PROPOSED

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for Multiple Species of Atlantic Coastal Plain Flora in Canada

Pink Coreopsis
Thread-leaved Sundew
Tubercled Spike-rush
Water-pennywort
Redroot
Golden Crest
Plymouth Gentian
Sweet Pepperbush
New Jersey Rush
Eastern Lilaeopsis
Long's Bulrush

2010

Environment Canada Environnement Canada
Parks Canada Parcs Canada
Canada

About the *Species at Risk Act* Recovery Strategy Series

What is the *Species at Risk Act* (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003, and one of its purposes is "*to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity*."

What is recovery?

In the context of species at risk conservation, **recovery** is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of the species' persistence in the wild. A species will be considered **recovered** when its long-term persistence in the wild has been secured.

What is a recovery strategy?

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets goals and objectives and identifies the main areas of activities to be undertaken. Detailed planning is done at the action plan stage.

Recovery strategy development is a commitment of all provinces and territories and of three federal agencies — Environment Canada, Parks Canada Agency and Fisheries and Oceans Canada — under the Accord for the Protection of Species at Risk. Sections 37–46 of SARA (www.sararegistry.gc.ca/approach/act/default_e.cfm) outline both the required content and the process for developing recovery strategies published in this series.

Depending on the status of the species and when it was assessed, a recovery strategy has to be developed within one to two years after the species is added to the List of Wildlife Species at Risk. A period of three to four years is allowed for those species that were automatically listed when SARA came into force.

What's next?

In most cases, one or more action plans will be developed to define and guide implementation of the recovery strategy. Nevertheless, directions set in the recovery strategy are sufficient to begin involving communities, land users, and conservationists in recovery implementation. Cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty.

The series

This series presents the recovery strategies prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as strategies are updated.

To learn more

To learn more about the *Species at Risk Act* and recovery initiatives, please consult the Species at Risk (SAR) Public Registry (www.sararegistry.gc.ca).

Recovery Strategy for Multiple Species of Atlantic Coastal Plain Flora in Canada [Proposed]

2010

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Atlantic Coastal Plain Flora lakeshore habitat, Tusket River, Nova Scotia; inset photos (from left) Golden Crest (*Lophiola aurea*), Pink Coreopsis (*Coreopsis rosea*), Thread-leaved Sundew (*Drosera filiformis*), and Plymouth Gentian (*Sabatia kennedyana*). Photos from the Wildlife Division, NS Department of Natural Resources (NS DNR).

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DECLARATION

This recovery strategy has been prepared in cooperation with the jurisdictions responsible for the SARA-listed species of Atlantic Coastal Plain Flora. Environment Canada and Parks Canada Agency have reviewed and accept this document as the recovery strategy for the SARA-listed species of Atlantic Coastal Plain Flora, as required under SARA. This recovery strategy also constitutes advice to other jurisdictions and organizations that may be involved in recovering these species.

The goals, objectives, and recovery approaches identified in the strategy are based on the best existing knowledge and are subject to modifications resulting from new findings and revised objectives.

This recovery strategy will be the basis for one or more action plans that will provide details on specific recovery measures to be taken to support conservation and recovery of the species. The Minister of the Environment will report on progress within five years, as required under SARA.

Success in recovery depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by any jurisdiction alone. In the spirit of the Accord for the Protection of Species at Risk, the Minister of the Environment invites all responsible jurisdictions and Canadians to join Environment Canada in supporting and implementing this strategy for the benefit of the SARA-listed species of Atlantic Coastal Plain Flora and Canadian society as a whole.

RESPONSIBLE JURISDICTIONS

Province of Nova Scotia
Environment Canada
Parks Canada Agency

CONTRIBUTORS

This recovery strategy was prepared by Samara T. Eaton, J. Sherman Boates, and Mark F. Elderkin in consultation with the Atlantic Coastal Plain Flora Recovery Team.

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The Atlantic Coastal Plain Flora (ACPF) Recovery Team has developed this Recovery Strategy with input and assistance from other individuals. This strategy 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 strategy: 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.

STRATEGIC ENVIRONMENTAL ASSESSMENT STATEMENT

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals.* The purpose of 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 strategy itself, but are also summarized below.

This recovery strategy will clearly benefit the environment by promoting the recovery of ACPF. The potential for this strategy to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects. This multiple species strategy maintains an ecosystem perspective and includes all 90 ACPF species in Nova Scotia; although the focus is on the 10 legally listed ACPF species under SARA and the *Nova Scotia Endangered Species Act* (NS ESA) and one species (Long's Bulrush) listed as Vulnerable under the 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 2.8 (Effects on Other Species) and Section 2.9 (Recommended Approach for Recovery Implementation), as well as the habitat and biological needs descriptions in Section 3 of the strategy.

RESIDENCE

SARA defines residence as: *a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating* **[Subsection 2(1)]**.

Residence descriptions, or the rationale for why the residence concept does not apply to a given species, are posted on the SAR Public Registry:
www.sararegistry.gc.ca/sar/recovery/residence_e.cfm.

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. This strategy largely meets the requirements for recovery planning under the NS ESA (Section 15). For the SARA-listed species of Special Concern (Vulnerable under NS ESA), their inclusion in this recovery strategy will also serve in lieu of a management plan as required under SARA (Sections 65-67) and the

NS ESA (Section 15). The inclusion of Long's Bulrush in this recovery strategy will serve as a management plan for the species as required under the NS ESA (section 15).

The ACPF Recovery Team, Province of Nova Scotia, Environment Canada, and Parks Canada Agency led the development of this recovery strategy. This recovery strategy 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 addresses the recovery of all 10 provincially and federally legally listed ACPF species at risk, including two Endangered species: *Coreopsis rosea* (Pink Coreopsis) and *Drosera filiformis* (Thread-leaved Sundew); the five Threatened species: *Eleocharis tuberculosa* (Tubercled Spike-rush), *Hydrocotyle umbellata* (Water-pennywort), *Lachnanthes caroliniana* (Redroot), *Lophiola aurea* (Golden Crest), and *Sabatia kennedyana* (Plymouth Gentian); and the three species of Special Concern (Vulnerable under the NS ESA): *Clethra alnifolia* (Sweet Pepperbush), *Juncus caesariensis* (New Jersey Rush), and *Lilaeopsis chinensis* (Eastern Lilaeopsis). It also addresses one species listed as Vulnerable under the NS ESA: *Scirpus longii* (Long's Bulrush).[1] Note that Plymouth Gentian and Water-pennywort are listed provincially as Endangered. The range of all species at risk in this strategy is primarily the United States (US), with disjunct populations in Nova Scotia (NS), Canada.

A unique aspect of this multiple species recovery strategy 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 strategy include the diversity of habitat types and threats addressed, the collaboration and coordination among three jurisdictions, the ecosystem perspective that is maintained within this strategy, and the challenges and opportunities associated with the primarily private land tenure within NS (over 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. This 2010 recovery strategy builds on the 2005 document, retaining much of the content but including additional information as required under SARA.

[1] The 10 provincially and federally legally listed ACPF species and the one Vulnerable species under the NS ESA will be referred to hereafter as "the legally listed ACPF species".

EXECUTIVE SUMMARY

Atlantic Coastal Plain Flora (ACPF) in Nova Scotia (NS) consists of a group of 90 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 90 ACPF species, 11 are legally listed under the *Species at Risk Act (*SARA*)* and/or the *Nova Scotia Endangered Species Act (*NS ESA*)*. An additional 12 are considered 'at risk' and 15 are considered 'potentially at risk' under the provincial general status assessment process. In Canada, ACPF species are at the northern limit of their range and the Canadian distribution for the 11 legally listed ACPF species is restricted to the province of NS. The focus of this multiple species recovery strategy is on the two provincially and federally legally listed Endangered species, *Coreopsis rosea* (Pink Coreopsis) and *Drosera filiformis* (Thread-leaved Sundew) and the five federally Threatened species, *Eleocharis tuberculosa* (Tubercled Spike-rush) [provincially Threatened], *Hydrocotyle umbellata* (Water-pennywort) [provincially Endangered], *Lachnanthes caroliniana* (Redroot) [provincially Threatened], *Lophiola aurea* (Golden Crest) [provincially Threatened], and *Sabatia kennedyana* (Plymouth Gentian) [provincially Endangered]. This strategy also addresses the three provincially and federally listed Special Concern species (Vulnerable under the NS ESA) *Clethra alnifolia* (Sweet Pepperbush), *Juncus caesariensis* (New Jersey Rush), and *Lilaeopsis chinensis* (Eastern Lilaeopsis); and one species, *Scirpus longii* (Long's Bulrush), listed as Vulnerable under NS ESA (Table 1).

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, 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 over 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.

The ACPF Recovery Team has adopted a multi-species approach to the recovery and conservation of ACPF. Although the primary focus of this recovery strategy is the 11 legally listed ACPF species, it is being developed within the context of all 90 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 identified, at least partially, for the seven Endangered and Threatened ACPF species listed under SARA. Examples of activities likely to result in the destruction of critical habitat are outlined as well as a schedule of studies required to complete the identification.

The recovery of ACPF is considered technically and biologically feasible. The general goal of this recovery strategy 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 strategy. 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 sets three recovery goals for all high priority ACPF species; including the 11 legally listed ACPF species, the 12 non-legally listed, Red ranked species, and the eight Undetermined ranked (data deficient) species.

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

1. **Protect all populations and their habitats** at the 36 high priority lakeshores, 41 high priority bogs/fens, 23 medium priority lakeshores, three medium priority bogs/fens, and five high priority estuaries/coastal habitats.

2. **Prevent, remove, and/or reduce threats** to species and habitats, including the seven high priority threats on lakeshores, seven high priority threats at bogs/fens, and one high priority threat 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 36 high priority lakeshores and 41 high priority bogs/fens and the 23 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 can increase 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 recovery strategy on the Species at Risk Public Registry.

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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 Maine, extending into Nova Scotia (NS). 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, 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 90 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 11 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 Strategy

This multiple species recovery strategy achieves a balance between the requirements for recovery planning under law (SARA and NS ESA) and requirements based on conservation needs. This recovery strategy addresses species that are legally protected and uses the best available information from the conservation community to provide recovery planning for species that are of high conservation concern, but have not yet been assessed for legal protection.

The focus of this strategy are the 11 legally listed ACPF species, including the two provincially and federally legally listed Endangered species, *Coreopsis rosea* (Pink Coreopsis) and *Drosera filiformis* (Thread-leaved Sundew) and the five federally Threatened species, *Eleocharis tuberculosa* (Tubercled Spike-rush) [provincially Threatened], *Hydrocotyle umbellata* (Water-pennywort) [provincially Endangered], *Lachnanthes caroliniana* [= *L. caroliana*] (Redroot) [provincially Threatened], *Lophiola aurea* (Golden Crest) [provincially Threatened], and *Sabatia kennedyana* (Plymouth Gentian) [provincially Endangered]. This strategy also addresses the three provincially and federally listed Special Concern species (Vulnerable under the NS ESA), *Clethra alnifolia* (Sweet Pepperbush), *Juncus caesariensis* (New Jersey Rush), and *Lilaeopsis chinensis* (Eastern Lilaeopsis); and one species, *Scirpus longii* (Long's Bulrush), listed as Vulnerable under the NS ESA (Table 1).

The strategy also addresses ACPF species for which there is a conservation concern, but that are not legally listed. These are species that have been assessed under the provincial general status process. By explicitly including these additional species in the recovery process, this multiple species recovery strategy 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 recovery strategy 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 strategy.

Under the provincial general status assessment process, 23 of the 90 ACPF species in NS are considered 'at risk' (Red ranked). Eleven of these 23 Red ranked species are the legally listed ACPF species and the remaining 12 non-legally listed Red ranked species will hereafter be referred to as the 'Red ranked' species. There are 15 species considered 'potentially at risk' (Yellow ranked), and eight species considered 'data deficient' (Undetermined ranked) due to insufficient information to assess their status. Forty are considered 'not at risk' (Green ranked) and four species are considered extirpated from NS (Blue ranked). 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[2] and Appendix 3 for definitions of terms and risk categories.

The list of NS's ACPF (Appendix 1 and 2) includes 27 species that have been added since the 2005 Recovery Strategy and Action Plan (ACPF RT 2007). Species that were candidates for inclusion on the ACPF list, but had not previously been examined by the Recovery Team were assessed in January 2007. 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 at the state level 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, salt marsh or estuarine shore).

[2] Appendix 1 provides information on the provincially and federally legally listed ACPF species, the non-legally listed Red ranked species, the Yellow ranked species, the Undetermined ranked species and the Blue ranked species. Appendix 2 provides information on the Green ranked species.

Table 1. The 11 legally listed Atlantic Coastal Plain Flora species.

Scientific Name (Common Name)	COSEWIC[1] Status & Year		SARA[2]	NS ESA[3] Status & Year		Global Rank	Estimated Population	Summary of 'Rationale for Status'
Coreopsis rosea (Pink Coreopsis)	E	1984 (2000)	E	E	2000	G3	> 6,000 flowering plants	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.
Drosera filiformis (Thread-leaved Sundew)	E	1991 (2001)	E	E	2000	G4G5	Unknown (likely 10's 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 from activities such as peat extraction and cranberry farming.
Eleocharis tuberculosa (Tubercled Spike-rush)	T	2000	T	T	2003	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.
Hydrocotyle umbellata (Water-pennywort)	T	19845 (1999)	T	E	2001	G5	2 stands (Wilsons), ~10 stands (KNP)[4]	A disjunct, primarily clonal species, found along the shorelines of only 2 lakes both of which are subjected to heavy recreational use. Downlisted from Endangered in 1998.
Lachnanthes caroliniana (Redroot)	T	2000	T	T	2002	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.
Lophiola aurea (Golden Crest)	T	1987 (2000)	T	T	2001	G4	Unknown (>5,000)	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.
Sabatia kennedyana (Plymouth Gentian)	T	1984 (2000)	T	E	2001	G3	> 1,300 plants	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.
Clethra alnifolia (Sweet Pepperbush)	SC	1986 (2001)	SC	V	2000	G5	Unknown	A disjunct and vigorous clonal species found only along the shores of 6 lakes where habitat destruction from cottage development is a threat. Downlisted from Threatened in 2001.
Juncus caesariensis (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 26 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.

Scientific Name (Common Name)	COSEWIC[1] Status & Year		SARA[2]	NS ESA[3] Status & Year		Global Rank	Estimated Population	Summary of 'Rationale for Status'
Lilaeopsis chinensis (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.
Scirpus longii (Long's Bulrush)	SC	1994	-	V	2001	G2	> 80 clones	A slow growing perennial species found in wetlands. Restricted range and limited sexual reproduction with significant reduction of one site due to road development.

[1] COSEWIC Status: E = Endangered, T = Threatened, SC = Special Concern; status was re-examined in years in ()
[2] **SARA Status: E= Endangered, T = Threatened, SC = Special Concern**
[3] NS ESA Status: E = Endangered, T = Threatened, V = Vulnerable
[4] KNP = Kejimkujik National Park

1.1.2 Ecological Role

All 11 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 is underway on Pink Coreopsis (Woods 2006), Thread-leaved Sundew (Cody 2002), and Plymouth Gentian (Sutton in progress 2007), but the extent of genetic isolation and variability from the US populations is not yet clear. Further genetics work is required to evaluate the potential importance of protecting these disjunct populations with regards to the long-term survival of the species.

