason 1952). The flowers are in small spikelets which are 5 to 8 mm long (Gleason 1952, Roland and Zinck 1998). Long's Bulrush flowers when disturbed. The bracts (modified leaves at base of flower or flower cluster) are black and on humid days are sticky. The scales are blackish and approximately 3 mm long, while the achenes (fruit) are brown or reddish and 0.8 mm long with five bristles (Gleason 1952, Hill 1992). In early September the leaves turn a golden colour and the plant dies back to its base. The plants are submerged from November till April and during this time new yellowish green leaves begin forming that are 8 cm long by early May. It is named *longii* after its discoverer, Bayard Long (Roland and Zinck 1998).



Hill and Johansson (1992)

3.11.3 Populations and Distribution

In the US, Long's Bulrush ranges from New Jersey to Maine. In Canada, it occurs in peatlands and occasionally on lakeshores in southern Nova Scotia, with known populations spread between Wilsons Lake in Yarmouth County and Smith Lake and Demones Run in Lunenburg County. It is known from lake-associated habitats at Shingle, Wilsons, Ponhook, Little Ponhook, Molega, Hog, Moosehorn, Lac de l'Ecole, Ten Mile, First Christopher, Kejimkujik, George and Loon Lakes; from river-associated habitats on the Pleasant, Mersey, Wildcat and Medway Rivers and Demones Run; and from large peatlands at Dunraven Bog, Eighteen Mile Brook, Quinns Meadow, Wilkins Lake, Bull Moose Lake, Big Sixteen Mile Bay of Lake Rossignol, Smith Lake, Little Rocky Lake, Barren Meadow Brook, and Blue Hill Bog Brook. Knowledge of the occurrences of Long's Bulrush in Nova Scotia is less complete than is the case with most other legally-listed ACPF. In the past decade it has been found at 26 new locations (AC CDC 2014; locations there defined based on a 1 km separation distance, so some large lakes have several locations), generally in habitats that are fairly common in southwestern Nova Scotia, so a considerable number of additional locations likely remain to be discovered. The unit by which population is measured for a future COSEWIC update report would be the rosette (a cluster of leaves from a single shoot coming off a rhizome), because the species can reproduce via rhizome fragmentation (Hill 1992). The number of rosettes is likely in the tens or hundreds of thousands at a few of the largest sites (Pleasant River and the west end of Shingle Lake, Ponhook Lake around Grassy Point and Eighteen Mile Brook) and is in the thousands at a number of other sites. The number of genetic individuals would be vastly lower because of the preponderance of vegetative reproduction.

Little is known about whether Canadian populations are expanding or declining. In the U.S., the species has been extirpated from New York, and two populations have been extirpated from Massachusetts.

Long's Bulrush has a Global Rank of G2G3 and a Sub-National Rank (S-Rank) of S2S3 in NS. See the table below for the S-Rank in US states where it occurs. It is legally protected under the NS ESA, where it is listed as Vulnerable and under Schedule 3 of SARA as a species of Special Concern.

US & Canada State/Province Status: S-Ranks (Source, 2006: http://www.natureserve.org)	
United States	Connecticut (SH), Maine (S2), Massachusetts (S2), New Hampshire (S1), New Jersey (S2), New York (SX), Rhode Island (S1)
Canada	Nova Scotia (S2S3)

3.11.4 Habitat and Biological Needs of Long's Bulrush

Long's Bulrush is found in five wetland habitats including stillwater peatlands, inland fens, lakeshore bay bogs, lakeshore barrier bogs and peat lakeshores (Hill 1992). It is located on peat substrates where competition from shrubs is minimal due to waterlogged conditions or ice scour, a low pH and low available nutrients (Hill 1992). It tends to grow in the most waterlogged areas

of these habitats, where shrub growth is suppressed (Hill and Johansson 1992). It tends to be located in sheltered areas such as coves and on east-facing shores (Wisheu et al. 1994). Stillwater meadows and fen habitats contain the oldest and largest colonies of Long's Bulrush and this may be correlated with lower levels of ice scouring (Hill 1992).

Flowering occurs very infrequently at all populations except for the colony at Lac de l'Ecole, which flowers annually. The main form of reproduction is vegetative through underground rhizomes. Leafy shoots develop from the growing ends of rhizomes and form colonies that slowly grow outwardly in a circular pattern. Flowering occurs between June and early July, and (except for Lac de l'Ecole) appears to be dependent on disturbance like OHV damage, fire, muskrat grazing, and road building (Schuyler and Stasz 1985, Hill 1992). It is assumed that this species is wind pollinated, and seed dispersal occurs by water or wind (Hill 1992). However, because seed production is infrequent, fragments of rhizome dislodged from ice scour or muskrat herbivory may play an important role in dispersal (Hill 1992).

When flowering, Long's Bulrush can hybridize with the weedy and common Wooly Bulrush (*Scirpus cyperinus)*, which is widespread in disturbed areas (MacKay et al. 2008). Hybridization of these two species has been observed in NS in two bogs that have been disturbed (MacKay et al. 2008). Reduction or elimination of disturbance that would increase Wooly Bulrush populations in the vicinity of Long's Bulrush should help to maintain the genetic integrity of this species.

3.12 Eastern Baccharis

3.12.1 Species Assessment Information from COSEWIC

Date of Assessment: November 2011 (New)

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.

3.12.2 Description

Eastern Baccharis is a densely branched and often multi-stemmed, perennial, woody shrub in the Aster family that occurs in the upper margins of saltmarshes and beaches. It is typically 1 to 3 metres tall in Canada, but is known to reach 6 m in more southern areas. Although Eastern Baccharis can be evergreen in most of its global range, it is semi-deciduous or deciduous in the northern United States, and is completely deciduous in Canada. Eastern Baccharis is dioecious, meaning male and female flowers are on separate plants. Male and female shrubs do not differ in vegetative characteristics. Flower heads contain 20 to 30 florets (small individual flowers) and are whitish, but profuse pollen production often gives male flowers a yellow colour. The achenes (seeds) are firmly attached to a tuft of 10 to 14 mm long 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. A more detailed and fully referenced description is available in COSEWIC (2011).

Britton, N.L., and A. Brown. 1913

3.12.3 Populations and Distribution

Eastern Baccharis occurs in eastern North and Central America and the northern Caribbean (COSEWIC 2011; Figure 1). 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. Eastern Baccharis is also native to Cuba and the Bahamas. Eastern Baccharis becomes more restricted to the coast in the northern end of its continuous distribution, from Virginia to Massachusetts.

Canadian occurrences are restricted to a 13 km wide x 12 km long coastal region of extreme southwestern Nova Scotia (Figure 2) east of Yarmouth, with a single individual a further 12 km southeast at West Pubnico. Within this small range, Eastern Baccharis is highly concentrated in a few sites on the Tusket River Estuary and Lobster Bay. A 300m x 250m area on Morris Island, Lobster Bay and a 400m x 100m 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. This concentration makes the species very susceptible to large, rapid population declines if development, storm events or other impacts were to affect the key sites. The total Canadian population is estimated at 2,850 individuals. Population trends in Canada are unknown. Small declines are likely occurring with shoreline development. 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 poorly understood.

US & Canada State/Province Status: S-Ranks (Source, 2006: http://www.natureserve.org)	
United States	Secure (S5): Delaware, New Jersey, New York, North Carolina and Virginia Not Ranked (SNR*) in Alabama, Arkansas, Connecticut, District of Columbia, Florida, Georgia, Louisiana, Maryland, Massachusetts, Mississippi, Oklahoma, South Carolina and Texas Vulnerable (S3): Pennsylvania Imperilled (S2): Rhode Island
Canada	Critically Imperilled (S1): Nova Scotia

* SNR - frequently but not necessarily indicating a lack of conservation concern

3.12.4 Habitat and Biological Needs of Eastern Baccharis

Rangewide, Eastern Baccharis occurs in open coastal forests, dune thickets, beaches and saline to freshwater intertidal marshes dominated by herbaceous or shrubby species (Penfound and Hathaway 1938; Mahler and Waterfall 1964; Allain and Grace 2001). In the southern United States, it can also be found in anthropogenically disturbed habitats such as fields, waste areas, roadsides and railways (Boldt 1989; Lance 2004).

In Canada, Eastern Baccharis occurs in a more restricted range of coastal habitats. Known occurrences are in unshaded or partially shaded sites on the margins of well-developed

salt marshes or on upper beaches, usually fronted by saltmarsh. Occurrences are above the extent of daily tidal inundation and all of the Canadian population is in estuaries or bays that provide significant protection from onshore wind and waves. The species is most often found in the upland fringe of salt marshes, in or near the transition zone to coastal forest, where soil salinity is lower and vegetation cover is predominantly graminoids and low shrubs. These habitats include both halophytic and non-halophytic species commonly including Saltwater Cordgrass, Freshwater Cordgrass, Tick Quackgrass (*Thinopyrum pycnanthum*), New Belgium Aster (*Symphyotrichum novi-belgii*), Seaside Goldenrod (*Solidago sempervirens*), Virginia Rose (*Rosa virginiana*), Black Huckleberry, Bayberry (*Myrica pensylvanica*), Winterberry Holly, Red Maple and Red or White Spruce (*Picea rubens* or *P. glauca*).

Climate likely plays a major role in limiting the species' Canadian distribution. Through the influence of ocean currents, the coastal zone of southwestern Nova Scotia from Digby to Liverpool, especially the area around Yarmouth where Eastern Baccharis occurs, has the warmest Canadian winters outside of southern British Columbia (USDA 1990), with temperatures considerably milder than the coast of Maine at the same latitudes (USDA 1990; Agriculture and Agrifood Canada 2000). The fact that the small islands and points on which Eastern Baccharis occurs within the Tusket River Estuary and Lobster Bay are surrounded by water that generally remains open through the winter likely further moderates winter temperatures.

Observations in Nova Scotia suggest that frequency and duration of flooding, exposure to wave action, and shading from tree cover are important limiting factors on a more local scale. At its Nova Scotian occurrences, Eastern Baccharis' is typically the woody species extending furthest into the saltmarsh from terrestrial habitats, suggesting it can tolerate higher salinity levels than other Nova Scotia shrubs. Studies elsewhere have verified tolerance of a range of soil and groundwater salinity levels (Young et al. 1994; Westman et al. 1975), but have shown intolerance to prolonged high-salinity conditions (Tolliver et al. 1997). Eastern Baccharis appears to occur only in areas above the zone subject to daily tidal flooding. 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. 2010).

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 because of greater cold-tolerance or other factors. Competition from taller woody plants appears to be a significant limitation because at all known Canadian sites, individuals seem to be restricted to open and semi-open 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).

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.

Within its narrow coastal habitat, and aside from the effects of salinity and flooding noted above, soil type and chemistry do not appear to significantly limit the species in Nova Scotia. Occurrences are in a region of generally acidic soils, and soils in which it grows include some with high organic content and some sandy or gravelly sites. Elsewhere Eastern Baccharis is known to thrive in a wide variety of substrates from pure sand to pure clay (Dirr and Heuser 1987), and studies indicate tolerance of a wide range of soil pH (3.6 to 9) and available nutrients (560-5500 ppm Kjeldhal nitrogen and 4-73 ppm phosphorous; Westman et al. 1975).