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 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 11 of the legally listed ACPF species at risk have some biologically limiting factors that 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 type, which is very limited in its occurrence in southwestern NS (Wisheu and Keddy 1989a). The 'rescue effect' for these species is low as they are isolated, disjunct populations with almost no 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 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 it is believed that a series of islands served as a biological link between southern NS and the Cape Cod region of Massachusetts (Keddy and Wisheu 1989, Pielou 1991). Rising sea levels eliminated the series of islands and separated the NS population from the main populations in the US (Roland and Smith 1969).

In general, the distribution of ACPF ranges from Texas to Southern Maine in the US, coinciding with the 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 11 legally listed ACPF species in this strategy occur only in the province of NS.

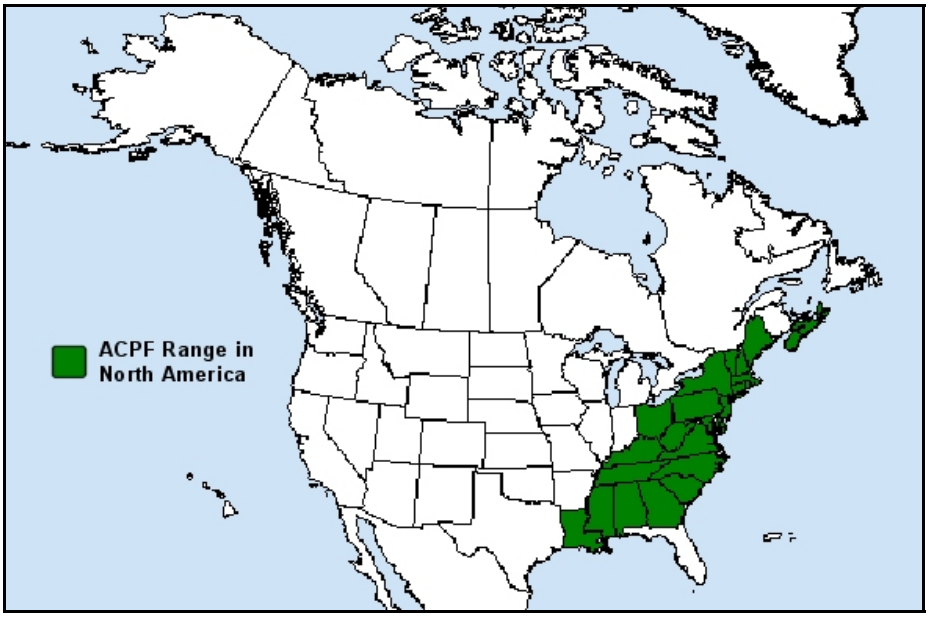

Figure 1. The general distribution of ACPF in North America.

The majority of ACPF species at risk in NS are concentrated in the southwestern portion of the province where 10 of the 11 legally listed ACPF species are located (Figure 2). However, ACPF

habitat does exist in other regions of the province and New Jersey Rush (*Juncus caesariensis*), for example, is located in southeastern Cape Breton Island.

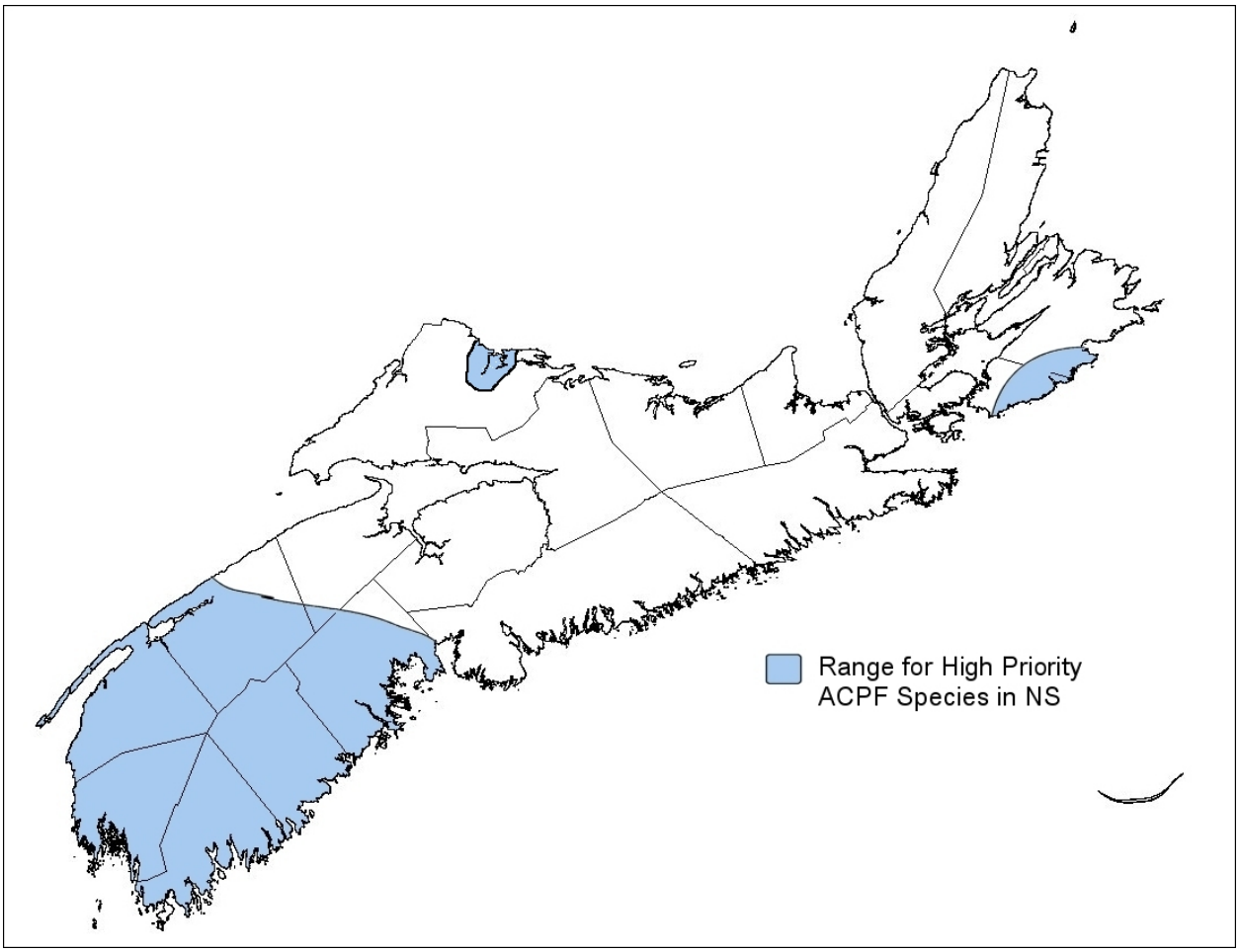

Figure 2. The general distribution of legally listed ACPF species, non-legally listed Red ranked species, and Undetermined ranked species in NS.

Five of the 90 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 (*Coreopsis rosea*), Plymouth Gentian (*Sabatia kennedyana*), New Jersey Rush (*Juncus caesariensis*), and Long's Bulrush (*Scirpus longii*), and Goldenrod (*Euthamia galetorum*), a species which is abundant locally. All five of these species have a very limited distribution along the eastern seaboard of North America and are at risk of extinction over most of their range, with only a few locations in the US where they are considered secure. 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). The ACPF Recovery Team has adopted a multiple species approach to the conservation and recovery of ACPF, 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 11 legally listed ACPF species are part of a broader complement of 90 ACPF species. A multiple species approach enables the conservation of other non-legally listed ACPF species to be addressed within the strategy 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 strategy and ultimately facilitating a more effective development and delivery of recovery actions.

1.4 Characterizing and Prioritizing Recovery Planning for ACPF

Priorities in this strategy 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 strategy.

When using a multiple species approach to conservation and recovery, establishing priorities is challenging, but essential. In this strategy 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 strategy addresses the recovery of the 11 legally listed ACPF species within the context of the full complement of 90 ACPF species. A high, medium, or low level of priority is assigned to all 90 ACPF species and with each of these levels comes a difference in the necessary or required approaches to conservation and recovery.

One third of the 90 ACPF species (33.4%) are assigned a high priority for recovery. High priority species include legally listed ACPF species at risk, and non-legally listed ACPF species with provincial Red and Undetermined ranks (Table 2). The primary focus of the recovery

strategy is the 11 federally and provincially legally listed ACPF species (Table 1). The 12 Red ranked species are also assigned a high priority for recovery as they are considered 'at risk' under the provincial general status assessment process and based 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 eight species that are 'data-deficient' or have insufficient data to determine their status (Undetermined rank) 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 and often 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.

An additional 16.7% of the species are assigned a medium priority (Table 2); these are the 15 Yellow ranked species (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 strategy. 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.

In NS, 44.4% of the 90 ACPF species are considered 'not at risk', common, or secure (Green ranked) (Table 2, see Appendix 2 for species list) and these species are assigned a low priority. The four species considered extirpated (Blue ranked), are also assigned a low priority (see Appendix 1 for species list). Conservation and recovery of these species are 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 strategy however, in order to provide the full context of how many ACPF species are in NS.

Blue ranked species are considered extirpated and with the reintroduction potential being very small and not considered feasible at this time they are assigned a low priority. This is based on the best available information and, as with all species, if the information changes then the priority status within the strategy should be re-evaluated.

The ACPF Recovery Team and agencies involved in recovery should continue to track the status of the group as a whole because conservation information could change and it is important that conservation priorities reflect the state of the information. This strategy can be amended and updated whenever it is necessary.

Table 2. The ranking or status for each of the 90 ACPF species and the assigned level of priority for each rank.

Assessment Process*	Ranking/ Status	# of Species	% of Total # of Species	Level of Priority for Recovery
Legally listed provincially & federally	SARA & NS ESA[1]	11	12.2	High
NS DNR General Status	Non-Legally Listed Red	12	13.3	High
	Undetermined	8	8.9	High
	Yellow	15	16.7	Medium
	Blue	4	4.4	Low
	Green	40	44.4	Low
Total # High & Medium Priority Species		46	51.2	
Total # Species		90	100.0	

***** See Appendix 3 for an explanation of species status assessment processes and definitions of ranks
[1] These species are Red ranked under the NS Department of Natural Resources (NS DNR) General Status assessment process

Table 3. The non-legally listed high priority species ranked as Red or Undetermined by the NS DNR General Status Assessment process.

Scientific Name	Common Name	NS DNR General Status
Agalinis maritima	Salt-Marsh False-Foxglove	Red
Amelanchier nantucketensis	Nantucket Shadbush	Red
Baccharis halimifolia	Groundseltree	Red
Carex longii	Greenish-White Sedge	Red
Eupatorium dubium	Joe-pye-weed (Joe-Pye Thoroughwort)	Red
Galium obtusum	Large Marsh Bedstraw	Red
Iris prismatica	Slender Blue Flag	Red
Panicum dichotomiflorum var. puritanorum	Spreading Panic-Grass	Red
Proserpinaca intermedia	Intermediate Mermaid-Weed	Red
Proserpinaca palustris var. palustris	Marsh Mermaid-Weed	Red
Toxicodendron vernix	Poison Sumac	Red
Utricularia resupinata	Northeastern Bladderwort	Red
Carex atlantica ssp. capillacea	Howe Sedge	Undetermined
Elymus virginicus var. halophilus	Terrell Grass	Undetermined
Iva frutescens ssp. oraria	Marsh Elder	Undetermined
Juncus subcaudatus	Rush (Woods-Rush)	Undetermined
Najas gracillima	Thread-Like Naiad	Undetermined
Potamogeton pulcher	Spotted Pondweed	Undetermined
Sisyrinchium fuscatum	Coastal-Plain Blue-Eyed-Grass	Undetermined
Suaeda maritima ssp. richii	Rich's Sea-blite	Undetermined

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 11 high priority legally listed ACPF species. Additional specific habitat information for these 11 species is provided in Section 3.

For the purpose of assigning priorities within this recovery strategy, 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.

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Table 4. Species-specific habitat and reproductive characteristics for the 11 legally listed ACPF species. For references please refer to species-specific information in Section 3.

Species	# of Locations per high priority Habitat Type[1]	Habitat Description	Essential Requirements	E/T/SC Species Co-occurring in at least one Location	Reproductive Strategy	Flowering Season	Pollination[2]	Seed Dispersal Mechanisms[3]
Pink Coreopsis, *Coreopsis rosea*	8 L 2 HL	Infertile, gently sloping sandy, gravel, peat, or cobblestone lake shorelines Associated with glacial deposits of red till.	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, *Drosera filiformis*	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
Tubercled Spike-rush, *Eleocharis tuberculosa*	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 conditions (shade intolerant)	None	Asexual (vegetative); Sexual (seeds)	Aug.	Wi	Wi Wa C
Water-pennywort, *Hydrocotyle umbellata*	2 L	Primarily on sand or gravel lake shorelines in a narrow band above or below the waterline. It is generally found on lakeshores with soils that are acidic and nutrient poor. Typically found growing in monocultures or with a minimal number of species.	Natural disturbances: fluctuating water conditions	Pink Coreopsis, Plymouth Gentian	Asexual (stolons); Sexual (seeds not observed in NS)	July-Sept.	N/A	U
Redroot, *Lachnanthes caroliniana*	6 L	Shorelines of lakes on substrates such as peat, sand, and gravel. Abundance is highest on cobble beaches of peat or gravel. Often associated with meadows of Twigrush (*Cladium mariscoides*).	Natural disturbances: fluctuating water conditions	Golden Crest, Long's Bulrush	Asexual (rhizomes); Sexual (seeds)	Aug.-Sept.	U	U
Golden Crest, *Lophiola aurea*	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.	Natural disturbances: fluctuating water conditions, wave action. Periodic flooding and waterlogged conditions.	Redroot, Long's Bulrush	Asexual (rhizomes); Sexual (sporadic seed production)	Aug. - Sept.	I	U

Species	# of Locations per high priority Habitat Type[1]	Habitat Description	Essential Requirements	E/T/SC Species Co-occurring in at least one Location	Reproductive Strategy	Flowering Season	Pollination[2]	Seed Dispersal Mechanisms[3]
Plymouth Gentian, *Sabatia kennedyana*	11 L 3 HL	Broad, infertile, gently sloping lakeshores of sand, cobblestone, gravel, or peat. It is associated with glacial deposits of red till.	Natural disturbances: fluctuating water conditions, ice scour, wave action	Pink Coreopsis, Water-pennywort, Long's Bulrush	Asexual (stolons); Sexual (sporadic seed production)	Mid July-Sept.	I	Wa
Sweet Pepperbush, *Clethra alnifolia*	6 L	Open shorelines that are often granite bouldered. Contrary to other ACPF species, it prefers areas that are protected from disturbances from wind and ice scour and is found in low catchment area lakes. Has been observed inland in shaded forested habitat and along rivers.	Areas that are protected from ice scour, wave action	None	Asexual (vegetative suckers); Sexual (seeds in all but 1 population)	Mid Aug.-Oct.	U	U
New Jersey Rush, *Juncus caesariensis*	26 B/F	Edges of small bays or coves of bogs and fens, and in small boggy openings in coniferous woods. It requires early successional or open conditions and moderate disturbance. 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.	Open conditions, moderate disturbance, intolerant of hydrological changes	None	Asexual (rhizomes); Sexual (seeds not observed in NS)	July-Aug.	Wi	U
Eastern Lilaeopsis, *Lilaeopsis chinensis*	5 E	Intertidal zone along the shorelines of estuaries, mainly on gentle, muddy slopes, and occasionally on gentle slopes of fine gravel. It generally occurs in estuaries near the mouth of large rivers cut off from the open ocean, with a long, narrow, rectangular shape. It grows well in the intertidal zone, and is submerged under 2 m of water for part of each day.	No specific or essential requirements	None	Asexual (rhizomes); Sexual (seeds)	Aug.-Sept.	U	Wa

Species	# of Locations per high priority Habitat Type[1]	Habitat Description	Essential Requirements	E/T/SC Species Co-occurring in at least one Location	Reproductive Strategy	Flowering Season	Pollination[2]	Seed Dispersal Mechanisms[3]
Long's Bulrush, *Scirpus longii*	6 L 9 B/F	Five wetland habitats including stillwater meadows, inland fens, bay bogs, barrier bogs and peat shores of high watershed area lakes. 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. It tends to grow in the most waterlogged areas of these habitats, and on east-facing shores.	Waterlogged conditions	Thread-leaved Sundew, Water-pennywort, Plymouth Gentian, Golden Crest	Asexual (rhizomes); Sexual (irregular seed production)	June-early July	Wi	Wa Wi

[1]**High priority habitat type:** L-lake, B-bog, F-fen, E-estuary, HL-historic lake; [2]**Pollination:** I-insect, Wi-wind, U-unknown, N/A-not applicable; [3]**Seed Dispersal Mechanisms:** Wa-water, Wi-wind, C-colonization from broken off plant clumps, 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, 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 10 of the 11 legally listed ACPF species and 10 of the other 20 high priority species. Estuary/Coastal habitat is the only known habitat type for the eleventh legally listed ACPF species 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. Even though there may be high priority species present at sites assigned a medium priority, the other conservation factors are not suitably well understood to warrant assigning a high level of priority at this time. The remaining habitat types have been assigned a low priority and include swamp/wooded swamp, meadow/field, and barrens (Table 5).

High priority habitats will be specifically targeted within this strategy 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 strategy.

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			Total # of High N=31 species	Medium Priority Species Yellow ranked, N=15	Level of Priority
	Legally listed, N=11	Red ranked, N=12	Und. ranked, N=8			
Lakeshore	8	8	1	17	11	High
Bog/ Fen	4	6	1	11	3	High
Estuary/Coastal (salt marsh, sea beach, tidal river)	1	3	3	7	2	High
River/stream Shore	2	5	0	7	7	Medium
Aquatic	1	3	2	6	1	Medium
Marsh	1	5	0	6	2	Medium
Swamp/ Wooded Swamp	0	4	2	6	4	Low
Meadow/ Field	0	1	1	2	2	Low
Barrens	0	1	3	4	3	Low

1.4.2.2 Characterization of Lakeshore Habitat

Eight of the 11 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 the shrub zone where shorelines are steeply sloped, free of ice scour disturbance, and often with granite boulders.

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 some 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, salt marshes, 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, *Lilaeopsis chinensis* (Eastern Lilaeopsis), occurs in estuaries at the mouths of large rivers in NS. Estuarine species are adapted to daily fluctuations in water levels and are inundated by several meters of water for part of each day. Additional high priority ACPF species occur in coastal habitats, including three Red ranked and three Undetermined ranked species (Appendix 4). Coastal habitat describes areas such as salt marshes, tidal beaches and tidal rivers where water level and water composition are affected by marine processes such as tide cycles.

1.4.3 ACPF Habitat: Locations

For this strategy *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 high priority (Red and Undetermined ranked) species, and then the number of medium priority 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, only 97 (1.4%) of all 6,700 lakes in NS are known to contain high priority ACPF species. Similarly, only 42 of the greater than 22,000 bogs in NS (0.19%) 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 11 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 strategy.

1.4.3.1 Prioritization of Lakes

Table 6 indicates which lakes have the greatest number of high and medium priority APCF species and what level of priority was assigned to conservation efforts at each of these locations. Note that the relevance of the watershed column included in Table 6 is explained in Section 1.5.3 below. High priority was assigned to lakes that contained one or more legally listed ACPF species as these are the primary focus of the strategy. Lakes containing one or more non-legally listed Red ranked species or Undetermined ranked species were assigned a medium priority. There are 36 high priority lakes and 23 medium priority lakes, many of which have more than one high priority species. 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. Low priority was assigned to the 38 lakes with one or more Yellow ranked species (contact the ACPF Recovery Team for a list of these lakes).

Table 6. The 36 high and 23 medium priority lakes for ACPF species in NS, including the total number of high and medium priority species and the watershed where they are located.

Watershed	Location	Species							Priority
		High Priority					Medium Priority	Total #	
		E*	T*	SC*	R+	U+	Y+		
Tusket	Wilsons Lake	1	2	1	2	0	3	9	High
Tusket	Gillfillan Lake	1	1	0	1	0	4	7	High
Tusket	Bennetts Lake	1	1	0	1	0	3	6	High
Tusket	Agard Lake	1	1	0	0	0	1	3	High
Tusket	Salmon Lake	1	0	0	1	1	1	4	High
Tusket	Pleasant Lake	1	0	0	1	0	0	2	High
Tusket	Sloans Lake	1	0	0	0	0	0	1	High
Tusket	Raynards Lake	1	0	0	0	0	0	1	High
Medway	Ponhook Lake	0	2	1	0	0	4	7	High
Tusket	Lac de l'Ecole	0	1	1	1	0	3	6	High
Barrington & Clyde	Great Pubnico Lake	0	1	0	1	0	1	3	High
Mersey	Kejimkujik Lake	0	1	0	1	0	4	6	High
Tusket	Kegeshook Lake	0	1	0	1	0	3	5	High
Medway	Beartrap Lake	0	2	0	0	0	2	4	High
Medway	Hog Lake	0	2	0	0	0	2	4	High
Tusket	Lake Fanning	0	1	0	1	0	1	3	High
Tusket	Pearl Lake	0	1	0	0	0	4	5	High
Medway	Molega Lake	0	1	0	0	0	4	5	High
Medway	Cameron Lake	0	1	0	0	1	3	5	High
Tusket	Third Lake	0	1	0	0	0	3	4	High
Tusket	Travis Lake	0	1	0	0	0	2	3	High
Barrington & Clyde	Harpers Lake	0	1	0	0	0	1	2	High
Roseway	Gold Lake	0	1	0	0	0	0	1	High
Roseway	Western Lake	0	1	0	0	0	0	1	High
Tusket	Kempt Snare Lake	0	1	0	0	0	0	1	High
Barrington & Clyde	Barrington Lake	0	1	0	0	0	0	1	High
Medway	Fancy Lake	0	1	0	1	0	0	2	High
Medway	Little Ponhook Lake	0	2	1	1	0	0	4	High
Medway	Shingle Lake	0	1	0	0	0	1	2	High
Tusket	Canoe Lake	0	0	1	0	0	0	1	High
Tusket	Louis Lake	0	0	1	0	0	0	1	High
Meteghan	Belliveau Lake	0	0	1	0	0	0	1	High
Medway	Mill Lake	0	0	1	0	0	0	1	High
Medway	Mudflat Lake	0	0	1	0	0	0	1	High
Medway	Pretty Mary Lake	0	0	1	0	0	0	1	High
Medway	Moosehorn Lake	0	0	1	0	0	0	1	High

Watershed	Location	Species							Priority
		High Priority					Medium Priority	Total #	
		E*	T*	SC*	R+	U+	Y+		
Mersey	Lake Rossignol	0	0	0	2	0	0	2	Medium
Tusket	Gavels Lake	0	0	0	2	0	0	2	Medium
Roseway	Lake John	0	0	0	1	0	5	6	Medium
Tusket	Parr Lake	0	0	0	1	0	3	4	Medium
Tusket	Ellenwood Lake	0	0	0	1	0	1	2	Medium
LaHave	Rhodenizer Lake	0	0	0	1	1	0	2	Medium
Sissabo & Bear	Lake Midway	0	0	0	1	0	0	1	Medium
Medway	Telfer Lake	0	0	0	1	0	1	2	Medium
Roseway	West Horseshoe Lake	0	0	0	1	0	0	1	Medium
Meteghan	Salmon River Lake	0	0	0	1	0	0	1	Medium
Roseway	Welshtown Lake	0	0	0	1	0	0	1	Medium
Grand	Barren Hill Lake	0	0	0	1	0	0	1	Medium
Annapolis	Cedar Lake	0	0	0	0	2	1	3	Medium
Mersey	Grafton Lake	0	0	0	0	1	3	4	Medium
LaHave	Wentzells Lake	0	0	0	0	1	1	2	Medium
Mersey	Mud Lake	0	0	0	0	1	1	2	Medium
Meteghan	Sears (Bay) Lake	0	0	0	0	1	0	1	Medium
Gaspereau	Mud Lake Bog	0	0	0	0	1	0	1	Medium
Tusket	Lily Lake	0	0	0	0	1	0	1	Medium
Musquodoboit	Jennings Lake	0	0	0	0	1	0	1	Medium
-	Ethel Lake (St. Paul Island)	0	0	0	0	1	0	1	Medium
Medway	Charlotte Lake	0	0	0	0	1	0	1	Medium
Roseway	Beaverdam Lake	0	0	0	0	1	0	1	Medium

* COSEWIC status: E= Endangered, T= Threatened, SC= Special Concern
+ Provincial Rank: R=Non-legally listed Red rank, U=Undetermined rank, Y= Yellow rank

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 two of the 41 bogs/fens known to support legally listed ACPF contain more than one species, while the remaining 39 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 41 bogs/fens. However, because only two 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.

Six medium priority non-legally listed Red ranked species are known to occur in bog/fen habitat and include: *Carex longii* (Greenish-white Sedge), *Galium obtusum* (Large Marsh Bedstraw), *Iris prismatica* (Slender Blue Flag), *Proserpinaca intermedia* (Intermediate Mermaid-Weed), *Proserpinaca palustris var. palustris* (Marsh Mermaid-Weed), and *Toxicodendron vernix* (Poison Sumac). Specific bog/fen locations for the Red ranked species are currently

undocumented. One Undetermined ranked species, *Carex atlantica ssp. capillacea* (Howe Sedge), is known to occur in three bog/fens (St. Paul Island Bog 2, Bog S of Kennington Cove Rd, and Fen N of Kennington Cove Rd) and these locations were assigned a medium priority.

Table 7. The 41 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[1]	E	T	SC	SC	
Watershed	**Location**	*Drosera filiformis* Thread-leaved Sundew)	*Lophiola aurea* (Golden Crest)	*Juncus caesariensis* (New Jersey Rush)	*Scirpus longii* (Long's Bulrush)	**Total # of Species**
Mersey	Dunraven Bog		1		1	2
Roseway	Quinns Meadows Bog	1			1	2
Roseway	Port La Tour Bog	1				1
Roseway	Swaines Road Bog	1				1
Roseway	Villagedale Bog	1				1
Roseway	West Baccaro Bog	1				1
Medway	Fen near Molega Lake				1	1
Medway	Fen at Eighteen Mile Brook				1	1
Medway	Eel Weir Stillwater Bog/Fen				1	1
Medway	Medway River Bog/Fen #1				1	1
Medway	Medway River Bog/Fen #2				1	1
Medway	Medway River Bog/Fen #3				1	1
Medway	Medway River Bog/Fen #4				1	1
Little River	Moores Lake Bog		1			1
Little River	Tiddville Bog		1			1
Grand	Gracieville (Bog 1 + Bog 2)*			1		1
Grand	Gracieville (Bog 3)			1		1
Grand	Gracieville (Bog 4)			1		1
Grand	Gracieville (Bog 5)			1		1
Grand	Gracieville			1		1
Grand	Grand River 'Bog 8'			1		1
Grand	Grand River 'Bog 9b'			1		1
Grand	Grand River West			1		1
Grand	Grand River East 1			1		1
Grand	Grand River East 2			1		1
Grand	Grand River (Indian Point)			1		1
Grand	Point Michaud			1		1
Grand	Point Michaud 'German Bog'			1		1
Grand	Point Michaud 'Elbow Bog'			1		1

	COSEWIC Status[1]	E	T	SC	SC	
Watershed	**Location**	*Drosera filiformis* Thread-leaved Sundew)	*Lophiola aurea* (Golden Crest)	*Juncus caesariensis* (New Jersey Rush)	*Scirpus longii* (Long's Bulrush)	**Total # of Species**
Sydney & Mira	L'Archevêque/ St. Esprit			1		1
Sydney & Mira	St. Esprit			1		1
Sydney & Mira	St. Espirit/ Ferguson Road Bog			1		1
Sydney & Mira	Lower St. Espirit			1		1
Sydney & Mira	Fen near Stirling			1		1
Sydney & Mira	Loch Lomond (Grace's Road Fen)			1		1
Sydney & Mira	Loch Lomond (Grace's Road Fen- new location)			1		1
Sydney & Mira	Bog E of South Arm Breeches Lake			1		1
Sydney & Mira	Bog near Framboise/Fourchu			1		1
Sydney & Mira	Framboise/Fourchu (opposite Morrison Beach Road)			1		1
Sydney & Mira	Bog W of Mulcuish Lake			1		1
Sydney & Mira	Mulcuish Lake (near gravel pit)			1		1

[1] 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 five estuaries where *Lilaeopsis chinensis* (Eastern Lilaeopsis) is found because these are the only known locations for Eastern Lilaeopsis. These five estuaries are located at the mouth of the Tusket, Medway, LaHave, and Roseway Rivers in southwestern NS and the River Philip in north-central NS.

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 50% of the 47 primary watersheds in NS. However, only 11 primary watersheds have legally listed high priority ACPF species. All 11 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 11 high priority watersheds, with eight of the eleven 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 11 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 *Juncus caesariensis*.