Availability of viable seeds and suitable microsites for seedling establishment and growth to maturity is a critical long-term need for Eastern Baccharis in the face of rising sea levels that will likely make currently occupied sites unsuitable. As a small, isolated occurrence, the Canadian population of Eastern Baccharis could be subject to genetic founder effects that limit seed production or viability (Ellstrand et al. 1993). No Canadian research on seed production and viability or seedling establishment has yet been undertaken.

3.13 Spotted Pondweed

3.13.1 Species Assessment Information from COSEWIC

Date of Assessment: (no COSEWIC assessment); July 2013 for NS ESA (New)

Common Name (population): Spotted Pondweed

Scientific Name: *Potamogeton pulcher*

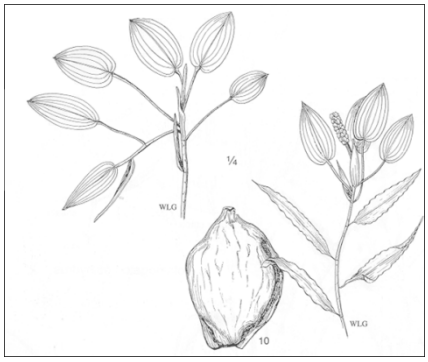
COSEWIC Status: Never evaluated
Nova Scotia ESA Status: Vulnerable

Reason for Designation: A freshwater aquatic plant of the Atlantic Coastal Plain Flora found within Canada almost exclusively in southwest Nova Scotia in highly acidic, nutrient-poor lakes and rivers. The most imminent threats are any activities that change water quality or quantity especially those that may enrich nutrient levels and increase competition from other plants.

Canadian Occurrence: NS, ON (historic)

COSEWIC Status History: Never evaluated.
Nova Scotia ESA Status History: Designated Vulnerable July 2013

3.13.2 Description



Holmgren (1998), with permission.

Spotted Pondweed is an aquatic herbaceous plant with annual stems arising from perennial rhizomes. Its vertical stem length varies with water depth from a few cm when stranded by receding water levels to 95+ cm in deeper water. Stems are usually conspicuously dark-spotted, especially toward the base. Both submersed and floating leaves are produced, with the submersed leaves 4-14 cm long, lance-shaped and having a fine, filmy texture, and the floating leaves 2-8 cm long and thicker with rounder tips. Buoyed by the floating leaves, the inflorescences are dense spikes of tiny flowers held just above the water's surface. Inflorescences are 2-3.5 cm long and 8-11 mm thick when in fruit.

The species is most similar to Large-leaved Pondweed (*Potamogeton amplifolius*) and is known to hybridize with that species in Nova Scotia and elsewhere. Spotted Pondweed is distinguished from Large-leaved Pondweed as follows: stem conspicuously dark-spotted (vs. not spotted); submersed leaves usually not arched (vs. arched), 1-2.5 cm wide (vs. up to 7.5 cm wide), with 7-19 (vs. 19-49) veins; floating leaves cordate or rounded (vs. wedge-shaped or rounded) at base

with 15-19 (vs. 27-49) veins; fruit rounded or lobed (vs. wedge-shaped) at base (Mazerolle and Blaney 2010).

3.13.3 Population and Distribution

Spotted Pondweed is found in the eastern United States and just into adjacent Canada, with the northern margin of its range in southern Nova Scotia, southern Maine, and the northern parts of New York, Michigan and Minnesota. It extends west to Minnesota, Missouri and southeast Texas. The species has a distinct affinity for the Atlantic Coastal Plain, with the densest documentation of records occurring between southern New Hampshire and Massachusetts and southern Texas, especially in the coastal regions north of North Carolina. It is otherwise rare in all states in which it occurs, except for Tennessee and Oklahoma. Nova Scotia populations are a minimum of 220 km northeast of the next nearest sites in Penobscot County, Maine and are thus significantly disjunct and presumably genetically isolated. (Mazerolle and Blaney 2010).

In Canada it is scattered in the southern half of Nova Scotia and there is one record from Rondeau Bay on Lake Erie in southernmost Ontario, but it has not been documented in Ontario since 1948 and may be extirpated there. New fieldwork since 2007 has significantly increased the known distribution of Spotted Pondweed in Nova Scotia. Almost all records are in the ACPF zone between southern Lunenburg County and southern Digby County, with two additional records from Halifax County, the northernmost from Upper Musquodoboit. Reports from elsewhere (Grand Lake in Annapolis County, Grand Etang in Inverness County, Chain Lake Brook in Colchester County) are either known to be incorrectly identified or are dubious and unsupported by specimens. The abundance of unsurveyed acidic lakes in southwest Nova Scotia similar to known sites, and the frequency with which new locations have been discovered in the past ten years strongly suggests that a fair number of additional locations could be discovered. However, the overall proportion of surveyed lakes in southern Nova Scotia found to have the species is low, so Spotted Pondweed is clearly uncommon. As of November 2014, Spotted Pondweed is known from Mill, Raynards, Salmon and Long Lakes in Yarmouth County; Belliveau, Sears* and Placides Lakes in Digby County; Molega, McBride and Carrigan Lakes and the Medway River* (three different sites) in Queens County; Shingle, Hirtle and Rhodenizer Lakes and “Maitland Pond”* (not a name in current use, but likely corresponds to one of Little Lake, Langille Little Lake or Naas Lake near Maitland) in Lunenburg County; and the Upper Musquodoboit area* in Halifax County. Asterisked sites are known only from historic records but may still be extant. (Mazerolle and Blaney 2010).

U.S. & Canada State/Province Status: S-ranks from NatureServe Explorer (2014)	
United States	Alabama (SNR), Arkansas (S3), Connecticut (SNR), Delaware (S5), Florida (SNR), Georgia (SNR), Illinois (S1), Indiana (S1), Kentucky (S1S2), Louisiana (SNR), Maine (S1), Maryland (SNR), Massachusetts (SNR), Michigan (S2), Minnesota (SNR), Mississippi (SNR), Missouri (S2S3), New Hampshire (SNR), New Jersey (S3S4), New York (S2), North Carolina (S4), Ohio (S2), Oklahoma (SNR), Pennsylvania (S1), Rhode Island (SNR), South Carolina (SNR), Tennessee (SNR), Texas (SNR), Vermont (SNR), Virginia (S4), West Virginia (S1), Wisconsin (S1)
Canada	Nova Scotia (S1S2), Ontario (SH)

3.13.4 Habitat and Biological Needs of Spotted Pondweed

Little published research is available on Spotted Pondweed's specific habitat requirements and ecology. Available information is largely based on qualitative field observations. Throughout its global range, Spotted Pondweed is reported to occur in various types of stagnant to slow-flowing aquatic habitats including lakes, ponds, muddy or peaty pools, rivers, slow-flowing streams and runnels in bogs. It is generally a species of acidic waters, but can also be found in waters with nearly neutral pH levels (Williams 1997).

Most confirmed populations in Nova Scotia are found in lakes, with river populations coming from larger rivers, which may have been in lake-like slow-flowing pools or stillwaters. Data collected in recent surveys indicates that the species is mainly found growing on muddy substrates at depths of approximately 10 cm to about 2 m, often within fairly dense stands composed of several submersed and emergent species. Plants at some sites (Carrigan Lake and Rhodenizer Lake) have been observed near shores within zones where water has receded entirely in the late summer, stranding plants on mud and peaty organic soil. An ability to tolerate extreme water level fluctuations is also suggested by Spotted Pondweed's occurrence on the Raynards Lake reservoir, where water levels fluctuate dramatically with Nova Scotia Power management. Commonly associated species include Pickerel weed (*Pontederia cordata*), Algae-like pondweed (*Potamogeton confervoides*), Purple bladderwort (*Utricularia purpurea*), Greater bladderwort (*Utricularia macrorhiza*), Seven-angled pipewort (*Eriocaulon aquaticum*), Yellow cowlily (*Nuphar lutea ssp. variegata*), American water-lily (*Nymphaea odorata*), Floating-heart, Nuttall pondweed (*Potamogeton epihydrus*) and Water lobelia (*Lobelia dortmanna*) (Mazerolle and Blaney 2010). All recently surveyed populations occur in oligotrophic to mesotrophic water bodies in clear to moderately turbid conditions.

Spotted Pondweed reproduces vegetatively by rhizome growth and fragmentation and sexually by seeds, which are moved by water and by animals. Anthropogenic processes or activities most likely to impact the habitat and biological needs of Spotted Pondweed are: 1) eutrophication of acidic, nutrient-poor lake habitat through industrial agriculture (especially mink farming), fish processing or other activities, which would likely act on the species through increased competition from more common native species; 2) habitat removal or alteration for development such as dock building or infilling into shallow water; 3) establishment of dense populations of invasive species such as Floating-hearts that might outcompete the species; 4) major, long-term water level alteration through dam creation or removal. (Mazerolle and Blaney 2010).

3.14 Tall Beakrush (*Rhynchospora macrostachya*)

3.14.1 Species Assessment Information from COSEWIC

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.

3.14.2 Description

Britton and Brown (1913)

Tall Beakrush is a perennial, herbaceous sedge. 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 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.

3.14.3 Populations and Distribution

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. Isolated records are reported for Kentucky, and northern New York. Reports from Illinois, Mississippi and Vermont are erroneous. The

Canadian occurrence is restricted to two lakes, Carrigan Lake and Molega Lake, which are 23 km apart in southern Nova Scotia and which are part of the Mersey and Medway watershed groupings, respectively. The vast majority of individuals (688, or 95%) are found on Carrigan Lake (AC CDC 2013). This occurrence is isolated from others further south by 468 km and is the northernmost worldwide, suggesting potential significance to the species' range-wide genetic diversity. The Canadian population supports less than 1% of the global population.

Tall Beakrush has a Global Rank of G4, a rank of N1 (Critically Imperilled) in Canada, and a Sub-National Rank (S-Rank) of S1 in NS. See the table below for the S-Rank in US states where it occurs.

US & Canada State/Province Status: S-Ranks (Source, 2014: http://www.natureserve.org)	
United States	Alabama (SNR), Arkansas (SNR), Connecticut (S1S2), Delaware (S4), District of Columbia (SNR), Florida (SNR), Georgia (SU), Indiana (S2), Kansas (S2), Kentucky (S1), Louisiana (SNR), Maine (S1), Maryland (SNR), Massachusetts (SNR), Michigan (S3S4), Mississippi (SNR), Missouri (SNR), New Jersey (SNR), New York (S3), North Carolina (S3?), Oklahoma (SNR), Rhode Island (S1), South Carolina (SNR), Tennessee (S1S2), Texas (SNR), Vermont (SNR), Virginia (S3)
Canada	Nova Scotia (S1)

3.14.4 Habitat and Biological Needs of Tall Beakrush

Tall Beakrush is an obligate wetland plant (Blaney 2011) occurring in Canada on shallow acidic open lakeshores that are fully exposed (or nearly so) during summer low water levels. Substrates are mostly gravelly, 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. The most frequently associated species, in order of frequency, are Virginia Marsh St. John's Wort (*Triadenum virginicum* s.st.), Eaton's Witchgrass (*Dichanthelium spretum*), Three-Way Sedge, Bog Aster, Sweet Gale, Twigrush, Pickerel Weed , Large Cranberry , Royal Fern (*Osmunda regalis* var. *spectabilis*), and Swamp Loosestrife (*Lysimachia terrestris*) (AC CDC 2013b). In the southern United States, Tall Beakrush also occupies freshwater and slightly saline tidal marshes, swamp forests, and marshes and sloughs within tallgrass prairies, and it can occur in disturbed habitats such as ditches, all-terrain vehicle tracks, pipeline rights-of-way, rice fields and impoundments. The lakeshore habitats occupied by Tall Beakrush in Nova Scotia support a high diversity of restricted and rare plants with affinity to the coastal plains of the eastern and southern U.S. These low biomass, high diversity lakeshore communities are maintained by acidic, nutrient-poor conditions and 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).

In Nova Scotia, Tall Beakrush flowers from July to September. Pollination is presumed to be largely or entirely by wind, as is the case with most sedges. It is believed to be self-compatible. Seed-like achenes are dispersed from the parent plant in the fall and their long bristles may facilitate dispersal via floatation or on animals. Internal and external dispersal by waterfowl over longer distances is also likely. In a closely related species, germination occurs best in drier periods that are ideal for growth. Reproduction before age one occurs in the United States but

probably requires at least two or three years in Nova Scotia, based on observation of mid-sized, non-flowering rosettes. The species is non-rhizomatous but vegetative reproduction occurs over very short distances via production of new rosettes to the side of existing ones. Demographics of vegetative reproduction are unknown, as are longevity of genetic individuals and ramets, and generation time.

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Appendix 1: High and Medium Priority ACPF Species

The high and medium priority ACPF species of NS and their rankings including: Global (G), Sub-national (S), and National (N), COSEWIC, *Species at Risk Act* (SARA), *NS Endangered Species Act* (NS ESA) status, Canada General Status Rank, and Provincial General Status (see Appendix 3 for definitions of ranks).

Scientific Name (NatureServe bracketed where diff.)	Common Name (NatureServe bracketed where diff.)	Global Rank	S-Rank	N-Rank	COSEWIC [1]	SARA [2]	NS ESA [3]	Canada General Status Rank[4]	Provincial General Status Rank
Coreopsis rosea	Pink Coreopsis	G3	S1	N1	E	E	E	At Risk	Red (At Risk)
Drosera filiformis	Thread-leaved Sundew	G4	S1	N1	E	E	E	At Risk	Red (At Risk)
Sabatia kennedyana	Plymouth Gentian	G3	S1	N1	E	T	E	At Risk	Red (At Risk)
Baccharis halimifolia	Groundseltree	G5	S1	NNR	T	T[5]	T	May Be At Risk	Red (At Risk)
Clethra alnifolia	Sweet Pepperbush	G5	S1	N2	T	SC	V	Sensitive	Red (At Risk)
Eleocharis tuberculosa	Tubercled Spike-rush	G5	S2	N1	SC	SC	V	At Risk	Red (At Risk)
Hydrocotyle umbellata	Water Pennywort	G5	S1	N2	SC	T	E	At Risk	Red (At Risk)
Lachnanthes caroliniana	Redroot	G4	S2	N2	SC	T	V	Sensitive	Red (At Risk)
Lophiola aurea	Golden Crest	G4	S2	N2	SC	T	V	At Risk	Red (At Risk)
Juncus caesariensis	New Jersey Rush	G2	S2	N1N2	SC	SC	V	Sensitive	Yellow (Sensitive)
Lilaeopsis chinensis	Eastern Lilaeopsis	G5	S2	N2	SC	SC	V	Sensitive	Yellow (Sensitive)
Potamogeton pulcher	Spotted Pondweed	G5	S2S3	N1	-	-	V	May Be At Risk	Yellow (Sensitive)
Scirpus longii	Long's Bulrush	G2G3	S3	N2	SC	SC[6]	V	Sensitive	Yellow (Sensitive)
Calamagrostis coarctata	Nuttall's Reed Grass	G5	SH	NNR	-	-	-	Extirpated	Blue (Extirpated/Historic)
Dichanthelium meridionale	Matting Witchgrass	G5	SH	N1	-	-	-	[not ranked]	Blue (Extirpated/Historic)
Scirpus expansus	Woodland Bulrush	G4	SH	NNR	-	-	-	Extirpated	Blue (Extirpated/Historic)
Torreyochloa pallida var. *pallida*	Pale Manna Grass	G5T5?	S1	NNR	-	-	-	[not ranked]	Blue (Extirpated/Historic)
Rhynchospora macrostachya	Tall Beakrush	G4	S1	-	E	-	-	May Be At Risk	Red (At Risk)
Amelanchier nantucketensis	Nantucket Shadbush	G3Q	S1	NNA	-	-	-	May Be At Risk	Red (May Be At Risk)
Eupatorium dubium	Coastal Plain Joe-Pye-Weed	G5	S2	N2	-	-	-	May Be At Risk	Red (May Be At Risk)

Scientific Name (NatureServe bracketed where diff.)	Common Name (NatureServe bracketed where diff.)	Global Rank	S-Rank	N-Rank	COSEWIC [1]	SARA [2]	NS ESA [3]	Canada General Status Rank[4]	Provincial General Status Rank
Iris prismatica	Slender Blue Flag	G4G5	S1	N1	-	-	-	May Be At Risk	Red (May Be At Risk)
Lyonia ligustrina	Maleberry	G5	S1	N1	-	-	-	May Be At Risk[7]	Red (May Be At Risk)
Panicum dichotomiflorum var. *puritanorum*	Spreading Panic Grass	G5T4	S1?	N1	-	-	-	[May Be At Risk]	Red (May Be At Risk)
Proserpinaca intermedia	Intermediate Mermaid-Weed	G4?	S1	N1N3	-	-	-	May Be At Risk	Red (May Be At Risk)
Proserpinaca palustris var. *palustris*	Marsh Mermaid-Weed	G5T5	S1?	NNR	-	-	-	[May Be At Risk]	Red (May Be At Risk)
Salix sericea	Silky Willow	G5T5	S2	NNR	-	-	-	Secure	Red (May Be At Risk)
Schoenoplectus torreyi	Torrey's Bulrush	G5?	S1	NNR	-	-	-	Secure	Red (May Be At Risk)
Sisyrinchium fuscatum	Coastal Plain Blue-Eyed-Grass	G5	S1	NNR	-	-	-	May Be At Risk	Red (May Be At Risk)
Toxicodendron vernix	Poison Sumac	G5	S1	N4	-	-	-	Secure	Red (May Be At Risk)
Trichostema dichotomum	Forked Bluecurls	G5	S1	N1	-	-	-	May Be At Risk	Red (May Be At Risk)
Agalinis maritima	Saltmarsh False-Foxglove	G5	S2	N1	-	-	-	May Be At Risk	Yellow (Sensitive)
Alnus serrulata	Brookside Alder	G5	S3	N2	-	-	-	Sensitive	Yellow (Sensitive)
Carex longii	Long's Sedge	G5	S2	N1	-	-	-	May Be At Risk	Yellow (Sensitive)
Cephalanthus occidentalis	Buttonbush	G5	S3	NNR	-	-	-	Secure	Yellow (Sensitive)
Eleocharis flavescens var. olivacea (Eleocharis olivacea)	Capitate Spike-rush	G5T4T5	S2S3	N4N5	-	-	-	Secure	Yellow (Sensitive)
Eleocharis rostellata	Beaked Spike-rush	G5	S3	N3	-	-	-	Sensitive	Yellow (Sensitive)
Galium obtusum	Blunt-leaved Bedstraw	G5	S2S3	NNR	-	-	-	Secure	Yellow (Sensitive)
Hudsonia ericoides	Golden-Heather	G4	S2	N2N3	-	-	-	Sensitive	Yellow (Sensitive)
Iva frutescens ssp. *oraria*	Marsh Elder	G5T5	S2	NNR	-	-	-	Sensitive	Yellow (Sensitive)

Scientific Name (NatureServe bracketed where diff.)	Common Name (NatureServe bracketed where diff.)	Global Rank	S-Rank	N-Rank	COSEWIC [1]	SARA [2]	NS ESA [3]	Canada General Status Rank[4]	Provincial General Status Rank
Juncus marginatus	Grassleaf Rush	G5	S3	NNR	-	-	-	Sensitive	Yellow (Sensitive)
*Juncus subcaudatus*var. *planisepalus*	Woodland Rush	G5	S3	NNR	-	-	-	Sensitive	Yellow (Sensitive)
Najas gracillima	Thread-like Naiad	G5?	S2	N2	-	-	-	Sensitive	Yellow (Sensitive)
Platanthera flava var. *flava*	Tubercled Orchid (or Southern-Rein Orchid)	G4T4?	S2	N1	-	-	-	[Yellow]	Yellow (Sensitive)
Schoenoplectus americanus	Olney's Bulrush	G5	S3	NNR	-	-	-	Sensitive	Yellow (Sensitive)
Spiranthes casei var. *novaescotiae*	Case's Ladies'-Tresses	G4TNR	S2	NNR	-	-	-	Secure	Yellow (Sensitive)
Utricularia resupinata	Northeastern Bladderwort	G4	S2	NNR	-	-	-	Secure	Yellow (Sensitive)
Elymus virginicus var. *halophilus*	Saltmarsh Virginia Wild Rye	G5T5	SNR	NNR	-	-	-	[Undetermined]	Undetermined
Suaeda maritima ssp. *richii*	Rich's Sea-Blite	G5T3	S1	N1	-	-	-	[not ranked]	Undetermined

Scientific Name (Kartesz 1999 bracketed if diff.)	Common Name (NatureServe bracketed if diff.)	Global Rank	S-Rank	N-Rank	COSEWIC [1]	SARA [2]	NS ESA [3]	Canada General Status Rank[4]	Provincial General Status Rank
Coreopsis rosea	Pink Coreopsis	G3	S1	N1	E	E	E	At risk	Red
Drosera filiformis	Thread-leaved Sundew	G4	S1	N1	E	E	E	At risk	Red
Sabatia kennedyana	Plymouth Gentian	G3	S1	N1	E	T	E	At risk	Red
Baccharis halimifolia	Eastern Baccharis	G5	S1	NNR	T	T[5]	T	May be at risk	Red
Clethra alnifolia	Sweet Pepperbush	G5	S1	N2	T	SC	V	Sensitive	Yellow
Eleocharis tuberculosa	Tubercled Spike-rush	G5	S2	N1	SC	SC	V	At risk	Red
Hydrocotyle umbellata	Water Pennywort	G5	S1	N2	SC	T	E	At risk	Red
Lachnanthes caroliniana	Redroot	G4	S2	N2	SC	SC	V	Sensitive	Red