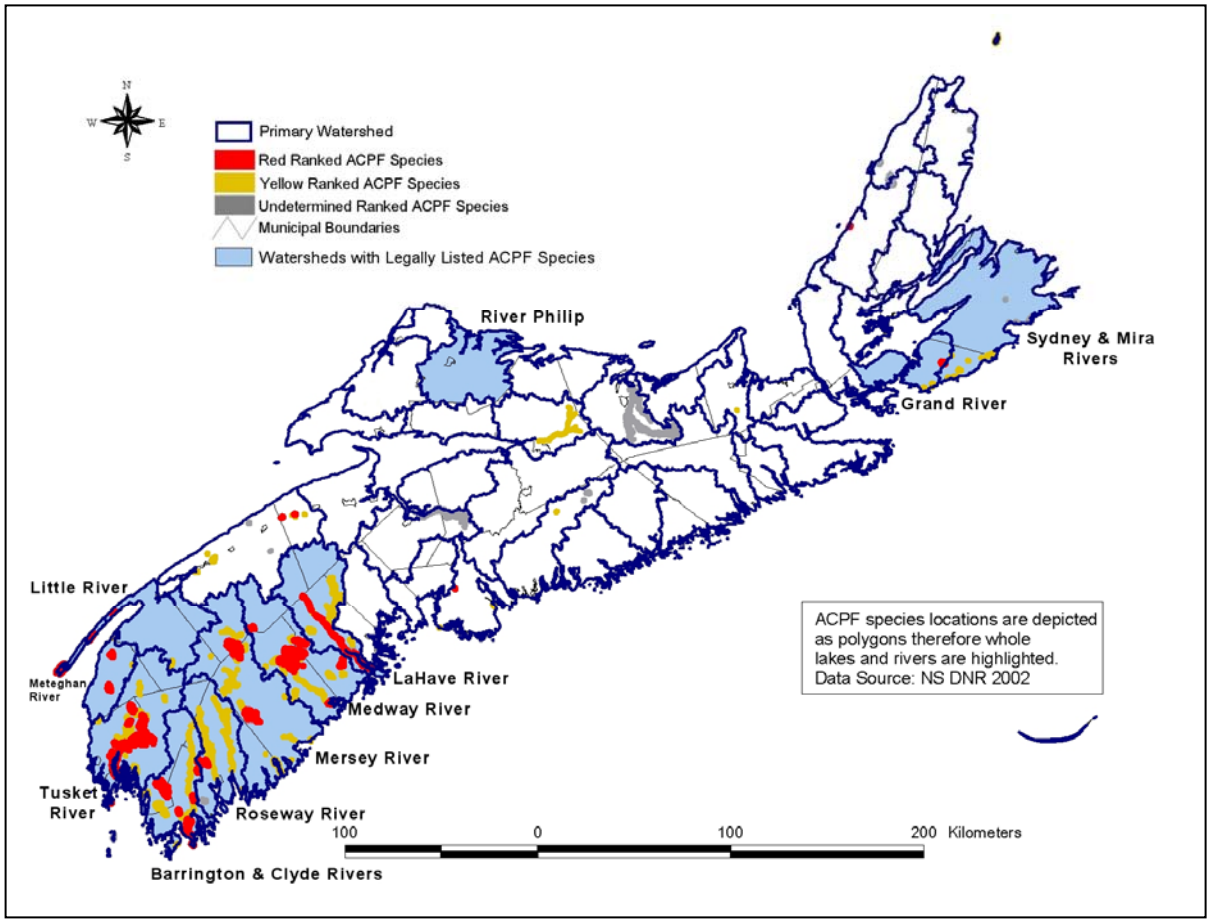


Figure 3. The 11 high priority watersheds in NS that contain high priority ACPF species.

1.5 Characterizing and Prioritizing Common Threats

1.5.1 Threat classification

Table 8 summarizes the 24 general and specific threats to the 11 legally listed ACPF species addressed in this strategy. 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 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 11 legally listed ACPF species

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***		
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	-	L
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. Peat mining	Habitat conversion; Removal of substrate	Local extinction; poor reproductive success	L	A	OT	H	H	H	-	H	-
8. Cranberry growing	Habitat conversion; Removal of substrate	Local extinction; poor reproductive success	L	A	C	H	H	H	-	H	-
9. 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
10. Diatomaceous earth	Removal of substrate	Local extinction	L	H	OT	H	H	L	-	L	-

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*		
mining											
11. Dam construction (Hydroelectric)	Habitat conversion	Local extinction	L	H	OT	H	H	L	L	-	-
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)	Eutrophication (increased nutrients)	↑ interspecific competition	W	C	C	L	U	M	M	-	-
2. Pesticide Use (*i.e.* landscaping, crop and animal production)	Direct exposure; Alteration of habitat characteristics (species composition)	↑ mortality; ↑ interspecific competition	W	C	C	L	U	L	M	-	-
3. Gas and oil leakage and spills (*i.e.* motorboats,	Direct exposure; Alteration of habitat characteristics (substrate conditions)	↑ mortality; poor reproductive success	L	C	C	L	U	L	L	L	L

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*		
OHVs, washing cars)											
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	U

[+]**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	***Coreopsis rosea*** (Pink Coreopsis)	***Eleocharis tuberculosa*** (Tubercled Spike-rush)	***Sabatia kennedyana*** (Plymouth Gentian)	***Hydrocotyle umbellata*** (Water-pennywort)	***Lachnanthes carolinana*** (Redroot)	***Clethra alnifolia*** (Sweet Pepperbush)	***Lophiola aurea*** (Golden Crest)	***Scirpus longii*** (Long's Bulrush)	***Drosera filiformis*** (Thread-leaved Sundew)	***Juncus caesariensis*** (New Jersey Rush)	***Lilaeopsis chinensis*** (Eastern Lilaeopsis)
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	√	√	√	√	√	√	√	√	√	√	√
2. Shoreline alterations (*i.e.* mowing & raking, boat docks & launches, wharves, breakwaters)	√	√	√	√	√	√	√	-	-	-	-
3. Dam operation (Hydroelectric)	√	-	√	√	-	-	-	-	-	-	√

	High Priority Species (legally-listed)*										
	Lakeshore (L)						**L & B/F**		**Bog/Fen (B/F)**		**Estuary/ Coastal**
General Threat	***Coreopsis rosea*** (Pink Coreopsis)	***Eleocharis tuberculosa*** (Tubercled Spike-rush)	***Sabatia kennedyana*** (Plymouth Gentian)	***Hydrocotyle umbellata*** (Water-pennywort)	***Lachnanthes carolinana*** (Redroot)	***Clethra alnifolia*** (Sweet Pepperbush)	***Lophiola aurea*** (Golden Crest)	***Scirpus longii*** (Long's Bulrush)	***Drosera filiformis*** (Thread-leaved Sundew)	***Juncus caesariensis*** (New Jersey Rush)	***Lilaeopsis chinensis*** (Eastern Lilaeopsis)
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	√	√	√	√	√	√	√	-	√	-	-
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**	**21**	**13**	**14**	**14**	**10**
	Lakeshore (L)						**L & B/F**		**Bog/Fen (B/F)**		**Estuary/ Coastal**

* - (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 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 estuarine species have 10 threats (Table 9). Golden Crest 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 11 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 Tables 8 and 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).

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 Estuarine Habitats and Species

Eastern Lilaeopsis is the only high priority estuarine ACPF species and it faces fewer severe current threats than lakeshore and bog/fen species. The only high priority threat to Eastern Lilaeopsis 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.

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 2010 Recovery Strategy 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 (Section 1.8) that still need to be addressed. This Recovery Strategy 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.

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, 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 (*Hydrocotyle umbellata*) population in KNP (Vasseur 2005). As a result there has been considerable variation in the amount and quality of survey data collected. 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.

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, and Dr. Nick Hill 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 11 ACPF species.

From a policy perspective, the provincial Integrated Resources Management (IRM) planning process now 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.

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.

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 the Nature Reserve. 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.

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.

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, 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 11 legally listed ACPF species, recovery is considered feasible for all 11 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 1.7).

The effectiveness of recovery relies upon both good science and education outreach; however, the securement of sufficient financial resources to address scientific gaps in knowledge remains a significant challenge. Similarly, limited financial incentives for private landowners to protect lands through conservation easements and donations impede the speed at which habitat protection can proceed. Stewardship, research, and habitat protection all will require better, non-static and directed financial resources in the future for ACPF recovery to be successful.

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 strategy, including the 11 legally listed ACPF species, the 12 non-legally listed, Red ranked species, and the eight Undetermined ranked (data deficient) species (Table 10).

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

Goal No.	Species Scientific Name (Common Name) (Status*)	Recovery Goal

Goal No.	Species Scientific Name (Common Name) (Status*)	Recovery Goal
1	*Coreopsis rosea* (Pink Coreopsis) **(E)** *Hydrocotyle umbellata* (Water-pennywort) **(T)** *Sabatia kennedyana* (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	*Drosera filiformis* (Thread-leaved Sundew) **(E)** *Eleocharis tuberculosa* (Tubercled Spikerush) **(T)** *Lachnanthes caroliniana* (Redroot) **(T)** *Lophiola aurea* (Golden Crest) **(T)** *Clethra alnifolia* (Sweet Pepperbush) **(SC)** *Juncus caesariensis* (New Jersey Rush) **(SC)** *Lilaeopsis chinensis* (Eastern Lilaeopsis) **(SC)** *Scirpus longii* (Long's Bulrush) **(SC)** *Agalinis maritima* (Salt-Marsh False-Foxglove) **(Red)** *Amelanchier nantucketensis* (Nantucket Shadbush) **(Red)** *Baccharis halimifolia* (Groundseltree) **(Red)** *Carex longii* (Greenish-White Sedge) **(Red)** *Eupatorium dubium* (Joe-pye-weed) **(Red)** *Galium obtusum* (Large Marsh Bedstraw) **(Red)** *Iris prismatica* (Slender Blue Flag) **(Red)** *Panicum dichotomiflorum var. puritanorum* (Spreading Panic-grass) **(Red)** *Proserpinaca intermedia* (Intermediate Mermaid-Weed) **(Red)** *Proserpinaca palustris var. palustris* (Marsh Mermaid-Weed) **(Red)** *Toxicodendron vernix* (Poison Sumac) **(Red)** *Utricularia resupinata* (Northeastern Bladderwort) **(Red)**	• Maintain extant populations at present levels of abundance or greater at current locations. • Maintain extent and quality of habitats for all 20 species.
3	*Carex atlantica ssp. capillacea* (Howe Sedge) **(Undetermined)** *Elymus virginicus var. halophilus* (Terrell Grass) **(Undetermined)** *Iva frutescens ssp. oraria* (Marsh Elder) **(Undetermined)** *Juncus subcaudatus* (Woods-Rush) **(Undetermined)** *Najas gracillima* (Thread-Like Naiad) **(Undetermined)** *Potamogeton pulcher* (Spotted Pondweed) **(Undetermined)** *Sisyrinchium fuscatum* (Coastal-Plain Blue-Eyed Grass) **(Undetermined)** *Suaeda maritima ssp. richii* (Rich's Sea-blite) **(Undetermined)**	• Improve information for all 8 species and ensure persistence of existing populations at present levels.

***** Status: Legally listed (SARA): Endangered (E), Threatened (T), Special Concern (SC) or General Status: Red, 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 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 strategy 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 ranked Species	Undetermined Species
1	**Protect all populations and their habitats** at the 36 high priority lakeshores, 41 high priority bogs/fens, 23 medium priority lakeshores, 3 medium priority bogs/fens, and 5 high priority estuaries/coastal habitats.	5-10	>10	>10
2	**Prevent, remove, and/or reduce threats** to species and habitats, including the 7 high priority threats on lakeshores, 7 high priority threats at bogs/fens, and one high priority threat 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 and ecological requirements** to support conservation and recovery.	5-10	>10	>10
5	Continue and/or implement **stewardship activities** at the 36 high priority lakeshores and 41 high priority bogs/fens and the 23 medium priority lakeshores, and 3 medium priority bogs/fens.	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 strategy 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 29 lakes and 8 bogs/fens with critical habitat identified or partially identified ► Apply these approaches at the additional 7 High priority lakes and 33 High priority 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 by the ACPF Recovery Team to be irreplaceable and work towards their formal acquisition, while also continuing to act opportunistically to acquire ACPF sites ► Work with the NSNT and other non-government and 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 by 2015 ► 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 ► Seek increased resource allocation for enforcement of protection for ACPF and their habitats	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 strategy 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	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)

► 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			
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 and are coordinating their recovery activities with the ACPF Recovery Team	High	5	All current threats
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	High	1, 3, 5,	***A.*** *Habitat Loss or Degradation*

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		6	(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 staff when they are developing educational materials for parks visitors and ensure their utility both within and outside of park boundaries ► Work with NSNT and other 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	Low	2, 5	***A.*** *Habitat Loss or Degradation*

three levels of government ► Identify all development companies, cottage associations, OHV clubs, 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			(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	High	3	All current threats

lakes			
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 research on key habitat characteristics required to identify critical habitat ► Determine *site* level habitat characteristics for Thread-leaved Sundew and Golden Crest	High	4	All current threats
20. 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 the genetic differences between US and NS populations	Medium	4	All current threats
21. 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
22. 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)
23. 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)
24. Coordinate scientific studies, approaches to recovery and encourage collaboration ► Ensure academics have the Recovery Strategy 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
25. 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 strategy. 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 strategy, 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 strategy 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 strategy. With such a high proportion of the land in NS being privately owned (greater than 70%) 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 strategy. 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 1.8); 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 strategy should take an adaptive management approach whereby new information feeds back into the strategy 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 strategy 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 36 high priority lakeshores, 41 high priority bogs/fens, 23 medium priority lakeshores, 3 medium priority bogs/fens, and 5 high priority estuaries/coastal habitats.	• Number of sites protected • No loss of populations or reduction in distribution
2	**Prevent, remove, and/or reduce threats** to species and habitats, including the 7 high priority threats on lakeshores, 7 high priority threats at bogs/fens, and one high priority threat 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 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 36 high priority lakeshores and 41 high priority bogs/fens and the 23 medium priority lakeshores and 3 medium priority bogs/fens.	• 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	• All landowners aware and educated regarding ACPF conservation and

Objective No.	Objective	Performance Measures
	species and their habitats.	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)). Under SARA critical habitat identification and protection only applies to Endangered and Threatened species. Thus in this multi-species recovery strategy, critical habitat is addressed for seven of the 11 legally listed ACPF species; the two Endangered species, Pink Coreopsis (*Coreopsis rosea*) and Thread-leaved Sundew (*Drosera filiformis*) and the five Threatened species; Tubercled Spike-rush (*Eleocharis tuberculosa*), Water-pennywort (*Hydrocotyle umbellata*), Redroot (*Lachnanthes caroliniana*), Golden Crest (*Lophiola aurea*), and Plymouth Gentian (*Sabatia kennedyana*). All seven 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 and is therefore not identified for the Sweet Pepperbush (*Clethra alnifolia*), New Jersey Rush (*Juncus caesariensis*), Eastern Lilaeopsis (*Lilaeopsis chinensis*), and Long's Bulrush (*Scirpus longii*). 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.

Sufficient information is available on the species' habitat requirements and distribution to enable the identification of critical habitat, at least partially, for all seven Endangered and Threatened ACPF species. Included below is a summary of the approach and rationale used for identifying critical habitat, followed by the identification or partial identification of critical habitat for each of the seven species. Additional critical habitat identification will be provided in a subsequent action plan or updated recovery strategy and the steps required to achieve this are outlined below in the schedule of studies (Section 2.6.4).

2.6.1 Approach and rationale for identifying species' critical habitat

For all seven 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. Sections 2.6.1.1 to 2.6.1.3 elaborate on the table and provide more specific explanation of the scales. 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 strategy. 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.

Table 15. For each species, the total number of lake, bogs/fens, and rivershore locations where critical habitat will be identified and whether or not critical habitat is fully, partially, or not identified at each scale.

	Critical Habitat Identified						
Scale (Description)	*Coreopsis rosea* (Pink Coreopsis)	Drosera filiformis (Thread-leaved Sundew)	Eleocharis tuberculosa (Tubercled Spike-rush)	Hydrocotyle umbellata (Water-pennywort)	Lachnanthes caroliniana (Redroot)	Lophiola aurea (Golden Crest)	Sabatia kennedyana (Plymouth Gentian)
# of Locations (Lake, bog/fen, or river)	8 lakes	5 bogs/ fens	5 lakes	2 lakes	6 lakes	6 lakes & 3 bogs/ fens	11 lakes & 1 river
Site (Specific occurrence within a *location*)	yes	no	yes	yes	yes	no	partial
Individual (Where the plant is growing)	yes	yes	yes	yes	yes	yes	yes

Location scale

For all seven species the *location* scale will ***not*** be identified as critical habitat. 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. Lake names and geographic locations will be defined as the 'NS Atlas Square Reference' they are documented in the NS Atlas (Province of NS 2001).