[5] Threatened status pending

Scientific Name (Kartesz 1999 bracketed if diff.)	Common Name (NatureServe bracketed if diff.)	Global Rank	S-Rank	N-Rank	COSEWIC [1]	SARA [2]	NS ESA [3]	Canada General Status Rank[4]	Provincial General Status Rank
Lophiola aurea	Goldencrest	G4	S2	N2	SC	T	V	At risk	Red
Juncus caesariensis	New Jersey Rush	G2	S2	N1N2	SC	SC	V	Sensitive	Yellow
Lilaeopsis chinensis	Eastern Lilaeopsis	G5	S2	N2	SC	SC	V	Sensitive	Yellow
Potamageton pulcher	Spotted Pondweed	G5	S3	N1	-	-	V	May be at risk	Yellow
Scirpus longii	Long's Bulrush	G2G3	S3	N2	SC	-	V	Sensitive	Yellow
Rhynchospora macrostachya	Tall Beakrush	G4	S1	-	E	-	-	May Be At Risk	Red (At Risk)
Amelanchier nantucketensis	Nantucket Shadbush (Nantucket Serviceberry)	G3Q	S1	NNA	-	-	-	May be at risk	Orange
Eupatorium dubium	Joe-Pye-Weed (Coastal Plain Joe-Pye-Weed)	G5	S2	N2	-	-	-	May be at risk	Orange
Iris prismatica	Slender Blue Flag	G4G5	S1	N1	-	-	-	May be at risk	Orange
Lyonia ligustrina	Maleberry	G5	S1	N1	-	-	-	May Be At Risk[7]	Red (May Be At Risk)
Panicum dichotomiflorum var. puritanorum	Spreading Panic-Grass (Fall Panic Grass)	G5T4	S1	N1	-	-	-	Secure[4]	Orange
Proserpinaca intermedia	Intermediate Mermaidweed	G4?	S1	N1N3	-	-	-	May be at risk	Orange
Proserpinaca palustris var. palustris	Marsh Mermaid-Weed	G5T5	S1?	NNR	-	-	-	Secure[4]	Orange
Salix sericea	Silky Willow	G5T5	S2	NNR	-	-	-	Secure	Orange
Schoenoplectus torreyi	Torrey's Bulrush	G5?	S1	NNR	-	-	-	Secure	Red (May Be At Risk)
Sisyrinchium fuscatum	Coastal-Plain Blue-Eyed-Grass	G5	S1	NNR	-	-	-	May be at risk	Orange
Toxicodendron vernix	Poison Sumac	G5	S1	N4	-	-	-	Secure	Orange
Trichostema dichotomum	Forked Bluecurls	G5	S1	N1	-	-	-	May Be At Risk	Red (May Be At Risk)
Elymus virginicus var. halophilus	Terrell Grass (Virginia Wild Rye)	G5T5	SNR	NNR	-	-	-	Secure[4]	Undetermined
Suaeda maritima ssp. richii	Rich's Sea-Blite (White Sea-Blite)	G5T3	S1	N1	-	-	-	Secure[4]	Undetermined
Agalinis maritima	Salt-Marsh False-Foxglove (Saltmarsh Agalinis)	G5	S2	N1	-	-	-	May be at risk	Yellow
Alnus serrulata	Brook-Side Alder (Smooth Alder)	G5	S3	N2	-	-	-	Sensitive	Yellow
Carex longii	Greenish-White Sedge (Long's	G5	S2	N1	-	-	-	May be at risk	Yellow

Scientific Name (Kartesz 1999 bracketed if diff.)	Common Name (NatureServe bracketed if diff.)	Global Rank	S-Rank	N-Rank	COSEWIC [1]	SARA [2]	NS ESA [3]	Canada General Status Rank[4]	Provincial General Status Rank
	Sedge)								
Cephalanthus occidentalis	Buttonbush (Common Buttonbush)	G5	S3	NNR	-	-	-	Secure	Yellow
Eleocharis olivacea (Eleocharis flavescens var. Olivacea)	Capitate Spikerush (Yellow Spikerush)	G5T4T5	S2	N4N5	-	-	-	Secure	Yellow
Eleocharis rostellata	Beaked Spikerush	G5	S23	N3	-	-	-	Sensitive	Yellow
Galium obtusum	Large Marsh Bedstraw (Blunt-Leaved Bedstraw)	G5	S2S3	NNR	-	-	-	Secure	Yellow
Hudsonia ericoides	Hudsonia (Pinebarren Golden Heather)	G4	S2	N2N3	-	-	-	Sensitive	Yellow
Iva frutescens ssp. oraria	Marsh Elder (Big-Leaved Marsh Elder)	G5T5	S2	NNR	-	-	-	Sensitive	Yellow
Juncus marginatus	Grassleaf Rush (Grass-Leaved Rush)	G5	S2S3	NNR	-	-	-	Sensitive	Yellow
Juncus subcaudatus	Rush (Woodland Rush)	G5	S3	NNR	-	-	-	Sensitive	Yellow
Najas gracillima	Thread-Like Naiad	G5?	S2	N2	-	-	-	Sensitive	Yellow
Platanthera flava var. flava	Fringed Orchid (Southern-Rein Orchid)	G4T4?	S2	N1	-	-	-	Sensitive[4]	Yellow
Schoenoplectus americanus	Three-Square Bulrush (Olney's Bulrush)	G5	S2S3	NNR	-	-	-	Sensitive	Yellow
Spiranthes casei var. novaescotiae	Case's Ladies'-Tresses	G4TNR	S2	NNR	-	-	-	Secure	Yellow
Utricularia resupinata	Northeastern Bladderwort (Inverted Bladderwort)	G4	S2	NNR	-	-	-	Secure	Yellow
Calamagrostis coarctata	Nuttall's Reed Grass	G5	SH	NNR	-	-	-	Extirpated	Purple
Dichanthelium meridionale	Matting Witchgrass	G5	SH	N1	-	-	-	-	Purple
Scirpus expansus	Woodland Bulrush	G4	SH	NNR	-	-	-	Extirpated	Purple
Torreyochloa pallida var. pallida	Pale False Manna Grass	G5T5?	S1	NNR	-	-	-	Secure[4]	Purple

[1] COSEWIC Status: E = Endangered, T = Threatened, SC = Special Concern
[2] SARA Status: E = Endangered, T = Threatened, SC = Special Concern
[3] NS ESA Status: E = Endangered, T = Threatened, V = Vulnerable
[4]Canada General Status ranks were not assigned to subspecies or varieties. For subspecies or varieties known within Canada only from Nova Scotia, the Canada General Status Rank would be the same as the provincial rank by definition. In these cases, Canada General Status is given in square brackets. For subspecies or varieties known from other Canadian jurisdictions, Canada General Status is given as "[not ranked]".

[5]Threatened status under *Species at Risk Act* is pending.
[6]Listed as Special Concern under Schedule 3 of the *Species at Risk Act*, indicating that it has never been re-assessed following adoption of the act.
[7]Discovered in Canada after 2010 Canada General Status Ranks were prepared. Canada General Status equals provincial General Status by definition because it occurs nowhere else in Canada.

Appendix 2: ACPF Species that Are not at Risk

The low priority ACPF species of NS which are considered secure and their rankings including: Global (G), Sub-national (S), and National (N), COSEWIC, *Species at Risk Act* (SARA), *NS Endangered Species Act* (NS ESA) status, Canada General Status Rank, and NS DNR General Status (see Appendix 3 for definitions of ranks).

Scientific Name (NatureServe bracketed if diff.)	Common Name	Global Rank	S-Rank	N-Rank	COSEWIC	SARA	NS ESA	Canada General Status Rank	Provincial General Status Rank
Agalinis neoscotica	Nova Scotia False-Foxglove (Nova Scotia Agalinis)	G4	S3	N4	-	-	-	Secure	Green (Secure)
Photinia pyrifolia	Red Chokeberry	G5	S4?	NNR	-	-	-	Secure	Green (Secure)
Bartonia paniculata ssp. *iodandra*	Branched Bartonia	G5	S4S5	NNR	-	-	-	[Secure]	Green (Secure)
Bartonia virginica	Yellow Bartonia	G5	S3	N3	-	-	-	Secure	Green (Secure)
Carex atlantica ssp. atlantica	Atlantic Sedge	G5T4	S4	NNR	-	-	-	[Secure]	Green (Secure)
Carex atlantica ssp. capillacea	Howe Sedge	G5T5?	S4	N2?	-	-	-	[Secure]	Green (Secure)
Carex bullata	Button Sedge	G5	S4	NNR	-	-	-	Secure	Green (Secure)
Corema conradii	Broom Crowberry	G4	S4	NNR		-	-	Secure	Green (Secure)
Cyperus dentatus	Toothed Flatsedge	G4	S4	NNR	-	-	-	Secure	Green (Secure)
Decodon verticillatus	Water-willow (Swamp Loosestrife)	G5	S3	NNR	-	-	-	Secure	Green (Secure)
Dichanthelium clandestinum	Deer-Tongue Panic Grass	GNA	S3	NNR	-	-	-	Secure	Green (Secure)
Dichanthelium spretum	Eaton's Witchgrass	G5	S4	NNR	-	-	-	Secure	Green (Secure)
Eleocharis robbinsii	Robbins' Spike-rush	G5	S4	NNR	-	-	-	Secure	Green (Secure)
Euthamia caroliniana	Carolina Grass-Leaved Goldenrod (Slender Fragrant Goldenrod)	G5	S4	NNR		-	-	Secure	Green (Secure)
Gaylussacia bigeloviana	Dwarf Huckleberry (Bigelow's Huckleberry)	G5	S5	NNR	-	-	-	Secure	Green (Secure)
Glyceria obtusa	Blunt Manna-Grass (Atlantic Manna Grass)	G5	S4	NNR	-	-	-	Secure	Green (Secure)
Gratiola aurea	Golden-Pert (Golden Hedge-Hyssop)	G5	S5	NNR	-	-	-	Secure	Green (Secure)
Ilex glabra	Inkberry	G5	S5	NNR	-	-	-	Secure	Green (Secure)

Scientific Name (NatureServe bracketed if diff.)	Common Name	Global Rank	S-Rank	N-Rank	COSEWIC	SARA	NS ESA	Canada General Status Rank	Provincial General Status Rank
Juncus militaris	Bayonet Rush	G4	S5	N4	-	-	-	Secure	Green (Secure)
Listera australis	Southern Twayblade	G4	S3	N2	-	-	-	May Be At Risk	Green (Secure)
Lycopodiella appressa	Southern Bog Clubmoss	G5	S4	NNR	-	-	-	Secure	Green (Secure)
Myrica pensylvanica (Morella pensylvanica)	Northern Bayberry	G5	S5	NNR	-	-	-	Secure	Green (Secure)
Myriophyllum humile	Low Water Milfoil	G5	S4	NNR	-	-	-	Secure	Green (Secure)
Panicum rigidulum var. *pubescens*	Redtop Panic Grass	G5T5?	S3	NNR	-	-	-	[Secure]	Green (Secure)
Panicum virgatum var. spissum	Old Switch Panic Grass	G5T?	S4	NNR	-	-	-	[Secure]	Green (Secure)
Persicaria hydropiperoides (Polygonum hydropiperoides)	Mild Water-Pepper (False Waterpepper)	G5	S5	NNR	-	-	-	Secure	Green (Secure)
Persicaria robustior (Polygonum robustius)	Stout Smartweed	G4G5	S4	N2	-	-	-	Secure	Green (Secure)
Platanthera blephariglottis	White Fringed Orchid	G4G5	S4	NNR	-	-	-	Secure	Green (Secure)
Potamogeton confervoides	Algae-Like Pondweed (Alga Pondweed)	G4	S5	N3N4	-	-	-	Secure	Green (Secure)
Proserpinaca pectinata	Comb-Leaved Mermaidweed	G5	S3	NNR	-	-	-	Secure	Green (Secure)
Rhexia virginica	Virginia MeadowBeauty	G5	S3	N3	-	-	-	Secure	Green (Secure)
Rhynchospora capitellata	Blackish Beakrush (Small-Headed Beakrush)	G5	S4	NNR	-	-	-	Secure	Green (Secure)
Rosa palustris	Swamp Rose	G5	S4	NNR	-	-	-	Secure	Green (Secure)
Schizaea pusilla	Curly-Grass Fern (Little Curlygrass Fern)	G3G4	S3	N3	-	-	-	Secure	Green (Secure)
Sisyrinchium angustifolium	Narrow-leaved Blue-Eyed-Grass	G5	S4	N4?	-	-	-	Secure	Green (Secure)
Sisyrinchium atlanticum	Eastern Blue-Eyed-Grass	G5	S3S4	NNR	-	-	-	Secure	Green (Secure)
Smilax rotundifolia	Round-Leaved Greenbrier	G5	S3	NNR	NAR	-	-	Secure	Green (Secure)
Solidago latissimifolia	Elliot's Goldenrod	G5	S3S4	NNR	-	-	-	Secure	Green (Secure)

Scientific Name (NatureServe bracketed if diff.)	Common Name	Global Rank	S-Rank	N-Rank	COSEWIC	SARA	NS ESA	Canada General Status Rank	Provincial General Status Rank
Symphyotrichum tradescantii	Tradescant Aster	G4Q	S4	NNR	-	-	-	Secure	Green (Secure)
Symplocarpus foetidus	Skunk Cabbage (Eastern Skunk Cabbage)	G5	S3S4	N5	-	-	-	Secure	Green (Secure)
Thelypteris simulata	Massachusetts Fern (Bog Fern)	G4G5	S4	NNR	-	-	-	Secure	Green (Secure)
Toxicodendron radicans ssp. *radicans*	Eastern Poison-Ivy	G5	S4	N5	-	-	-	[Secure]	Green (Secure)
Triadenum virginicum	Virginia Marsh St. John's-Wort	G5	S5	NNR	-	-	-	Secure	Green (Secure)
Utricularia purpurea	Purple Bladderwort (Eastern Purple Bladderwort)	G5	S5	NNR	-	-	-	Secure	Green (Secure)
Utricularia radiata	Small Swollen Bladderwort (Little Floating Bladderwort)	G4	S4	N3	-	-	-	Secure	Green (Secure)
Utricularia subulata	Zigzag Bladderwort	G5	S4	N3	-	-	-	Secure	Green (Secure)
Vaccinium corymbosum	Highbush Blueberry	G5	S3S4	N4?	-	-	-	Secure	Green (Secure)
Viola lanceolata	Lance-Leaved Violet	G5	S5	N5	-	-	-	Secure	Green (Secure)
Woodwardia areolata	Dwarf Chain Fern (Netted Chain Fern)	G5	S3	N2	-	-	-	Secure	Green (Secure)
Xyris difformis	Lakeshore Yellow-Eyed Grass (Bog Yellow-Eyed-Grass)	G5	S4	NNR	-	-	-	Secure	Green (Secure)

Scientific Name (Kartesz 1999 bracketed if diff.)	Common Name (NatureServe bracketed if diff.)	Global Rank	S-Rank	N-Rank	COSEWIC	SARA NS ESA	Canada General Status Rank	NS DNR
Agalinis neoscotica	Nova Scotia False-Foxglove (Nova Scotia Agalinis)	G4	S3	N4	-	- -	Secure	Green
Aronia arbutifolia (Photinia pyrifolia)	Red Chokeberry	G5	S4?	NNR	-	- -	Secure	Green
Bartonia paniculata	Screw-Stem (Branched Bartonia)	G5	S4S5	NNR	-	- -	Secure	Green
Bartonia virginica	Yellow Screwstem (Yellow Bartonia)	G5	S3	N3	-	- -	Secure	Green
Carex atlantica ssp. atlantica	Atlantic Sedge	G5T4	S4	NNR	-	- -	Secure	Green

Scientific Name (Kartesz 1999 bracketed if diff.)	Common Name (NatureServe bracketed if diff.)	Global Rank	S-Rank	N-Rank	COSEWIC	SARA NS ESA	Canada General Status Rank	NS DNR
Carex atlantica ssp. capillacea	Howe Sedge (Atlantic Sedge)	G5T5 ?	S4	N2?	-	- -	Secure[4]	Green
Carex bullata	Button Sedge	G5	S4	NNR	-	- -	Secure	Green
Corema conradii	Broom Crowberry	G4	S4	NNR			Secure	Green
Cyperus dentatus	Toothed Sedge (Toothed Flatsedge)	G4	S3	NNR	-	- -	Secure	Green
Dichanthelium clandestinum	Deer-Tongue Panic Grass	GNA	S3	NNR	-	- -	Secure	Green
Dichanthelium spretum	Eaton's Witchgrass	G5	S3	NNR	-	- -	Secure	Green
Decodon verticillatus	Water-willow (Swamp Loosestrife)	G5	S3	NNR	-	- -	Secure	Green (Secure)
Euthamia caroliniana	Grass-Leaved Goldenrod (Slender Fragrent Goldenrod)	G5	S4	NNR			Secure	Green
Eleocharis robbinsii	Robbins' Spike-rush	G5	S4	NNR	-	- -	Secure	Green (Secure)
Gaylussacia bigeloviana	Dwarf Huckleberry (Bigelow's Huckleberry)	G5	S5	NNR	-	- -	Secure	Green
Glyceria obtusa	Blunt Manna-Grass (Atlantic Manna Grass)	G5	S4	NNR	-	- -	Secure	Green
Gratiola aurea	Golden-Pert (Golden Hedge-Hyssop)	G5	S5	NNR	-	- -	Secure	Green
Ilex glabra	Inkberry	G5	S5	NNR	-	- -	Secure	Green
Juncus militaris	Bayonet Rush	G4	S5	N4	-	- -	Secure	Green
Listera australis	Southern Twayblade	G4	S3	N2	-	- -	May be at risk	Green
Lycopodiella appressa	Southern Bog Clubmoss	G5	S4	NNR	-	- -	Secure	Green
Morella pensylvanica	Northern Bayberry	G5	S5	NNR	-	- -	Secure	Green
Myriophyllum humile	Low Water Milfoil	G5	S4	NNR	-	- -	Secure	Green
Panicum rigidulum	Redtop Panic Grass	G5T5 ?	S4	NNR	-	- -	Sensitive	Green
Panicum virgatum var. spissum	Old Switch Panic Grass (Switch Grass)	G5T?	S3S4	NNR	-	- -	Secure[4]	Green
Persicaria hydropiperoides (Polygonum hydropiperoides)	Mild Water-Pepper (False Waterpepper)	G5	S5	NNR	-	- -	Secure	Green
Persicaria robustior (Polygonum robustius)	Water Smartweed (Stout Smartweed)	G4G5	S4	N2	-	- -	Secure	Green
Platanthera blephariglottis	White Fringed Orchid	G4G5	S4	NNR	-	- -	Secure	Green
Potamogeton confervoides	Algae-Like Pondweed (Alga Pondweed)	G4	S4S5	N3N4	-	- -	Secure	Green

Scientific Name (Kartesz 1999 bracketed if diff.)	Common Name (NatureServe bracketed if diff.)	Global Rank	S-Rank	N-Rank	COSEWIC	SARA NS ESA	Canada General Status Rank	NS DNR
Proserpinaca pectinata	Comb-Leaved Mermaidweed	G5	S3	NNR	-	- -	Secure	Green
Rhexia virginica	Virginia MeadowBeauty	G5	S3	N3	-	- -	Secure	Green
Rhynchospora capitellata	Brownish Beakrush (Small-Headed Beakrush)	G5	S4	NNR	-	- -	Secure	Green
Rosa palustris	Swamp Rose	G5	S3	NNR	-	- -	Secure	Green
Schizaea pusilla	Curly-Grass Fern	G3G4	S3	N3	-	- -	Secure	Green
Sisyrinchium angustifolium	Pointed Blue-Eyed-Grass (Narrow-leaved Blue-Eyed-Grass)	G5	S4	N4?	-	- -	Secure	Green
Sisyrinchium atlanticum	Eastern Blue-Eyed-Grass	G5	S3S4	NNR	-	- -	Secure	Green
Smilax rotundifolia	Catbrier (Round-Leaved Greenbrier)	G5	S3	NNR	NAR	- -	Secure	Green
Solidago latissimifolia	Elliot's Goldenrod	G5	S3S4	NNR	-	- -	Secure	Green
Symphyotrichum tradescantii	Tradescant Aster	G4Q	S4	NNR	-	- -	Secure	Green
Symplocarpus foetidus	Skunk Cabbage (Eastern Skunk Cabbage)	G5	S3S4	N5	-	- -	Secure	Green
Thelypteris simulata	Massachusetts Fern (Bog Fern)	G4G5	S4S5	NNR	-	- -	Secure	Green
Toxicodendron radicans	Poison-ivy	G5	S4	N5	-	- -	Secure	Green
Triadenum virginicum	Marsh St. John's-Wort (Virginia St. John's-Wort)	G5	S5	NNR	-	- -	Secure	Green
Utricularia purpurea	Purple Bladderwort (Eastern Purple Bladderwort)	G5	S5	NNR	-	- -	Secure	Green
Utricularia radiata	Small Swollen Bladderwort (Little Floating Bladderwort)	G4	S4	N3	-	- -	Secure	Green
Utricularia subulata	Zigzag Bladderwort	G5	S4	N3	-	- -	Secure	Green
Vaccinium corymbosum	Highbush Blueberry	G5	S3S4	N4?	-	- -	Secure	Green
Viola lanceolata	Lance-Leaved Violet	G5	S5	N5	-	- -	Secure	Green
Woodwardia areolata	Dwarf Chain Fern (Netted Chain Fern)	G5	S3	N2	-	- -	Secure	Green
Xyris difformis	Yellow-Eyed Grass (Bog Yellow-Eyed-Grass)	G5	S4	NNR	-	- -	Secure	Green

Appendix 3: Definitions of Terms and Risk Categories

***Species at Risk Act* (SARA)**

SARA is one part of a three part Government of Canada strategy for the protection of wildlife species at risk. It complements existing laws and agreements to provide for the legal protection of wildlife species and conservation of biological diversity.

Extinct - A species that no longer exists.

Extirpated - A species no longer existing in the wild in Canada, but occurring elsewhere.

Endangered - A species facing imminent extirpation or extinction.

Threatened - A species likely to become endangered if limiting factors are not reversed.

Special Concern - A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events (formerly "vulnerable").

Nova Scotia Endangered Species Act

Provincially listed species assessments are conducted by the NS Species at Risk Working Group and are based on a process similar to that used by COSEWIC. However, a provincial context - as opposed to a national context - is considered and therefore a species' provincial status can differ from that assigned by COSEWIC. Protection is afforded to a provincially listed species under the *NS Endangered Species Act* (NS ESA).

Extinct - A species that no longer exists.

Extirpated - A species that no longer exists in the wild in the Province but exists in the wild outside the Province.

Endangered - A species facing imminent extinction or extirpation.

Threatened - A species that is likely to become endangered if the factors affecting its vulnerability are not reversed.

Vulnerable - A species of special concern due to characteristics that make it particularly sensitive to human activities or natural events.

Canada and Nova Scotia General Status Ranks

Canada General Status Ranks provide a coarse-scale picture of the national general status of species in Canada. The National General Status Working Group assigns Canada General Status Ranks by thoroughly reviewing the ranks and associated information from provinces, territories, and ocean regions. General status ranks are used by COSEWIC to help prioritize species for detailed status assessments. Nova Scotia participates in the Canadian Endangered Species

Conservation Council (CESCC) and provincial rankings share the same definitions as the Canada General Status Ranks but are relevant to the province rather than all of Canada. Colour rank equivalents used by the Nova Scotia government are given in brackets after the given Canada General Status Rank.

Extinct (Blue) - Species that are extirpated worldwide (i.e., they no longer exist anywhere).

Extirpated (Blue in NS) - Species that are no longer present in a given geographic area, but occur in other areas.