There are five lakeshore species including, Pink Coreopsis (*Coreopsis rosea*), Tubercled Spike-rush (*Eleocharis tuberculosa*), Water-pennywort (*Hydrocotyle umbellata*), Redroot (*Lachnanthes caroliniana*), and Plymouth Gentian (*Sabatia kennedyana*). Thread-leaved sundew (*Drosera filiformis*) is a bog and fen species and Golden Crest (*Lophiola aurea*) is found along lakes and in bog/fens. Plymouth Gentian (*Sabatia kennedyana*) is the only species for which critical habitat will be identified on rivershores.

Site Scale

At the *site* scale critical habitat is completely identified for four species: Pink Coreopsis (*Coreopsis rosea*), Tubercled Spike-rush (*Eliocharis tuberculosa*), Water-pennywort (*Hydrocotyle umbellata*), and Redroot (*Lachnanthes carolinian*) and partially identified for Plymouth Gentian (*Sabatia kennedyana*). Critical habitat cannot be identified, at this time, for two species; Thread-leaved sundew (*Drosera filiformis*) and Golden Crest (*Lophiola aurea*) (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. Without these sites, the species would not be able to survive.

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, 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, no detailed *site* scale mapping has been conducted at *locations* where critical habitat is identified. However, the identification of *site* scale critical habitat based on specific habitat characteristics is considered a valid approach to the identification of critical habitat. It is important to include this critical habitat identification in this recovery strategy from a habitat protection and management perspective. The *location* and habitat characteristics provide biologists and botanists with 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 is identification is complete for all seven 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. For the five species with identified *site* scale critical habitat, 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 29 lakes, one rivershore, and eight bogs/fens where these seven species are known to occur and where critical habitat is identified at the *site* scale, *individual* scale, or both scales.

Table 16. *Locations* (lakes, rivershores, and bogs/fens) where critical habitat is identified at either the *site* scale, *individual* scale, or both.

Watershed	**Location**	**NS Atlas Square Reference** (2001)	*Coreopsis rosea* (Pink Coreopsis)	*Drosera filiformis* (Thread-leaved Sundew)	*Eleocharis tuberculosa* (Tubercled Spike-rush)	*Hydrocotyle umbellata* (Water-pennywort)	*Lachnanthes caroliniana* (Redroot)	*Lophiola aurea* (Golden Crest)	*Sabatia kennedyana* (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	Lac de l'Ecole	82W2							√
Tusket	Pearl Lake	77W5							√
Tusket	Travis Lake	77W4							√
Tusket	Kegeshook Lake	82X1							√
Tusket	Third Lake	82W1							√
Tusket	Kempt Snare Lake	77W5							√
Tusket	Lake Fanning	77V5							√
Tusket	Tusket River	82W1							√
Roseway	Gold Lake	83V3			√				
Roseway	Western Lake	83V4			√				
Barrington & Clyde	Great Pubnico Lake	86Y1			√				
Barrington & Clyde	Harpers Lake	83V4			√				
Barrington & Clyde	Barrington Lake	86Z3			√				
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	Cameron Lake	73V4					√		
Medway	Molega Lake	73W3					√		
Medway	Beartrap Lake	73V4					√	√	
Medway	Hog Lake	73V3					√	√	

Watershed	Location	NS Atlas Square Reference (2001)	*Coreopsis rosea* (Pink Coreopsis)	*Drosera filiformis* (Thread-leaved Sundew)	*Eleocharis tuberculosa* (Tubercled Spike-rush)	*Hydrocotyle umbellata* (Water-pennywort)	*Lachnanthes caroliniana* (Redroot)	*Lophiola aurea* (Golden Crest)	*Sabatia kennedyana* (Plymouth Gentian)
Medway	Ponhook Lake	73V4					√	√	
Medway	Little Ponhook Lake	73W4					√	√	
Medway	Shingle Lake	73W2						√	
Medway	Fancy Lake	73Z4						√	
Mersey	Dunraven Bog	78Y4						√	
Little River	Moores Lake Bog	70Y2						√	
Little River	Tiddville Bog	70Y2						√	
Total # of Locations	29 Lakes		8	0	5	2	6	6	11
	8 Bogs/Fens		0	5	0	0	0	3	0
	1 Rivershore		0	0	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 fully identified for Pink Coreopsis (Endangered), Tubercled Spike-rush (Threatened), Water-pennywort (Threatened), Redroot (Threatened) and partially identified for Plymouth Gentian (Threatened). For all five of these species critical habitat, at the lake locations, 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, Tubercled Spike-rush, Water-pennywort, 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. Unoccupied habitat is also important for Redroot because populations can move over time, particularly as a result of ice scouring, which can dislodge and transport intact plants or viable portions of rhizomes.

For Plymouth Gentian, critical habitat at the *site* scale is partially identified because additional work is required to determine the rivershore key habitat characteristics for this species. This information is not well enough documented in the literature at this time. The schedule of studies (Section 2.6.4) indicates what additional studies are required to complete the identification of critical habitat at the *site* scale for this species.

For Thread-leaved Sundew (Endangered), critical habitat at the *site* scale is not identified at this time because, although some habitat information is available, key habitat characteristics are not well documented in the literature. The schedule of studies (Section 2.6.4) indicates what additional steps are required to complete the identification of critical habitat at the *site* scale level for this species.

For Golden Crest (Threatened), critical habitat at the *site* scale is not identified at this time because, although some habitat information is available, key habitat characteristics are not well documented in the literature. The schedule of studies (Section 2.6.4) indicates what additional steps are required to complete the identification of critical habitat at the *site* scale for this species.

Critical habitat at the *individual* scale is identified for Pink Coreopsis, Tubercled Spike-rush, Water-pennywort, Redroot, 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 17-21.

For Thread-leaved Sundew (Endangered) and Golden Crest (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.

Studies required to complete the identification of critical habitat for Thread-leaved Sundew and Golden Crest and to complete the identification of critical habitat for Plymouth Gentian are outlined in the schedule of studies (section 2.6.4).

Table 17. Descriptions of the key habitat characteristics of critical habitat at the *site* scale for Pink Coreopsis (*Coreopsis rosea*).

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	*Platanthera flava, Solidago galetorum, Cladium mariscoides, Xyris caroliniana, Panicum longifolium, Lycopodium inundatum, Dulichium arundinaceum, and Gratiola aurea*

*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 Tubercled Spike-rush (*Eleocharis tuberculosa*).

Habitat Parameter	Description of Habitat Characteristic*
Position on Shoreline	Peat islands or mats either floating or washed on to shore; On edges of peaty wetlands bordering the lake edge; In full sun (shade intolerant)
Substrate Composition	Sandy, stony shoreline; Gravel bars; On fringes of peat layers
Soil Quality	Low nutrients; Poor drainage
Natural Disturbances	Natural fluctuating water conditions, ice scour, wave action
Other Associated Species	*Euthamia galetorum, Dulichium arundinaceum, Aster nemoralis, Triadenum virginicum, Bartonia paniculata, Lycopodiella appressa, Panicum spretum, Juncus pelocarpus, Juncus filiformis, Juncus articulatus, Juncus canadensis, Viola lanceolata, Sium suave, Muhlenbergia uniflora, Agrostis hyemalis, Lobelia dortmanna, Drosera intermedia, Spartina pectinata, Gratiola aurea, Lysimachia terrestris, Xyris difformis, Xyris montana, Rhexia virginica, Cyperus dentatus, Calamagrostis canadensis, Calamagrostis pickeringii, Cladium mariscoides, Rhynchospora fusca, Rhynchospora alba, Carex oligosperma, Eleocharis tenuis, Eriophorum tenellum, Scirpus americanus*

*Information obtained from Zinck 1997, Roland and Zinck 1998, and Newell and Zinck 1999.

Table 19. Descriptions of the key habitat characteristics of critical habitat at the *site* scale for Water-pennywort (*Hydrocotyle umbellata*).

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	*Eriocaulon septangulare, Panicum longifolium, Alnus serrulata, Utricularia radiata, Eriocaulon septangulare, Glyceria borealis, Carex lenticularis, Solidago galetorum, Gratiola aurea, Juncus filiformis, Sabatia kennedyana, Xyris difformis, Hypericum ellipticum, Viola lanceolata, and Ranunculus reptans, Nymphoides cordata, 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 20. Descriptions of the key habitat characteristics of critical habitat at the *site* scale for Redroot (*Lachnanthes caroliniana*).

Habitat Parameter	Description of Habitat Characteristic*
Shore Slope & Width	Low gradient, gently to slightly sloping; any width (broader is better)

Habitat Parameter	Description of Habitat Characteristic*
Position on Shoreline	From areas nearly permanently flooded a few cm deep to slightly above average annual maximum water level; most common where exposure to disturbance is greatest and within zone of annual flooding and exposure
Substrate Composition	Sand, gravel, peat, small cobblestone to average stone size of about 20cm; sand and gravel, especially with a thin layer of peat are most ideal
Soil Quality	Low nutrients
Natural Disturbances	Natural fluctuating water conditions, ice scour, wave action
Other Associated Species	*Vaccinium macrocarpon, Panicum rigidulum var. pubescens, Viola lanceolata, Euthamia caroliniana (including E. galetorum and E. tenuifolia), Cladium mariscoides, Lysimachia terrestris, Gratiola aurea, Sium suave, Symphyotrichum tradescantii, Xyris difformis, Drosera intermedia, Spartina pectinata, Iris versicolor, Hypericum ellipticum, Dichanthelium spretum, Juncus pelocarpus, J. canadensis, J. filiformis, J. brevicaudatus, J. militaris, Ranunculus flammula var. filiformis, Eriocaulon aquaticum, Lobelia dortmanna, Panicum virgatum var. spissum, Carex lenticularis, Lycopodiella appressa, Osmunda regalis var. spectabilis, Calamagrostis canadensis, Pogonia ophioglossoides, Myrica gale, Symphyotrichum novi-belgii, Rhynchospora capitellata, Rhexia virginica*

*Information obtained from Blaney and Smith (2008, in review). [COSEWIC Status Report on Redroot (*Lachnanthes caroliniana*)]

Table 21. Descriptions of the key habitat characteristics of critical habitat at the *site* scale for Plymouth Gentian (*Sabatia kennedyana*).

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	*Solidago galetorum, Cladium mariscoides, and Gratiola aurea*, *Panicum longifolium, Plantanthera flava, Utricularia subulata, Xyris caroliniana, Lycopodium inundatum, Dulichium arundinaceum*

*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.

2.6.3 Examples of activities likely to result in 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 (*Species at Risk Act* Policies, 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 any where 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 22. The scales at which activities may have to be managed in order to ensure critical habitat is not destroyed are indicated.

Table 22. Examples of activities likely to result in the destruction of critical habitat and the habitat type which these activities may impact.

Activity	Habitat Type*	Scale (as per Table 14)		
		Location	Site	Individual
Infilling and road building	L & B/F	√		
Off-highway vehicle use	L & B/F		√	√
Cottage and residential development resulting in nutrient runoff from land clearing, septic system, landscaping	L & B/F	√		
Shoreline alterations including mowing and raking, construction of boat docks and launches, wharves, and breakwaters	L		√	√
Crop and animal production resulting in nutrient runoff or alteration of the hydrologic regime	L	√		
Forest harvesting practices resulting in nutrient runoff or alteration of the hydrologic regime	L	√		
Hydroelectric dam operation: stabilization of water levels and draining of lake	L	√		
Peat mining	B/F	√		
Cranberry growing	B/F	√		

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

2.6.4 Schedule of studies to identify critical habitat

For Thread-leaved Sundew and Golden Crest critical habitat has not been identified at the *site* scale and requires additional research on habitat characterization. Plymouth Gentian at the *site* scale is partially identified because additional research on habitat characterization for rivershore locations is required. The activities outlined in the schedule of studies (Table 23) are required to

complete the identification of critical habitat for all species. Upon completion of these studies, the remaining critical habitat will be identified for each species and presented in the subsequent action plan or the updated recovery strategy.

Table 23. Schedule of studies necessary to complete the identification of critical habitat .

Description of Activity	Outcome/Rationale	Completion Date	Pink Coreopsis	Thread-leaved Sundew	Tubercled Spike-rush	Water-pennywort	Redroot	Golden Crest	Plymouth Gentian
Complete research on *site* level habitat characteristics and requirements	Comprehensive description of key habitat characteristics will be completed	2011		√				√	√

2.7 Existing and Recommended Approaches to Habitat Protection

With regards to the protection of critical habitat for the seven Endangered and Threatened species, only one location occurs on federal land; Water-pennywort (*Hydrocotyle umbellata*) at Kejimkujik National Park and National Historic Site (KNP). All other known locations for these species and their critical habitat, as identified above, occur on provincial crown land or private land; however some locations do occur in provincial protected areas or land protected by non-government organizations.

Prohibitions relating to critical habitat in SARA are explained in Section 58 (1) stating that "…no person shall destroy any part of the critical habitat of any listed endangered species or of any listed threatened species…" and that this is enacted if: "(a) the critical habitat is on federal land…". Based on the critical habitat identified above, these prohibitions will only be enacted for Water-pennywort at KNP as this is the sole location for all Endangered and Threatened ACPF species that occurs on federal land.

Legal protection of the remaining critical habitat would be governed by provincial legislation. If it is determined (in consultation between the Minister of the Environment and the appropriate provincial minister) that the laws of the province do not effectively protect the critical habitat for ACPF, the Governor in Council may specify, by order, the protection of the critical habitat on non-federal lands in the province.

The enactment of prohibitions protecting critical habitat does not automatically prohibit specific activities. On federal lands regulations may be enacted to legislate what cannot be done on critical habitat. See Section 2.6.3 for examples of activities likely to result in destruction of critical habitat.

Information about what is being done to protect critical habitat must be published in the

Public Registry every six months until the critical habitat is protected or no longer needs to be protected.

2.7.1 Legislative Protection on Federal Lands

For the Atlantic Coastal Plain Flora, only the Water-pennywort occurs on federal lands, specifically in Kejimkujik National Park and National Historic Site of Canada. The Water-pennywort and its critical habitat are protected under the Canada National Parks Act (S.C. 2000, c.32) and the Species at Risk Act (S.C. 2002, c.29). Parks Canada is the federal authority to ensure the continued survival and existence of this species. .

2.7.2 Legislative Protection on Non- Federal Lands

Non-federal lands are those that fall under provincial or private ownership. The protection of critical habitat on provincial lands can occur under a variety of existing legislation or other means. Over 70% of land in NS is privately owned and a large portion of the critical habitat for these ACPF species is found on lands under private ownership and their protection will require several different approaches, including stewardship. Protection of critical habitat on both provincial crown and private land could be provided through a variety of legislation, including the following provincial acts and regulations:

1) The *NS Endangered Species Act* (NS ESA)*, 1999* provides for the protection of all seven Endangered and Threatened species that are listed under this provincial act. Under the NS ESA, the province of NS may identify "core habitat", which is defined as "*specific areas of habitat essential for the long-term survival and recovery of endangered or threatened species and that are designated as core habitat…*" (subsection 3(b)). The process for identifying core habitat is not yet developed as the emphasis as been on other existing and tested tools for habitat protection. It is still unclear how the identification of "critical habitat" under SARA will impact the listing of "core habitat" under the NS ESA and vice versa.

2) The *Wildlife Act, 1989* provides a regulatory framework under which provincial policies and programs regarding the protection and conservation of wildlife and wildlife habitats.

3) The *NS Environment Act, 1994* affords protection to species at risk and habitat because it deals with controlling pollution and toxic substances, waste management, and water quality. This act also outlines the process for environmental assessments and ensures that any potential impacts on a listed wildlife species are considered during a project evaluation. It also provides legislative authority to require permits and approvals for certain activities in and around lakes and wetland habitats.

4) The *Wildlife Habitat and Watercourse Regulations, 2002* serve as regulations for forestry operations on all forest lands in province and are one way in which to assist in the sustainability of woodland diversity, water quality and wildlife habitat on all lands in forest production.

5) The *Special Places Protection Act, 1981* designates sites of ecological significance as Nature Reserves. Several already exist which contain habitat for Endangered and Threatened ACPF; Ponhook Lake Nature Reserve, Tusket River Nature Reserve located on Wilson's Lake, and land surrounding Quinns Meadow Bog.

6) The *Wilderness Areas Protection Act, 1998* enables wilderness areas to be established and managed, affording protection to the integrity of natural processes. The Tobeatic Wilderness Area, as well as Tidney River and Bowers Meadows Wilderness Areas already exist in the region of the province where ACPF occur.

7) The *Provincial Parks Act, 1989* enables provincial protected areas to be established. The purpose of the act is to preserve unique, rare, representative or otherwise significant elements of the natural environment. Fancy Lake and Ellenwood Lake Provincial Parks exist in southwestern NS in areas where ACPF occur.

8) The *Conservation Easements Act, 2001* enables landowners to enter into an agreement to protect, restore, or enhance their land that contains natural ecosystems or habitat of species at risk.

9) The *Crown Lands Act, 1989* identifies provincial crown ownership of the shoreline of lakes, down from the average highwater mark and including the lake bottom. As a result, permits and approvals must be obtained for most shoreline alterations, many of which could negatively impact critical habitat. For 13 lakes in the Tusket River watershed which contain identified critical habitat for Pink Coreopsis, Plymouth Gentian, and Water-pennywort specific restrictions for wharves permitting and shoreline alteration have been developed by NS DNR and will applied by Department of Environment and Labour.

2.7.3 Non-Legislative Conservation

For both federal and non-federal lands there are a variety of non-legislative approaches to the conservation of critical habitat, including the following:

1) *Stewardship* which includes a broad array of activities (i.e. hand-shake agreements, informal easements, guardian programs) and while private landowners and citizens are often the focus of stewardship, stewardship can apply to a diversity of audiences including, but not limited to, industry, aboriginal groups, all levels of government, individuals, non-government organizations.

2) *Municipal stewardship* warrants being highlighted specifically because although municipal governments are not mandated explicitly to be involved in species at risk conservation and recovery they can play an important role. Municipalities could include species at risk and wildlife habitat considerations in such activities as, municipal planning, permitting, educational initiatives, and protected areas establishment.

3) *Provincial policies and programs* exist and can be developed to play a role in conserving species at risk habitat either directly or indirectly. For example, the provincial Integrated Resources Management (IRM) planning process for provincial crown lands now highlights key ACPF conservation and recovery areas. This means any proposed development in these areas is closely scrutinized for potential impacts on ACPF.

4) *Acquisitions* of important habitat areas can be made by governments, non-government organizations, or other groups or individuals who are able to make sure that the land is then protected in perpetuity.

5) *Private, community, or industry reserves and protected areas* (i.e. Bowater Pocket Wilderness) can be developed to afford protection to species at risk and their habitat.

6) *Best management practices*, including certification, can be developed which outline specific activities for a variety of industries and land developers that can suggest modifications in their actions that would eliminate or minimize impacts on species at risk and their habitat.

2.8 Effects on Other Species

Overall, it is anticipated that the recovery approaches and steps outlined in this strategy will benefit non-target species, ecological processes, and the environment. This strategy maintains an ecosystem level perspective, ensuring that recovery and conservation of high priority ACPF species are sustainable and mimic natural processes as much as possible. It is possible that specific recovery steps could have a negative effect on another species. A holistic, ecosystem approach, is required to ensure approaches to conserve target species do not adversely affect other species and processes.

All 90 ACPF species (Appendix 1 and 2), not just the 11 legally listed ACPF species, are addressed explicitly in this recovery strategy and will benefit from recovery approaches proposed. Specific recovery and conservation goals, objectives, and approaches are even being set for the 12 Red ranked species and eight Undetermined ranked species. As a result of their similar geographic, habitat, and ecological requirements and thus associations with the legally listed ACPF species, all 90 ACPF species will also receive benefits from recovery approaches.

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 strategy 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 strategy will be coordinated with other recovery teams. This will help to avoid potential 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.

2.9 Recommended Approach for Recovery Implementation

A multiple species approach to recovery implementation is being proposed because the species addressed in this recovery strategy 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 strategy (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.

2.10 Statement on Action Plans

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 recovery strategy on the Species at Risk Act 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 (*Coreopsis rosea*)

3.1.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2000

Common Name (population): Pink Coreopsis

Scientific Name: *Coreopsis rosea*

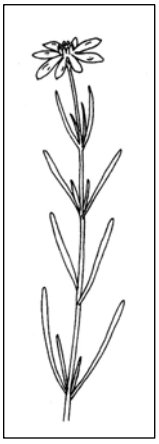
COSEWIC Status: Endangered

Reason for Designation: A shoreline aquatic occurring only along portions of three lakes* within one river system where it reproduces mainly vegetatively. It is subject to continued threats from development of recreational properties.

Canadian Occurrence: NS

COSEWIC Status History: Designated Endangered in April 1984. Status re-examined and confirmed Endangered in April 1999 and in May 2000. Last assessment based on an existing status report.

*As of 2007 *Coreopsis rosea* is now known to occur along the shorelines of eight lakes.



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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 seven eight lakes in the Tusket River watershed in Yarmouth County, including Salmon, Wilsons, Bennetts, Raynards, Gillfillan, Agard, Sloans, and Pleasant 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. More than 5000 plants (flowering and vegetative) are located at Salmon Lake, and approximately 1200 flowering individuals are located at Wilsons Lake. The other locations have less than 1000 flowering plants.

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 (*Sabatia kennedyana*), Water-pennywort (*Hydrocotyle umbellata*) and Tubercled Orchid (*Platanthera flava*). It is also associated with *Solidago galetorum, Cladium mariscoides, Xyris caroliniana, Panicum longifolium, Lycopodium inundatum, Dulichium arundinaceum, and Gratiola aurea* (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 (*Drosera filiformis*)

3.2.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2001

Common Name (population): Thread-leaved Sundew

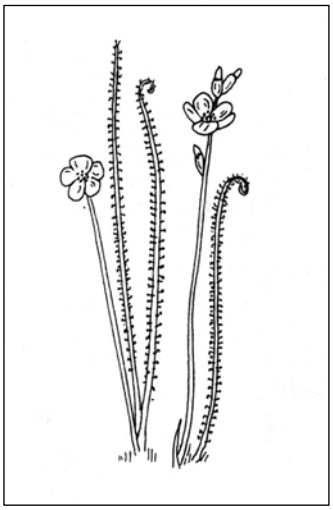
Scientific Name: *Drosera filiformis*

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. Last assessment based on an update status report.



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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 G4G5 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 Clumped Deer-grass (*Scirpus caespitosus*) (Freedman and Jotcham 2001) and *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 *Scirpus caepitosus, Carex exilis, Rhynchospora alba, Sarracenia purpurea, Solidago uliginosa, Schizaea pusilla, Drosera rotundifolia, Utricularia cornuta, Aster nemoralis, Chamaedaphne calyculata, Kalmia angustifolia, Kalmia polifolia, Andromeda glaucophylla, Aronia sp., Gaylussacia dumosa, Juniperus communis, Vaccinium oxycoccus,* and *Vaccinium macrocarpon.*

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 (*Eleocharis tuberculosa*)

3.3.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2000

Common Name (population): Tubercled Spikerush

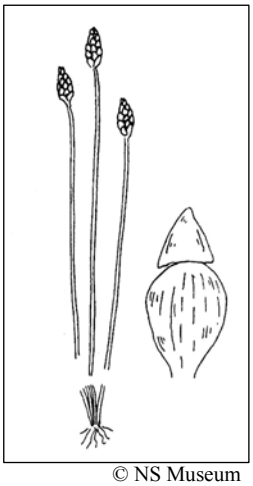
Scientific Name: *Eleocharis tuberculosa*

COSEWIC Status: Threatened

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. Assessment based on a new status report.



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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 five lakes that include Harper, Gold, Western, and Barrington Lakes in Shelburne County and Great Pubnico Lake in Yarmouth County. An estimated 3000 to 4000 clumps have been documented with 60 to 70% occurring on Barrington Lake alone. Evidence suggests that the population size fluctuates dramatically on a

yearly basis and the species' presence or absence at sites varies from year to year. Long-term population trends are unknown.

Tubercled Spike-rush 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, 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 (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 (S1)

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, indicating that this species may be intolerant 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, *Euthamia galetorum, Aster nemoralis, Bartonia paniculata, Utricularia subulata*, *Scirpus rufus, Juncus articulatus,* and *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 (*Hydrocotyle umbellata*)

3.4.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2000

Common Name (population): Water-pennywort

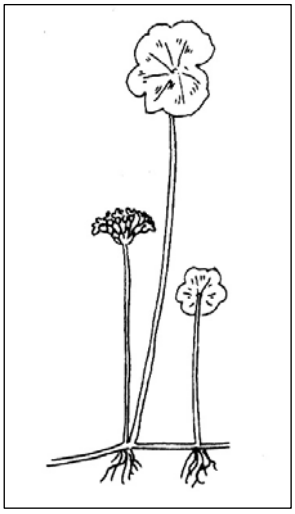
Scientific Name: *Hydrocotyle umbellata*

COSEWIC Status: Threatened

Reason for Designation: A disjunct, primarily clonal species, found along the shorelines of only two lakes both of which are subjected to heavy recreational use.

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. Last assessment based on an existing status report.



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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 two lakes in southwestern NS; Kejimkujik Lake, located in Kejimkujik National Park and National Historic Site, Queens County and Wilsons 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. 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 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 minimal number of species (Vasseur *et al.* 2002). Rare associated species include *Coreopsis rosea* and *Sabatia kennedyana* at Wilsons Lake, and *Panicum longifolium, Alnus serrulata,* and *Utricularia radiata* at Kejimkujik Lake (Wilson 1984).

Reproduction occurs asexually through stolons or runners. The stolon connection between plants 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 *et 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 (*Lachnanthes caroliniana*)

3.5.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2000

Common Name (population): Redroot

Scientific Name: *Lachnanthes caroliniana*

COSEWIC Status: Threatened

Reason for Designation: Restricted range and limited sexual reproductive potential with considerable threats from on-going development of the shoreline habitat.

Canadian Occurrence: NS

COSEWIC Status History: Designated Threatened in April 1994. Status re-examined and confirmed in May 2000. Last assessment based on an existing status report.

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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). Redroot may not flower every year, however, 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 six lakes including, Ponhook, Little Ponhook, Molega,

Cameron, Hog, and Beartrap Lakes in Queens County (Roland and Zinck 1998). It was first discovered in NS in the early 1940s. It wasn't formally surveyed in Canada until 1989, and has an estimated population of >5000 individuals.

Redroot 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 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 (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 (S1)

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 (Keddy 1994, Wisheu *et al.* 1994). Fluctuations in water levels control its distribution and abundance. Meadows of Twigrush (*Cladium mariscoides*) are often associated with the presence of Redroot (Keddy 1994). Redroot is also associated with Golden Crest (*Lophiola aurea*).

Plant reproduction occurs asexually and sexually through rhizomes and seeds. 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 Golden Crest (*Lophiola aurea*)

3.6.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2000

Common Name (population): Golden Crest

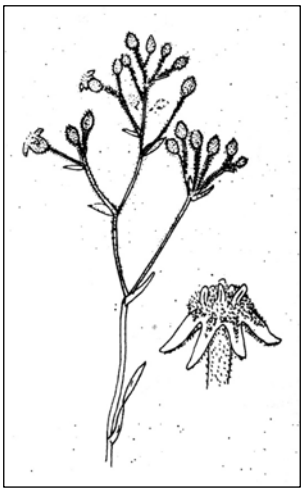
Scientific Name: *Lophiola aurea*

COSEWIC Status: Threatened

Reason for Designation: A disjunct species at the northern edge of its range reproduces mainly vegetatively. It is present in only a few lakeside and wetland habitats subject to continued threats from development and habitat alteration. There are a substantial number of individuals at the largest site protected within a reserve.

Canadian Occurrence: NS

COSEWIC Status History: Designated Threatened in April 1987. Status re-examined and confirmed in April 1999 and in May 2000. Last assessment based on an existing status report.



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3.6.2 Description

Golden Crest 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, Golden Crest ranges New Jersey south to Florida and Mississippi (Roland and Zinck 1998). In Canada, it is found in NS on the shorelines of six lakes including Beartrap, Hog, Ponhook and Little Ponhook Lakes in Queens County and Fancy and Shingle Lakes in Lunenburg County. It is also found in three bogs including Dunraven Bog in Queens County, and Moores Lake Bog and Tiddville Bog in Digby County. Two populations of Golden Crest

have been extirpated in NS, including a small population on Brier Island and an extensive population on Digby neck. The Digby Neck population was extirpated due to diatomaceous earth mining and damming of the river that flowed through the wetland habitat (Newell 1998c). Rough population estimations are currently available for 6 of the known locations. Golden Crest was observed 39 times along the shore of Ponhook Lake, and each location was estimated to contain 1 to >1000 flowering plants. Thousands of flowering plants occur along Fancy Lake and Dunraven Bog. It was found in six locations in Tiddville Bog, where two locations were estimated to contain ~1000 flowering plants while the remaining populations were substantially smaller. Shingle Lake contains ~50 flowering plants, while Hog Lake has <10 flowering plants.

Golden Crest 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 Golden Crest

Golden Crest 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 *Cladium mariscoides* (Newell 1998c). It is often associated with rare species such as *Lachnanthes caroliniana*, *Cephalanthus occidentalis*, and *Scirpus longii* (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). Golden Crest is insect pollinated (Newell and Proulx 1998).

3.7 Plymouth Gentian (*Sabatia kennedyana*)

3.7.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2000

Common Name (population): Plymouth Gentian

Scientific Name: *Sabatia kennedyana*

COSEWIC Status: Threatened

Reason for Designation: A shoreline aquatic, disjunct from its main range along the American Atlantic seaboard and found at only 10 lakes, mainly within one river system. These comprise three populations of significant size and they are subject to continued threat from recreational land use and development.

Canadian Occurrence: NS

COSEWIC Status History: Designated Threatened in April 1984. Status re-examined and confirmed in April 1999 and in May 2000. Last assessment based on an existing status report.

*As of 2007 *Sabatia kennedyana* is now known to occur on the shores of 11 lakes.