At Risk (Red in NS) - Species for which a formal, detailed risk assessment (COSEWIC status assessment or provincial or territorial equivalent) has been completed and that have been determined to be at risk of extirpation or extinction (i.e. Endangered or Threatened). A COSEWIC designation of Endangered or Threatened automatically results in a Canada General Status Rank (Canada rank) of At Risk. Where a provincial or territorial formal risk assessment finds a species to be Endangered or Threatened in that particular region, then, under the general status program, the species automatically receives a provincial or territorial general status rank of At Risk.

May Be At Risk (Red in NS)- Species that may be at risk of extirpation or extinction and are therefore candidates for a detailed risk assessment by COSEWIC, or provincial or territorial equivalents.

Sensitive (Yellow in NS) - Species that are not believed to be at risk of immediate extirpation or extinction but may require special attention or protection to prevent them from becoming at risk.

Secure (Green in NS) - Species that are not believed to belong in the categories *Extirpated*, *Extinct*, *At Risk*, *May Be At Risk*, *Sensitive*, *Accidental* or *Exotic*. This category includes some species that show a trend of decline in numbers in Canada but remain relatively widespread or abundant.

Undetermined - Species for which insufficient data, information, or knowledge is available with which to reliably evaluate their general status.

Not Assessed - Species that are known or believed to be present regularly in the geographic area in Canada to which the rank applies, but have not yet been assessed by the general status program.

Exotic - Species that have been moved beyond their natural range as a result of human activity.

Accidental - Species occurring infrequently and unpredictably, outside their usual range.

<u>General Status Rankings of the Nova Scotia Department of Natural Resources (NS DNR)</u>

General Status rankings for Nova Scotia have the same definitions as those listed above but have an alternate colour name as noted in brackets above. Both the At Risk and May Be At Risk have a Red colour rank because the difference in those two statuses is a technical one related only to whether a status report has been prepared.

The Nature Conservancy and Conservation Data Centre's Ranking System
A standardised element ranking system that has evolved over 23 years with input from hundreds of scientists is used by the Nature Conservancy and the Conservation Data Centres. The ranks are assigned by committees of experts, the Atlantic Canada Conservation Data Centre, and provincial biologists.

National (N-Ranks) and Subnational (S-Ranks or Provincial Level) Ranks
N1/S1 Critically imperiled - Critically imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.
N2/S2 Imperiled - Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.
N3/S3 Vulnerable - Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
N4/S4 Apparently Secure - Uncommon but not rare; some cause for long-term concern due to declines or other factors.

Appendix 4. Habitat Types for ACPF Species

An indication that a species occurs in a particular habitat type is based on the expert opinion of the botanists on the ACPF Recovery Team and is based on the observation of the species in that habitat type in NS. A species can occur in more than one habitat type. Habitat types are considered broad ecological and functional groups.

COSEWIC Status	Provincial General Status Ranks	Species Scientific Name	Species Common Name (NatureServe bracketed if diff.)	Aquatic	Lakeshore	Bog/Fen	River/ Stream Shore	Estuary/ Coastal (*Salt marsh, sea beach, tidal river)	Swamp/ Wooded Swamp	Marsh	Forest	Meadow/ Field	Barrens
E	R	*Coreopsis rosea*	Pink Coreopsis		1								
E	R	*Drosera filiformis*	Thread-leaved Sundew			1							
E	R	*Sabatia kennedyana*	Plymouth Gentian		1		1						
T	R	*Baccharis halimifolia*	Eastern Baccharis					1					
T	Y	*Clethra alnifolia*	Sweet Pepperbush		1		1		1				
SC	R	*Eleocharis tuberculosa*	Tubercled Spike-rush		1								
SC	R	*Hydrocotyle umbellata*	Water Pennywort	1	1								
SC	R	*Lachnanthes caroliniana*	Redroot		1		1						
SC	R	*Lophiola aurea*	Goldencrest		1	1							
SC	Y	*Juncus caesariensis*	New Jersey Rush			1							
SC	Y	*Lilaeopsis chinensis*	Eastern Lilaeopsis					1					
-	Y	*Potamageton pulcher*	Spotted Pondweed	1									
SC	Y	*Scirpus longii*	Long's Bulrush		1	1	1						
-	R	*Amelanchier nantucketensis*	Nantucket Shadbush (Nantucket Serviceberry									1	1
-	R	*Eutrochium dubium*	Joe-pye-weed (Coatal Plain Joe-Pye-Weed)		1		1		1				
-	R	*Iris prismatica*	Slender Blue Flag			1		1		1			
-	R[1]	*Panicum dichotomiflorum var puritanorum*	Panic Grass (Fall Panic-Grass)		1								
	R	*Lyonia ligustrina*	Maleberry		1								
-	R	*Proserpinaca intermedia*	Intermediate Mermaid-Weed	1	1	1	1						
-	R[1]	*Proserpinaca palustris var. palustris*	Marsh Mermaid-Weed	1	1	1	1			1			

COSEWIC Status	Provincial General Status Ranks	Species Scientific Name	Species Common Name (NatureServe bracketed if diff.)	Aquatic	Lakeshore	Bog/Fen	River/ Stream Shore	Estuary/ Coastal (*Salt marsh, sea beach, tidal river)	Swamp/ Wooded Swamp	Marsh	Forest	Meadow/ Field	Barrens
-	R	*Rhynchospora macrostachya*	Tall Beakrush (White Beakrush)		1	1							
-	R	*Salix sericea*	Silky Willow		1		1		1	1			
	R	*Schoenoplectus torreyi*	Torrey's Bulrush		1								
-	R	*Sisyrinchium fuscatum*	Coastal-Plain Blue-Eyed-Grass		1							1	1
-	R	*Toxicodendron vernix*	Poison Sumac		1	1			1	1			
-	R	*Trichostema dichotomum*	Forked Bluecurls										1
-	U[1]	*Elymus virginicus var. halophilus*	Terrell Grass (Virginia Wild Rye)					1					
-	U[1]	*Suaeda maritima ssp. Richii*	Rich's Sea-blite (White Sea-Blite)					1					
-	Y	*Agalinis maritima*	Salt-Marsh False-Foxglove (Saltmarsh Agalinas)					1					
-	Y	*Alnus serrulata*	Brookside Alder (Smooth Alder)		1		1		1				
-	Y	*Carex longii*	Greenish-White Sedge (Long's Sedge)		1		1		1				
-	Y	*Cephalanthus occidentalis*	Buttonbush (Common Buttonbush)		1	1	1		1	1			
-	Y[1]	*Eleocharis flavescens var. olivacea (Eleocharis olivacea var. olivacea)*	Spikerush (Capitate Spikerush)		1					1			
-	Y	*Eleocharis rostellata*	Beaked Spikerush					1					
-	Y	*Galium obtusum*	Large Marsh Bedstraw (Blunt-Leaved Bedstraw)		1	1	1		1				
-	Y	*Hudsonia ericoides*	Hudsonia (Golden-Heather)										1
-	Y[1]	*Iva frutescens ssp. oraria*	Marsh Elder (Big-Leaved Marsh Elder)					1					
-	Y	*Juncus marginatus*	Grassleaf Rush (Grass-Leaved Rush)		1							1	1
-	Y	*Juncus subcaudatus*	Rush (Woodland-Rush)						1				
-	Y	*Najas gracillima*	Thread-Like Naiad	1									
-	Y[1]	*Platanthera flava var. flava*	Fringed Orchid (Southern-Rein Orchid)		1		1						
-	Y	*Schoenoplectus americanus*	Three-Square Bulrush (Olney's Bulrush)					1					
-	Y[1]	*Spiranthes casei var. novaescotiae*	Case's Ladies'-Tresses									1	1
-	Y	*Utricularia resupinata*	Northeastern Bladderwort (Inverted Bladderwort)	1	1								
	G	*Agalinis neoscotica*	Nova Scotia False-Foxglove (Nova Scotia Agalinis)		1		1	1				1	

COSEWIC Status	Provincial General Status Ranks	Species Scientific Name	Species Common Name (NatureServe bracketed if diff.)	Aquatic	Lakeshore	Bog/Fen	River/ Stream Shore	Estuary/ Coastal (*Salt marsh, sea beach, tidal river)	Swamp/ Wooded Swamp	Marsh	Forest	Meadow/ Field	Barrens
-	G	*Bartonia paniculata*	Screw-Stem (Branched Bartonia)		1	1	1						1
-	G	*Bartonia virginica*	Yellow Screw-Stem (Yellow Bartonia)		1	1	1		1				1
-	G	*Carex atlantica spp. atlantica*	Atlantic Sedge			1			1				1
-	G	*Carex atlantica spp. capillacea*	Howe Sedge (Atlantic Sedge)			1			1				1
-	G	*Carex bullata*	Button Sedge		1	1	1		1	1			
-	G	*Corema conradii*	Broom Crowberry										1
-	G	*Cyperus dentatus*	Toothed Sedge (Toothed Flatsedge		1		1						
-	G	*Dichanthelium clandestinum*	Deer-Tongue Panic Grass		1		1		1		1		
-	G	*Dichanthelium spretum*	Eaton's Witchgrass		1	1	1						
-	G	*Decodon verticillatus var. laevigatus*	Water-willow (Swamp Loosestrife)		1	1	1						
-	G	*Euthamia caroliniana*	Grass-Leaved Goldenrod (Slender Fragrant Golden-Rod)		1		1						
-	G	*Gaylussacia bigeloviana*	Dwarf Huckleberry (Begelow's Huckleberry)			1							1
-	G	*Glyceria obtusa*	Blunt Manna-grass (Atlantic Manna-Grass)		1	1	1		1	1			
-	G	*Gratiola aurea*	Golden-pert (Golden Hedge-Hyssop)	1	1		1						
-	G	*Ilex glabra*	Inkberry		1	1	1		1		1		1
-	G	*Juncus militaris*	Bayonet Rush		1		1						
-	G	*Lycopodiella appressa*	Southern Bog Clubmoss		1								
-	G	*Morella pensylvanica*	Northern Bayberry		1	1	1	1	1	1	1	1	1
-	G	*Myriophyllum humile*	Low Water Milfoil		1		1						
-	G	*Panicum rigidulum*	Panic Grass (Redtop Panic-Grass)		1		1						
-	G	*Panicum virgatum var. spissum*	Old Switch Panic Grass (Switch Grass)		1		1						
-	G	*Persicaria hydropiperoides*	Mild Water-pepper (False Waterpepper)	1	1		1		1				
-	G	*Persicaria robustior*	Water Smartweed (Stout Smartweed)		1		1		1				
-	G	*Photinia pyrifolia (Aronia arbutifolia)*	Chokeberry (Red Chokeberry)		1	1	1		1		1	1	1
-	G	*Platanthera blephariglottis*	White Fringed Orchid			1			1		1		1
-	G	*Potamogeton confervoides*	Algae-Like Pondweed (Alga Pondweed)	1									