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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 is located 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, Travis, and Kempt Snare 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. The largest population is located on the shores of Wilsons Lake with an estimated population of

1300 flowering stems (Newell 1998d). The other lakes have significantly fewer plants; Gillfillan Lake may have 1000s of plants but most are vegetative in any one season. Plymouth Gentian has been discovered on additional lakes since a 1984 survey, but ongoing shoreline development suggests that the species could be decreasing in population size and range in NS. The NS population represents a significant proportion of the total global population (Keddy and Keddy 1983b).

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)
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 *Cladium mariscoides* (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 *Solidago galetorum, Cladium mariscoides, and Gratiola aurea*, as well as rare species such as *Coreopsis rosea, Hydrocotyle umbellata, Panicum longifolium, Plantanthera flava,* and *Utricularia subulata* (Keddy and Keddy 1983b).

The main form of reproduction is vegetative through shoots called stolons. Each stolon terminates in a small leafy rosette, of which a small proportion gives rise to a flowering stem that arises from the center of the rosette (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). Consequently, irregular seed production may hinder the recovery of this species (Newell 1998d). 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 (*Clethra alnifolia*)

3.8.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2001

Common Name (population): Sweet Pepperbush

Scientific Name: *Clethra alnifolia*

COSEWIC Status: Special Concern

Reason for Designation: A highly disjunct and vigorous clonal species restricted to a geographically small area of occurrence and found only along the shores of six lakes where it grows on private and public lands with conservation efforts in place to inform landowners of this interesting Coastal Plain disjunct species.

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. Last assessment based on an existing status report with an addendum.

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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 flowers are inflorescence and raceme, meaning they are clustered together along a central elongated axis, and each individual flower is connected to the central axis by a short stalk (Roland and Zinck 1998, Silberhorn 1999). It flowers from mid-August to mid-October, and on rare occasions may produce 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). 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 Mill, Mudflat, and Pretty Mary Lakes in Annapolis County. Specific population estimates are currently unavailable; however, five of the lakes have extensive stands and significant numbers of plants, whereas Canoe Lake contains a single pepperbush plant.

Sweet Pepperbush has a Global Rank of G5 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	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 (S1S2)

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 prefers 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 *Myrica gale* and *Gaylussacia baccata*. At lower frequencies, *Myrica pensylvanica, Aronia* sp., *Ilex verticillata* and *Acer rubrum* are also associated with Sweet Pepperbush (Taschereau 1986).

In NS, reproduction is vegetative by growth of suckers (Newell 2001). Flowering takes place between mid August and mid October, however, the ovules are not maturing to seed despite an abundance of pollinators during flowering. The reasons for the lack of 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 (*Juncus caesariensis*)

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. Last assessment based on an update status report.

*As of 2007 *Juncus caesariensis* is located in 26 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 26 bogs and fens (Table 7) and has an estimated population of

5000 to 10,000 mature individuals. It is likely that this estimation will increase with additional wetland surveys. The number of individuals per site varies from 3 to >500. The current extent of occurrence is 350 km^2 and the area of occupancy is 0.09 km^2 (Newell 2004). 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 (S1S2)

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 levels are important as they provide an edge to the New Jersey Rush by removing competing vegetation, such as along animal trails (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, *Picea mariana, Calamagrostis pickeringii, Carex exilis, Maianthemum trifolium, Sarracenia purpurea,* and *Kalmia polifolia* (Newell and Newell 1992).

Plant reproduction is achieved mainly asexually through the division of the rhizome. Sexual reproduction is known to occur infrequently in the US, but seed production has not been observed in NS (Newell 2004). 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 (*Lilaeopsis chinensis*)

3.10.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2004

Common Name (population): Eastern Lilaeopsis

Scientific Name: *Lilaeopsis chinensis*

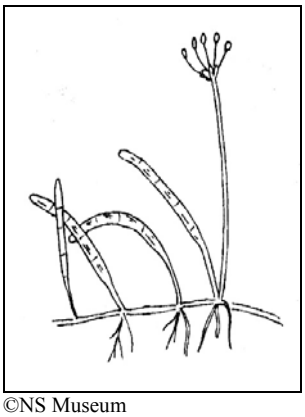
COSEWIC Status: Special Concern

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. Last assessment based on an update status report.

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



©NS Museum

3.10.2 Description

Eastern Lilaeopsis is a small, semi-aquatic, delicate, 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 in length (Scoggan 1978). At the top of the flower stalk, tiny white flowers with five petals occur in clusters of 5 to 7 (Keddy 1987a). The stalks or pedicles for each flower are within an umbel, meaning each pedicle originates from the same point. The fruit is ovoid and approximately 2 mm in length (Gleason 1952). It is named *chinensis* because Linné erroneously believed it originated in China (Roland and Zinck 1998).

3.10.3 Populations and Distribution

Eastern Lilaeopsis ranges 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 five river

estuaries: Tusket River 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). The estimated population is 130,000-187,000 mature individuals (Holder 2004), not including an estimate for the River Philip concentration. Its extent of occurrence is 90 km^2, while its area of occupancy is 9 km^2 (Holder 2004). 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 S1. 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 (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 (S1)

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). Habitat commonalities between all five populations include locations near the mouth of large rivers cut off from the open ocean, and a long, narrow rectangular shape (Keddy 1987a). It grows well in the intertidal zone, and is submerged under 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 *Spartina alterniflora* dominates the intertidal river shore, and is sometimes associated with *Glaux maritima* and *Plantago maritima.* The level of tolerance to competing vegetation is unclear (Holder 2004).

Reproduction is both vegetative through the division 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 remain viable over considerable distances (Holder 2004).

3.11 Long's Bulrush (*Scirpus longii*)

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

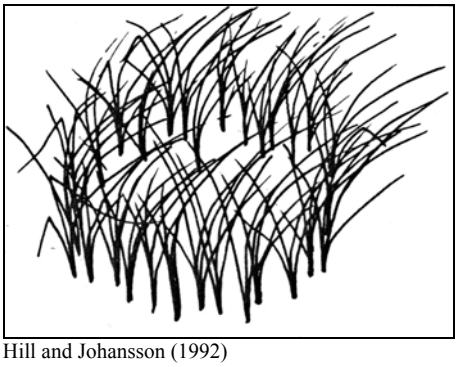
Reason for Designation: Restricted range and limited sexual reproduction with significant reduction of one site due to road development.

Canadian Occurrence: NS

COSEWIC Status History: Designated Special Concern in April 1994. Assessment based on a new status report.

3.11.2 Description

Long's Bulrush is a slow growing perennial that grows in circular clusters, with 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 are likely 150 to 400 years old (Hill 1992). At 40 years of age a cluster is about 1 m wide. 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 plant has 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 is located in NS and occurs in wetlands near six lakes including Ponhook, Little Ponhook, and Moosehorn Lakes in Queens County, Wilsons and Lac de L'École in Yarmouth County and near Shingle Lake in

Lunenburg County. It is also found in Dunraven Bog in Queens County and Quinns Meadow in Shelburne County. The largest population covers about 30 hectares of Eel Weir Stillwater (fen) near Shingle Lake. In addition to the populations around Ponhook Lake, it also grows over 15 hectares of fen near Ponhook Lake at Eighteen Mile Brook. Only two small populations have been found in the Tusket River at Wilson's Lake and Lac de L'École. There is a small population that grows in the southeastern corner of Quinns Meadow, and a small population at Dunraven Bog and Moosehorn Lake. Four new locations (Medway River Bog/Fen #1, #2, #3, and #4) were identified in 2006 in bogs/fens associated with the Medway River (Bayne and Ritchie pers. com. 2006). An additional new location was identified in a fen near Molega Lake as well (Bayne and Ritchie pers. com. 2006). 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 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, 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 (S2)

3.11.4 Habitat and Biological Needs of Long's Bulrush

Long's Bulrush is found in five wetland habitats including stillwater meadows, inland fens, bay bogs, 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).

Sexual reproduction is an infrequent occurrence. 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 is rare, occurring between June and early July, and 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 grazing 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). It is critical to reduce or eliminate disturbance in and in the vicinity of Long's Bulrush habitat to maintain the genetic integrity of this species.

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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 NS DNR General Status (see Appendix 3 for definitions of ranks).

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	NS DNR General Status Rank
Coreopsis rosea	Pink Coreopsis	G3	S1		E	E	E	At risk	Red
Drosera filiformis	Thread-leaved Sundew	G4G5	S1	N1	E	E	E	At risk	Red
Eleocharis tuberculosa	Tubercled Spike-rush (Long-Tubercled Spike-rush)	G5	S1		T	T	T	At risk	Red
Hydrocotyle umbellata	Water-pennywort (Many-Flowered Pennywort)	G5	S1	N2	T	T	E	At risk	Red
Lachnanthes caroliniana	Redroot (Carolina Redroot)	G4	S1		T	T	T	At risk	Red
Lophiola aurea	Golden Crest	G4	S2		T	T	T	At risk	Red
Sabatia kennedyana	Plymouth Gentian	G3	S1	N3	T	T	E	At risk	Red
Clethra alnifolia	Sweet Pepperbush (Coast Pepper-Bush)	G5	S1S2	N2	SC	SC	V	Sensitive	Red
Juncus caesariensis	New Jersey Rush	G2	S1S2		SC	SC	V	Sensitive	Red
Lilaeopsis chinensis	Eastern Lilaeopsis	G5	S1		SC	SC	V	Sensitive	Red
Scirpus longii	Long's Bulrush	G2	S2	N1	SC	-	V	Sensitive	Red
Agalinis maritima	Salt-Marsh False-Foxglove	G5	S1		-	-	-	May be at risk	Red
Amelanchier nantucketensis	Nantucket Shadbush	GNR	S1	N1	-	-	-	May be at risk	Red
Baccharis halimifolia	Groundseltree	GNR	S1		-	-	-	May be at risk	Red
Carex longii	Greenish-White Sedge	GNR	S1?	N1	-	-	-	May be at risk	Red
Eupatorium dubium	Joe-pye-weed (Joe-Pye Thoroughwort)	G5	S2	N1	-	-	-	May be at risk	Red
Galium obtusum	Large Marsh Bedstraw	G5	S1		-	-	-	Secure	Red
Iris prismatica	Slender Blue Flag	G5	S1		-	-	-	May be at risk	Red
Panicum dichotomiflorum var. puritanorum	Spreading Panic-Grass	G5T4	S1		-	-	-		Red
Proserpinaca intermedia	Intermediate Mermaid-Weed	G5T5	S1S2		-	-	-	May be at risk	Red

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	NS DNR General Status Rank
Proserpinaca palustris var. palustris	Marsh Mermaid-Weed	G5T5	S1?		-	-	-		Red
Toxicodendron vernix	Poison Sumac	G5T5	S1	N4	-	-	-	Secure	Red
Utricularia resupinata	Northeastern Bladderwort	G4	S1		-	-	-	Secure	Red
Carex atlantica ssp. capillacea	Howe Sedge	G5T5	S2		-	-	-		Undetermined
Elymus virginicus var. halophilus	Terrell Grass	G5	S?		-	-	-		Undetermined
Iva frutescens ssp. oraria	Marsh Elder	G5	S2SE		-	-	-	Undetermined	Undetermined
Juncus subcaudatus	Rush (Woods-Rush)	G5T?	S3		-	-	-	May be at risk	Undetermined
Najas gracillima	Thread-Like Naiad	GNR	S1S2	N2	-	-	-	May be at risk	Undetermined
Potamogeton pulcher	Spotted Pondweed	G5	S1		-	-	-	May be at risk	Undetermined
Sisyrinchium fuscatum	Coastal-Plain Blue-Eyed-Grass	GNR	S1		-	-	-	Undetermined	Undetermined
Suaeda maritima ssp. richii	Rich's Sea-blite	G4	S1	N1	-	-	-		Undetermined
Alnus serrulata	Brook-Side Alder	G5	S2		-	-	-	Sensitive	Yellow
Cephalanthus occidentalis	Buttonbush (Common Buttonbush)	G5	S2S3		-	-	-	Secure	Yellow
Decodon verticillatus	Water-willow (Hairy Swamp Loosestrife)	G5	S2S3		-	-	-	Secure	Yellow
Eleocharis flavescens var. olivacea (Eleocharis olivacea)	Capitate Spikerush	G5	S2		-	-	-	Secure	Yellow
Eleocharis rostellata	Beaked Spikerush	G5	S2	N3	-	-	-	Sensitive	Yellow
Euthamia tenuifolia (Euthamia caroliniana)	Grass-Leaved Goldenrod	G5	S3		-	-	-		Yellow
Hudsonia ericoides	Hudsonia (Golden-Heather)	G4	S2	N2N3	-	-	-	Sensitive	Yellow
Juncus marginatus	Grassleaf Rush	G5	S2S3		-	-	-	Sensitive	Yellow
Panicum longifolium (Panicum rigidulum var. pubescens)	Redtop Panic Grass	G5T5?	S2		-	-	-		Yellow
Platanthera flava var. flava	Fringed Orchid (Southern Rein Orchid)	G4T4?	S2	N1	-	-	-		Yellow
Proserpinaca pectinata	Comb-Leaved Mermaid-Weed	G5	S3		-	-	-	Secure	Yellow
Salix sericea	Silky Willow	G5T5	S2		-	-	-	Secure	Yellow
Schoenoplectus americanus	Three-Square Bulrush	G5	S2		-	-	-	Sensitive	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	NS DNR General Status Rank
Spiranthes casei var. novaescotiae	Case's Ladies'-Tresses	G4	S2		-	-	-		Yellow
Woodwardia areolata	Dwarf Chain Fern (Netted Chainfern)	G5	S2	N2	-	-	-	Sensitive	Yellow
Calamagrostis coarctata	Nuttall's Small-Reedgrass	GNA	SH		-	-	-	Extirpated	Blue - Historic
Panicum leucothrix (Dichanthelium meridionale)	Matting Witchgrass	G5	SH		-	-	-		Blue - Historic
Scirpus expansus	Woodland Bulrush	G4	SH		-	-	-	May be at risk	Blue - Historic
Torreyochloa pallida var. pallida	Pale Manna Grass	G5T5	S1		-	-	-		Blue - Historic