COSEWIC Status	Provincial General Status Ranks	Species Scientific Name	Species Common Name (NatureServe bracketed if diff.)	Aquatic	Lakeshore	Bog/Fen	River/ Stream Shore	Estuary/ Coastal (*Salt marsh, sea beach, tidal river)	Swamp/ Wooded Swamp	Marsh	Forest	Meadow/ Field	Barrens
-	G	*Proserpinaca pectinata*	Mermaid Weed (Comb-Leaved Mermaid-Weed)	1	1	1	1		1	1			
-	G	*Rhexia virginica*	Virginia Meadow-Beauty		1		1						
-	G	*Rhynchospora capitellata*	Brownish Beakrush (Small-Headed Beakrush)		1	1							1
-	G	*Rosa palustris*	Swamp Rose		1	1	1		1	1			
-	G	*Shizaea pusilla*	Curly-Grass Fern		1	1							
-	G	*Sisyrinchium angustifolium*	Pointed Blue-Eyed-Grass (Narrow-Leaved- Blue-Eyed-Grass)		1		1					1	1
-	G	*Sisyrinchium atlanticum*	Eastern Blue-Eyed-Grass		1		1					1	1
-	G	*Smilax rotundifolia*	Catbrier (Round-Leaved Greenbrier)		1	1	1		1		1		
-	G	*Solidago latissimifolia*	Elliot's Goldenrod		1	1	1		1		1		1
-	G	*Symphyotrichum tradescantii*	Tradescant Aster		1		1						
-	G	*Thelypteris simulata*	Massachusetts Fern (Bog Fern)			1			1		1		
-	G	*Toxicodendron radicans*	Poison-ivy		1	1	1	1	1	1	1	1	
-	G	*Triadenum virginicum*	Marsh St. John's-wort (Virginia St. John's-wort)		1	1	1		1	1			
-	G	*Utricularia purpurea*	Purple Bladderwort (Eastern Purple Bladderwort)	1									
-	G	*Utricularia radiata*	Small Swollen Bladderwort (Little Floating Bladderwort)	1									
-	G	*Utricularia subulata*	Zigzag Bladderwort	1	1	1	1						
	G	*Vaccinium corybosum*	Highbush Blueberry		1	1	1		1				
-	G	*Viola lanceolata*	Lance-Leaved Violet		1		1			1		1	1
-	G	*Woodwardia areolata*	Dwarf Chain Fern (Netted Chain Fern)		1	1	1		1				
-	G	*Xyris difformis*	Yellow-Eyed Grass (Bog Yellow-Eyed-Grass)		1	1							1
-	P	*Calamagrostis coarctata*	Nuttall's Small-Reedgrass		1	1	1		1				
-	P	*Dichanthelium meridionale*	Panic Grass (Matting Witchgrass)		1							1	
-	P	*Scirpus expansus*	Woodland Bulrush		1								
-	P	*Torreyochloapallida var. pallida*	Pale False Manna Grass		1		1		1	1			

[1] Variety not assessed

Appendix 5: ACPF Species on High Priority Lakes

High priority was assigned to 53 lakes that contained one or more legally listed ACPF species. This information was complied from a number of sources including the NS DNR Significant Species and Habitat (SigHab) database, AC CDC database, and from input from experts on the species. Some of these records date back to the 1920s and for some locations have not been revisited recently. Note that some of these species also occur in other habitat types that are not mentioned in this appendix.

COSEWIC Status		E	E	T	T	SC	SC	SC	SC	SC	SC					E																		
Provincial General Status Ranks		R	R	Y	R	R	R	R	Y	Y	Y	R	R	R	R	R	R	R	R	R	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y		
Watershed	**Site**	Pink Coreopsis	Plymouth Gentian	Sweet Pepperbush	Goldencrest	Tubercled Spike-rush	Wate r-pennywort	Redroot	Spotted Pondweed	Long's Bulrush	Eastern Lilaeopsis	Coastal Joe -pye-weed	Fall Panic Grass	Intermediate Mermaidweed	Marsh Mermaidweed	Tall Beakrush	Silky Willow	Maleberry	Torrey's Bulrush	Poision Sumac	Saltmarsh Agalinis	Smooth Alder	Long's Sedge	Common Buttonbush		Yellow Spikerush	Beaked Spikerush	Blunt-leaved Bedstraw	Grassleaf Rush	Thread-like Naiad	Southern Rein Orchid	Inverted Bladderwort	**Total # of High Priority Species**	**Total Number of ACPF Species**
Medway	**Molega Lake**				√			√	√	√						√						√		√						√		**5**	**10**
Tusket	**Wilsons Lake**	√	√				√			√		√											√							√		**6**	**10**
Medway	**Hog Lake**				√			√		√												√		√					√	√	√		**5**	**10**
Medway	**Little Ponhook Lake**				√			√		√		√												√						√		**4**	**8**
Medway	**Ponhook Lake**				√			√		√												√		√						√	√	**4**	**9**
Medway	**Shingle Lake**				√				√	√												√		√								**3**	**7**
Medway	**Beartrap Lake**				√			√														√		√								**2**	**5**
Medway	**First Christopher Lake**							√		√												√		√								**2**	**5**
Mersey	**Kejimkujik Lake**						√			√			√									√		√								**3**	**6**
Meteghan	**Belliveau Lake**			√					√																							**2**	**2**
Tusket	**Agard Lake**	√	√																													**2**	**3**
Tusket	**Bennetts Lake**	√	√									√																		√		**4**	**8**
Tusket	**Gillfillan Lake**	√	√									√										√								√		**3**	**8**
Tusket	**Lac de l'Ecole**		√							√		√																		√		**4**	**8**
Tusket	**Mill Lake**					√			√																					√		**2**	**3**
Tusket	**Raynards Lake**	√							√					√								√										**3**	**5**
Tusket	**Salmon Lake**	√							√			√																		√		**4**	**5**

COSEWIC Status		E	E	T	T	SC	SC	SC	SC	SC	SC					E																	
Provincial General Status Ranks		R	R	Y	R	R	R	R	Y	Y	Y	R	R	R	R	R	R	R	R	R	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	
Watershed	**Site**	Pink Coreopsis	Plymouth Gentian	Sweet Pepperbush	Goldencrest	Tubercled Spike-rush	Wate r-pennywort	Redroot	Spotted Pondweed	Long's Bulrush	Eastern Lilaeopsis	Coastal Joe -pye-weed	Fall Panic Grass	Intermediate Mermaidweed	Marsh Mermaidweed	Tall Beakrush	Silky Willow	Maleberry	Torrey's Bulrush	Poision Sumac	Saltmarsh Agalinis	Smooth Alder	Long's Sedge	Common Buttonbush		Yellow Spikerush	Beaked Spikerush	Blunt-leaved Bedstraw	Grassleaf Rush	Thread-like Naiad	Southern Rein Orchid	Inverted Bladderwort	**Total # of High Priority Species**	**Total Number of ACPF Species**
Annapolis	**Grand Lake**								√																							**1**	**1**
Barrington	**Barrington Lake**					√																						√			√	**3**	**4**
Barrington	**Great Pubnico**					√																								√	√	**2**	**5**
Barrington	**Harpers Lake**					√							√																			**2**	**2**
LaHave	**Hirtle Lake**								√													√										**1**	**2**
LaHave	**Rhodenizer Lake**								√						√																	**2**	**3**
LaHave	**Seven Mile Lake**				√																										√	**2**	**4**
LaHave	**Smith Lake**																		1													**1**	**1**
Medway	**Russell Lake**																		1													**1**	**1**
Medway	**Long Lake**																		1													**1**	**1**
Medway	**Beavertail Lake**							√																√								**1**	**3**
Medway	**Cameron Lake**							√														√		√		√				√		√	**3**	**7**
Medway	**Fancy Lake**				√																	√				√						**1**	**3**
Medway	**McBride Lake**								√											√		√										**2**	**3**
Medway	**Mill Lake**			√																								√				**2**	**2**
Medway	**Moosehorn**									√																						**1**	**1**
Medway	**Mudflat Lake**			√																												**1**	**1**
Medway	**Pretty Mary**			√																						√						**1**	**2**
Mersey	**Carrigan Lake**								√							√						√		√					√			**3**	**5**
Mersey	**Little Ten Mile Lake**					√																							√			**2**	**3**
Mersey	**Loon Lake**									√														√								**1**	**3**
Mersey	**Ten Mile Lake**									√														√								**1**	**2**
Roseway	**Gold Lake**					√																										**1**	**1**

COSEWIC Status		E	E	T	T	SC	SC	SC	SC	SC	SC					E																	
Provincial General Status Ranks		R	R	Y	R	R	R	R	Y	Y	Y	R	R	R	R	R	R	R	R	R	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	
Watershed	**Site**	Pink Coreopsis	Plymouth Gentian	Sweet Pepperbush	Goldencrest	Tubercled Spike-rush	Wate r-pennywort	Redroot	Spotted Pondweed	Long's Bulrush	Eastern Lilaeopsis	Coastal Joe -pye-weed	Fall Panic Grass	Intermediate Mermaidweed	Marsh Mermaidweed	Tall Beakrush	Silky Willow	Maleberry	Torrey's Bulrush	Poision Sumac	Saltmarsh Agalinis	Smooth Alder	Long's Sedge	Common Buttonbush		Yellow Spikerush	Beaked Spikerush	Blunt-leaved Bedstraw	Grassleaf Rush	Thread-like Naiad	Southern Rein Orchid	Inverted Bladderwort	**Total # of High Priority Species**	**Total Number of ACPF Species**
Roseway	**Western Lake**					√																										**1**	**1**
Tusket	**Canoe Lake**			√																		√						√				**1**	**5**
Tusket	**Kegeshook**		√									√																√		√		**1**	**6**
Tusket	**Lake Fanning**		√									√					√											√		√		**1**	**5**
Tusket	**Long Lake**								√													√						√	√			**1**	**4**
Tusket	**Louis Lake**			√																												**1**	**1**
Tusket	**Pearl Lake**		√																			√								√		**1**	**6**
Tusket	**Placides Lake**								√																							**1**	**1**
Tusket	**Pleasant Lake**	√									√	√									√		√			√	√					**2**	**7**
Tusket	**Sloans Lake**	√																														**1**	**1**
Tusket	**Springhaven Duck Lake**						√											1														**1**	**2**
Tusket	**Third Lake**		√																							√				√		**1**	**6**
Tusket	**Travis Lake**		√																													**1**	**3**
	Total	**8**	**10**	**6**	**8**	**7**	**3**	**8**	**13**	**13**	**1**	**9**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**17**	**3**	**13**		**5**	**1**	**4**	**4**	**4**	**15**	**5**	**9**	**34**

Appendix 6: ACPF Species on Medium Priority Lakes

Medium priority was assigned to 23 lakes that contained one or more non-legally listed Red, Orange or Undetermined ranked species. This information was complied from a number of sources including the NS DNR Significant Species and Habitat (SigHab) database, AC CDC database, and from input from experts on the species. Some of these records date back to the 1920s and for some locations have not been revisited recently. Note that some of these species also occur in other habitat types that are not mentioned in this appendix.

NS DNR General Status Ranks		R	R	R	R	R	R	R	Y	Y		Y	Y			
Watershed	**Site**	Coastal Plain Joe-pye-weed	Blunt-leaved Bedstraw	Fall Panic Grass	Intermediate Mermaidweed	Silky Willow	Coastal Plain Blue-eyed Grass	Poison Sumac	Smooth Alder	Common Buttonbush		Thread-like Naiad	Southern Rein Orchid	**Total Number of High Priority Species**	**Total Number of Medium Priority Species**	**Total Number of ACPF Species**
Gaspereau	**Four Mile Lake**				√									**1**	**0**	**1**
LaHave	**Wentzells Lake**					√	√							**2**	**0**	**2**
Medway	**Apple Tree Lake**							√	√			√		**1**	**2**	**3**
Medway	**Second Christopher Lake**			√						√				**1**	**2**	**3**
Medway	**Telfer Lake**							√	√	√				**1**	**3**	**4**
Roseway	**Welshtown Lake**			√										**1**	**0**	**1**
Shubenacadie	**Lake Egmont**				√									**1**	**0**	**1**
Shubenacadie	**Shubenacadie Grand Lake**					√								**1**	**0**	**1**
Tusket	**Ellenwood Lake**	√											√	**1**	**1**	**2**
Tusket	**Parr Lake**	√				√							√	**2**	**1**	**3**
Tusket	**Petes Lake**	√	√						√				√	**2**	**2**	**4**
Tusket	**Randals Lake**	√												**1**	**0**	**1**
MEDIUM PRIORITY TOTAL		4	1	2	2	3	1	2	3	2		2	3			

Appendix 7: Watersheds Containing Legally Listed ACPF Species

The legally listed high priority ACPF species that occur in each of the 13 high priority, primary watersheds in NS.

COSEWIC Status[1]	E	E	E	T	T	SC	SC	SC	SC	SC	SC	SC	V*	
Watershed	Pink Coreopsis	Thread-leaved Sundew	Plymouth Gentian	Eastern Baccharis	Sweet Pepperbush	Tubercled Spike-rush	Water Pennywort	New Jersey Rush	Redroot	Goldencrest	Eastern Lilaeopsis	Long's Bulrush	**Spotted Pondweed**	**Total # High Priority ACPF Species in Watershed**
Tusket	√		√	√	√	√	√				√	√	√	**9**
Medway					√				√	√	√	√	√	**6**
Mersey						√	√			√		√	√	**5**
Roseway		√				√					√	√		**4**
Barrington & Clyde						√						√		**2**
LaHave										√	√	√	√	**4**
Meteghan					√								√	**2**
Grand								√						**1**
Petit Riviere										√				**1**
Musquodoboit													√	**1**
Philip											√			**1**
Sydney/Mira								√						**1**
Kiack Brook							√							**1**
Tidney												√		**1**
Total # Watershed with Each Species	**1**	**1**	**1**	**1**	**3**	**4**	3	**2**	**1**	**4**	**5**	**6**	**6**	

[1] COSEWIC Status: E = Endangered, T = Threatened, SC = Special Concern
*=Provincially Vulnerable

Appendix 8: ACPF Research In Ns Since 1990

A summary of ACPF research in NS since 1990, including a brief description of the research. Refer to References (Section 4) for full citations.

Author(s)	Date	Type of Publication	Research
Atlantic Canada Conservation Data Centre	2001-2014	Digital database	Extensive ACPF fieldwork for COSEWIC status reports and other projects, with numerous reports published and all species data recorded in the AC CDC database
Mersey Tobeatic Research Institute	2010-2014	Digital database	Atlas of ACPF Species at Risk occurrence on Nova Scotia lakeshores
Sutton J.	Ongoing	Masters Thesis	Reproductive ecology and genetics of Plymouth Gentian between populations in NS, Massachusetts and North Carolina. In NS, examining gene flow and clonal structure between disturbed and undisturbed sites.
Lusk J. M. & Reekie E. G.	in press	Journal	The effect of growing season length and water level fluctuations on the growth and survival of Pink Coreopsis and Water Pennywort.
Dawe C. E. & Reekie E. G.	in press	Journal	The effects of flooding regime on the growth and development of Water Pennywort.
Hill N., Myra M. & Johnston M.	2006	Journal	The level of natural seed production, and the rate of self-fertilization and inbreeding depression in a Plymouth Gentian population in NS.
Lusk J. M.	2006	Masters Thesis	The impacts of hydrological alterations on Water Pennywort and Pink Coreopsis and the potential for managing water levels at reservoir lakes to benefit rare ACPF species.
Wood S.	2006	Honours Thesis	Genetic structure and variation between Pink Coreopsis populations in NS and Massachusetts.
Dawe C. E.	2006	Honours Thesis	The effects of flooding regime and subzero temperatures on Water Pennywort.
Trant A. J.	2005	Masters Thesis	The effects of lakeshore development on pollinator visitation rates and seed bank composition for Plymouth Gentian, and the role of stewardship in the recovery process.
Brittain C.	2005	KNP Report	Monitoring report for Water Pennywort populations in KNP.
Vasseur L.	2005	KNP Report	Research report assessing spatial and temporal trends of Water Pennywort populations in KNP using current and historic data. Refinement of monitoring protocol.
Hazel S.	2004	Honours Thesis	Tolerance limits of ACPF species and the identification of factors that may prevent ACPF from colonizing reservoir lakes.
McConnell M.	2004	Honours Thesis	Effect of crab spider inhabitation on pollinator visitation rates to Plymouth Gentian.
Eaton S. T. & Boates J. S.	2003	NS DNR Publication	The impacts of water quality and the level of alien invasive species at high priority lakes containing ACPF in the Medway and Tusket watersheds in NS.
Cody N.	2002	Honours Thesis	Genetic variation and reproductive success in Three-leaved Sundew.
Eaton S. T. & Boates J. S.	2002	NS DNR Publication	Assessment of the anthropogenic threats to ACPF in the Tusket River Watershed.

Author(s)	Date	Type of Publication	Research
Morris P. A., Hill N. M., Reekie E. G. & Hewlin H. L.	2002	Journal	The association of disturbance gradients such as catchment area, wave action and depth with the presence of rare ACPF species.
Holder M. & Kingsley A.	2001	NS DNR Publication	Summary of all historic ACPF data.
Myra M.	2001	Honours Thesis	Reproductive biology of Plymouth Gentian.
Starzomski B. M. & Boates J. S.	2001	NS DNR Publication	Analyses and mapping of ACPF habitat and spatial structure for hotspot delineation and management.
Hill N. M., Boates J. S. & Elderkin M. F.	2000	Journal	The importance of low catchment area lakes for the conservation of rare ACPF.
Hill N. M., Keddy P.A. & Wisheu I. C.	1998	Journal	A hydrological model for predicting the effects of dams on the shoreline vegetation of lakes and reservoirs. A comparison of the vegetation and hydrological regimes of regulated and unregulated systems.
Hill, N. M. & Johansson M. E.	1998	Journal	The geographical distribution and ecology of Long's Bulrush.
Holt T. D., Ilya B. & Hill N. M.	1995	Journal	A watershed level analysis of the lakeshore plant community.
Morris P. D.	1994	Masters Thesis	Relationship between disturbance and ACPF distribution in NS. Examined richness and community composition in relation to shoreline disturbance, watershed area, wind direction and shoreline indentation.
Wisheu I. C., Keddy C. J., Keddy P.A. & Hill N.M.	1994	Journal	The distribution, habitat and conservation priorities for ACPF in NS.
Wisheu I. C. & Keddy P.A.	1994	Journal	The low competitive ability of ACPF and implications for conservation.
Sweeney S. & Ogilvie R.	1993	Journal	Conservation attempts and future needs for the recovery of ACPF in NS.
Hill N. M. & Keddy P. A.	1992	Journal	Prediction of the location of ACPF on NS lakeshores from habitat variables such as watershed area, soil substrate, water chemistry, and shoreline width.
Wisheu, I. C. & Keddy P. A.	1991	Journal	The role of seed banks in the persistence of rare ACPF in NS. The effect of ATV use on seed bank density and survival.

Appendix 9: Threat Information Definitions

The definitions for the threat information categories included in Table 8. These definitions are from the 2006 Technical Guidelines for Writing Recovery Strategies (RENEW 2006).

Extent – Indicate whether the threat is widespread, localized, or unknown across the species range.

Occurrence – Indicate whether the threat is historic (contributed to decline but no longer affecting the species), current (affecting the species now), imminent (is expected to affect the species very soon), anticipated (may affect the species in the future), or unknown. If applicable, also indicate whether the occurrence differs between 'local' populations or smaller areas of the range and the full 'range-wide' distribution.

Frequency – Indicate whether the threat is a one-time occurrence, seasonal (either because the species is migratory or the threat only occurs at certain times of the year – indicate which season), continuous (on-going), recurrent (reoccurs from time to time but not on an annual or seasonal basis), or unknown. If applicable, also indicate whether the frequency differs between 'local' populations or smaller areas of the range and the full 'range-wide' distribution.

Causal certainty – Indicate whether the best available knowledge about the threat and its impact on population viability is high (evidence causally links the threat to stresses on population viability), medium (correlation between the threat and population viability, expert opinion, etc), or low (assumed or plausible threat only). This should be a general reflection of the degree of evidence that is known for the threat, which in turn provides information on the risk that the threat has been misdiagnosed. If applicable, also indicate whether the level of knowledge differs between 'local' populations or smaller areas of the range and the full 'range-wide' distribution.

Severity – Indicate whether the severity of the threat is high (very large population-level effect), moderate, low, or unknown. If applicable, also indicate whether the severity differs between 'local' populations or smaller areas of the range and the full 'range-wide' distribution.

Level of concern – Indicate whether managing the threat is an overall high, medium, or low concern for recovery of the species, taking into account all of the above factors.

Appendix 10: 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*[4]. 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.

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 document itself, but are also summarized below in this statement.

This recovery strategy and management plan will clearly benefit the environment by promoting the recovery of ACPF. 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. This multiple species document maintains an ecosystem perspective and includes all 98 ACPF species in Nova Scotia; although the focus is on the legally listed ACPF species under SARA and the *Nova Scotia Endangered Species Act* (NS ESA). Recovery at this scale will help to address immediate threats and offer protection to legally listed ACPF species, while also increasing the likelihood of long-term persistence of associated ACPF species not at risk. The reader should refer to the following sections of the document in particular: Section 2.7 (Recommended Approach for Recovery Implementation), as well as the habitat and biological needs descriptions in Section 3 of the document.

There are several proposed recovery approaches that will also benefit non-target species, ecological processes, and the environment. Threats to ACPF fundamentally impact the integrity of the natural environment and habitats and thus steps taken to reduce and mitigate these threats will inevitably benefit species in other taxonomic groups. Reduction of some of the threats to ACPF would include changing how cottage development occurs, eliminating or reducing shoreline alterations, decreasing nutrient runoff, and stopping infilling in lake, bog/fen and estuarine habitats. As a result of these steps there are several associated plant species not covered under this document that may also benefit (see associated species listed in Tables in Section 2.6). There are also associated species from other taxa, such as pollinator insects or fish species and aquatic insects that will also benefit.

Where other species at risk co-exist with ACPF, recovery and conservation initiatives outlined in this document will be coordinated with other recovery teams. This will help to avoid potential

[4] http://www.ceaa.gc.ca/default.asp?lang=En&n=B3186435-1

conflicts with other recovery actions planned or underway and will ensure actions are mutually beneficial to other species at risk. Open communication will be maintained with the following Recovery Teams in particular: the Endangered Atlantic Whitefish (*Coregonus huntsmani*), the Endangered Blanding's Turtle (*Emydoidea blandingii*), and the Threatened Eastern Ribbonsnake (*Thamnophis sauritus)*.

Stewardship actions as well as education and awareness initiatives with landowners, all levels of government, industry and other audiences will lead to a greater understanding, appreciation, and ensuing action towards conservation and recovery in general. Ecological processes are difficult to understand due to their complexities. Using the precautionary approach means adapting effectively to emerging information and making decisions that err on the side of caution. Management decisions must weigh both the short and long term outcomes of threats and management intervention based on the best available science to ensure effective conservation on an ecosystem level.