[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

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 (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	G2G3	S4		-	-	-	Secure	Green
Aronia arbutifolia (Photinia pyrifolia)	Red Chokeberry	G5	S4S5		-	-	-		Green
Bartonia paniculata	Screw-stem (Twining Bartonia)	G5T?	S4S5		-	-	-		Green
Bartonia virginica	Yellow Screwstem	G5	S3		-	-	-		Green
Carex atlantica ssp. atlantica	Atlantic Sedge	G5T4	S4		-	-	-		Green
Carex bullata	Button Sedge	G5	S4		-	-	-		Green
Cyperus dentatus	Toothed Sedge	GNA	S3		-	-	-	Secure	Green
Euthamia galetorum	Narrow-Leaf Fragrant Golden-Rod	G3	S3S4		-	-	-		Green
Gaylussacia dumosa	Bog Huckleberry (Dwarf Huckleberry)	G5	S4		-	-	-		Green
Glyceria obtuse	Blunt Manna-Grass	G5	S4		-	-	-		Green
Gratiola aurea	Golden-pert (Golden Hedge-Hyssop)	G5	S5		-	-	-		Green
Ilex glabra	Inkberry	G5	S5		-	-	-		Green
Juncus militaris	Bayonet Rush	G5	S5		-	-	-		Green
Lycopodiella appressa	Southern Bog Clubmoss	G5	S3		-	-	-		Green
Myrica pensylvanica (Morella pensylvanica)	Northern Bayberry	G5	S5		-	-	-		Green
Myriophyllum humile	Low Water-Milfoil	G5	S3?		-	-	-		Green
Panicum clandestinum (Dichanthelium clandestinum)	Deer-Tongue Witchgrass	GNA	S3		-	-	-	Secure	Green
Panicum spretum (Dichanthelium spretum)	Eaton's Witchgrass	G5	S3S4		-	-	-		Green
Panicum virgatum var. spissum	Old Switch Panic Grass	G5T?	S3S4		-	-	-		Green
Platanthera blephariglottis	White Fringed Orchid	G4G5	S4		-	-	-		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
Polygonum hydropiperoides	Mild Water-pepper	G5	S5		-	-	-		Green
Polygonum robustius	Water Smartweed (Stout Smartweed)	G5T5	S3S4		-	-	-		Green
Potamogeton confervoides	Algae-Like Pondweed	G5T5	S3S4	N3N4	-	-	-	Secure	Green
Rhexia virginica	Virginian Meadow-beauty	G5	S3		-	-	-		Green
Rhynchospora capitellata	Brownish Beakrush	G5	S4		-	-	-		Green
Rosa palustris	Swamp Rose	G5	S3		-	-	-		Green
Sisyrinchium angustifolium	Pointed Blue-Eyed-Grass	GNR	S3S4	N4?	-	-	-	Secure	Green
Sisyrinchium atlanticum	Eastern Blue-Eyed-Grass	G5	S3		-	-	-		Green
Smilax rotundifolia	Catbrier (Common Greenbrier)	G5	S4		-	-	-		Green
Symphyotrichum tradescantii	Tradescant Aster	G4	S3		-	-	-	Secure	Green
Symplocarpus foetidus	Skunk Cabbage	G4	S3	N5	-	-	-	Secure	Green
Thelypteris simulata	Massachusetts Fern (Bog Fern)	G4G5	S4S5		-	-	-		Green
Toxicodendron radicans	Poison-ivy	G5	S4		-	-	-		Green
Triadenum virginicum	Marsh St. John's-wort	G5	S4S5		-	-	-		Green
Utricularia purpurea	Purple Bladderwort	G5	S4		-	-	-		Green
Utricularia radiata	Small Swollen Bladderwort	G4	S3		-	-	-		Green
Utricularia subulata	Zigzag Bladderwort	G5	S3		-	-	-		Green
Vaccinium corymbosum	Highbush Blueberry	GNR	S3		-	-	-	Secure	Green
Viola lanceolata	Lance-leaved Violet	G5	S5		-	-	-		Green
Xyris difformis	Yellow-eyed Grass	G5	S4		-	-	-		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 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.

Extinct- Species that are extirpated worldwide (i.e., they no longer exist anywhere).
Extirpated- Species that are no longer present in a given geographic area, but occur in other areas.
At Risk- 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- 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- 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- 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.

General Status Rankings of the Nova Scotia Department of Natural Resources (NS DNR)
The NS DNR General Status assessment process involves a science-based, less rigorous review of current information on each species. Unlike the legal listing processes, a detailed status report is not required for each species; and a panel of experts jointly reviews the status.

Red - Any species known to be, or believed to be, at risk.
Yellow - Any species known to be, or believed to be, particularly sensitive to human activities or natural events.
Green - Any species known to be, or believed to be, not at risk.
Grey - Undetermined species, insufficient information to determine status
Blue – Historic, no longer in Nova Scotia or extinct in the wild

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 - Extremely rare throughout its range in the country (N) or province (S) (typically five or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.
N2/S2 - Rare throughout its range in the country (N) or province (S) (6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.
N3/S3 - Uncommon throughout its range in the country (N) or province (S), or found only in a restricted range, even if abundant in at some locations. (21 to 100 occurrences).

N4/S4 - Usually widespread, fairly common throughout its range in the country (N) or province (S), and apparently secure with many occurrences, but the Element is of long-term concern (e.g. watch list). (100+ occurrences).
N5/S5 - Demonstrably widespread, abundant, and secure throughout its range in the country (N) or province (S), and essentially ineradicable under present conditions.
N#/N#/S#S# Numeric range rank - A range between two consecutive numeric ranks. Denotes range of uncertainty about the exact rarity of the Element (e.g., S1S2).
NH/SH Historical - Element occurred historically throughout its range in the country (N) or province (S) (with expectation that it may be rediscovered), perhaps having not been verified in the past 20 - 70 years (depending on the species), and suspected to be still extant.
N?/S? Unranked - Element is not yet ranked.

Global Ranks (G-Ranks)
G1 - Critically imperilled globally because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.
G2 - Imperilled globally because of rarity (6 to 20 occurrences or less than 3000 individual) or because of vulnerability to extinction due to some natural or man-made factor.
G3 - Either very rare and local throughout its range (21 to 100 occurrences or less than 10,000 individuals) or locally in a restricted range or vulnerable to extinction from other factors.
G4 - Apparently secure globally (may be rare in parts of its range).
G5 - Demonstrably secure globally.
G#? - Tentative rank (e.g. G2?)
G#G# - Range of rank; insufficient data to assign specific global rank (e.g. G2G3).
G#T# - Rank of a taxonomic subgroup such as a subspecies or variety; the G portion of the rank refers to the entire species and the T portion refers to the specific subgroup; numbers have same definitions as above (e.g. G3T1).
G? - Not yet ranked (temporary).

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	NS DNR General Status Ranks	Species Scientific Name	Species Common Name	Aquatic	Lakeshore	Bog/Fen	River/ Stream Shore	Estuary/ Coastal (*salt marsh, sea beach, tidal river)	Swam/ Wooded Swamp	Marsh	Forest	Meadow/ Field	Barrens
E	R	*Coreopsis rosea*	Pink Coreopsis		1								
E	R	*Drosera filiformis*	Thread-Leaf Sundew			1							
T	R	*Eleocharis tuberculosa*	Tubercled Spike-rush (Long-Tubercled Spike-rush)		1								
T	R	*Hydrocotyle umbellata*	Water-pennywort	1	1								
T	R	*Lachnanthes caroliniana*	Redroot (Carolina Redroot)		1								
T	R	*Lophiola aurea*	Golden Crest		1	1							
T	R	*Sabatia kennedyana*	Plymouth Gentian		1		1						
SC	R	*Clethra alnifolia*	Sweet Pepperbush (Coast Pepper-Bush)		1								
SC	R	*Juncus caesariensis*	New Jersey Rush			1							
SC	R	*Lilaeopsis chinensis*	Eastern Lilaeopsis					1					
SC	R	*Scirpus longii*	Long's Bulrush		1	1	1			1			
-	R	*Agalinis maritima*	Salt-Marsh False-Foxglove					1		1			
-	R	*Amelanchier nantucketensis*	Nantucket Shadbush									1	1
-	R	*Baccharis halimifolia*	Groundseltree					1		1			
-	R	*Carex longii*	Greenish-White Sedge		1	1	1		1				
-	R	*Eupatorium dubium*	Joe-pye-weed (Joe-Pye Thoroughwort)		1		1		1				
-	R	*Galium obtusum*	Large Marsh Bedstraw		1	1	1		1				
-	R	*Iris prismatica*	Slender Blue Flag			1		1		1			
-	R	*Panicum dichotomiflorum var puritanorum*	Panic Grass (Spreading Panic-Grass)		1								
-	R	*Proserpinaca intermedia*	Intermediate Mermaid-Weed	1	1	1	1						

COSEWIC Status	NS DNR General Status Ranks	Species Scientific Name	Species Common Name	Aquatic	Lakeshore	Bog/Fen	River/ Stream Shore	Estuary/ Coastal (*salt marsh, sea beach, tidal river)	Swam/ Wooded Swamp	Marsh	Forest	Meadow/ Field	Barrens
-	R	*Proserpinaca palustris var. palustris*	Marsh Mermaid-Weed	1	1	1	1			1			
-	R	*Toxicodendron vernix*	Poison Sumac		1	1			1	1			
-	R	*Utricularia resupinata*	Bladderwort (Northeastern Bladderwort)	1	1								
-	U	*Carex atlantica spp. capillacea*	Sedge (Howe Sedge)			1			1				1
-	U	*Elymus virginicus var. halophilus*	Terrell Grass					1					1
-	U	*Iva frutescens ssp. oraria*	Marsh Elder					1					
-	U	*Juncus subcaudatus (Juncus subcaudatus var. planisepalus)*	Rush (Woods-Rush)						1				
-	U	*Najas gracillima*	Thread-Like Naiad	1									
-	U	*Potamageton pulcher*	Pondweed (Spotted Pondweed)	1									
-	U	*Sisyrinchium fuscatum*	Coastal-Plain Blue-Eyed-Grass		1							1	1
-	U	*Suaeda maritima ssp. Richii*	Rich's Sea-blite					1					
-	Y	*Alnus serrulata*	Alder (Brook-Side Alder)		1		1		1				
-	Y	*Cephalanthus occidentalis*	Buttonbush (Common Buttonbush)		1	1	1		1	1			
-	Y	*Decodon verticillatus var. laevigatus*	Water-willow (Hairy Swamp Loosestrife)		1	1	1						
-	Y	*Eleocharis flavescens var. olivacea (Eleocharis olivacea var. olivacea)*	Spikerush (Capitate Spikerush)		1					1			
-	Y	*Eleocharis rostellata*	Beaked Spikerush					1					
-	Y	*Euthamia tenuifolia (Euthamia caroliniana)*	Grass-Leaved Goldenrod		1		1						
-	Y	*Hudsonia ericoides*	Hudsonia (Golden-Heather)										1
-	Y	*Juncus marginatus*	Rush (Grassleaf Rush)		1							1	1
-	Y	*Panicum longifolium (Panicum rigidulum var. pubescens)*	Panic Grass (Redtop Panic-Grass)		1								
-	Y	*Platanthera flava var. flava*	Fringed Orchid (Southern Rein Orchid)		1		1						

COSEWIC Status	NS DNR General Status Ranks	Species Scientific Name	Species Common Name	Aquatic	Lakeshore	Bog/Fen	River/ Stream Shore	Estuary/ Coastal (*salt marsh, sea beach, tidal river)	Swam/ Wooded Swamp	Marsh	Forest	Meadow/ Field	Barrens
-	Y	*Salix sericea*	Silky Willow		1		1		1				
-	Y	*Schoenoplectus americanus*	Three-Square Bulrush					1					
-	Y	*Spiranthes casei var. novaescotiae*	Case's Ladies'-Tresses									1	1
-	Y	*Utricularia gibba*	Bladderwort (Humped Bladderwort)	1	1								
-	Y	*Woodwardia areolata*	Dwarf Chain Fern (Netted Chainfern)		1	1	1		1				
-	B	*Calamagrostis coarctata*	Nuttall's Small-Reedgrass		1	1	1		1				
-	B	*Panicum leucothrix (Dichanthelium meridionale)*	Panic Grass (Matting Witchgrass)		1							1	
-	B	*Scirpus expansus*	Woodland Bulrush		1								
-	G	*Proserpinaca pectinata*	Mermaid Weed (Comb-Leaved Mermaid-Weed)	1	1	1	1			1			
-	G	*Rhexia virginica*	Virginia Meadow-beauty		1		1						
-	G	*Aronia arbutifolia (Photinia pyrifolia)*	Chokeberry (Red Chokeberry)		1	1			1		1	1	1
-	G	*Bartonia paniculata (Bartonia paniculata ssp. iodandra)*	Screw-stem (Twining Bartonia)		1	1							1
-	G	*Bartonia virginica*	Screw-stem (Yellow Screwstem)		1	1			1				
-	G	*Calopogon tuberosus*	Grass-pink		1	1							
-	G	*Carex atlantica spp. atlantica*	Sedge (Atlantic Sedge)			1			1				1
-	G	*Carex bullata*	Sedge (Button Sedge)		1	1			1				
-	G	*Drosera intermedia*	Sundew (Spoon-Leaved Sundew)		1	1							
-	G	*Euthamia galetorum*	Goldenrod (Narrow-Leaf Fragrant Golden-Rod)		1								
-	G	*Gaylussacia dumosa*	Bog Huckleberry (Dwarf Huckleberry)			1							1
-	G	*Glyceria obtuse*	Manna-grass (Blunt Manna-Grass)		1	1			1	1			
-	G	*Gratiola aurea*	Golden-pert (Golden Hedge-Hyssop)	1	1								
-	G	*Ilex glabra*	Inkberry			1			1		1		1
-	G	*Juncus militaris*	Rush (Bayonet Rush)		1		1						

COSEWIC Status	NS DNR General Status Ranks	Species Scientific Name	Species Common Name	Aquatic	Lakeshore	Bog/Fen	River/ Stream Shore	Estuary/ Coastal (*salt marsh, sea beach, tidal river)	Swam/ Wooded Swamp	Marsh	Forest	Meadow/ Field	Barrens
-	G	*Lycopodiella appressa*	Clubmoss (Southern Bog Clubmoss)		1								
-	G	*Myrica pensylvanica*	Bayberry (Northern Bayberry)		1	1		1			1	1	1
-	G	*Myriophyllum humile*	Water-milfoil (Low Water-Milfoil)		1		1						
-	G	*Panicum spretum (Dichanthelium spretum)*	Panic Grass (Eaton's Witchgrass)		1	1							
-	G	*Panicum virgatum var. spissum*	Panic Grass (Old Switch Panic Grass)		1								
-	G	*Platanthera blephariglottis*	White Fringed Orchid			1			1		1		1
-	G	*Polygonum hydropiperoides*	Mild Water-pepper	1	1		1		1				
-	G	*Polygonum robustius*	Water Smartweed (Stout Smartweed)		1		1		1				
-	G	*Rhynchospora capitellata*	Beaked-rush (Brownish Beakrush)		1	1							1
-	G	*Rosa palustris*	Swamp Rose		1	1			1	1			
-	G	*Sisyrinchium atlanticum*	Blue-eyed Grass (Eastern Blue-Eyed-Grass)		1							1	1
-	G	*Smilax rotundifolia*	Catbrier (Common Greenbrier)		1				1		1		
-	G	*Thelypteris simulata*	Massachusetts Fern (Bog Fern)			1			1		1		
-	G	*Toxicodendron radicans*	Poison-ivy		1	1			1		1	1	
-	G	*Triadenum virginicum*	Marsh St. John's-wort		1	1			1	1			
-	G	*Utricularia purpurea*	Bladderwort (Purple Bladderwort)	1									
-	G	*Utricularia radiata*	Bladderwort (Small Swollen Bladderwort)	1									
-	G	*Utricularia subulata*	Bladderwort (Zigzag Bladderwort)	1	1	1	1						
-	G	*Viola lanceolata*	Lance-leaved Violet		1		1			1			
-	G	*Xyris difformis*	Yellow-eyed Grass		1	1							1

APPENDIX 5: ACPF SPECIES ON HIGH PRIORITY LAKES

High priority was assigned to 36 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	T	T	T	T	T	SC	SC																
NS DNR General Status Rank		R	R	R	R	R	R	R	R	R	R	R	R	U	U	Y	Y	Y	Y	Y	Y	Y	Y		
Watershed	**Site**	Pink Coreopsis (*Coreopsis rosea*)	Tubercled Spike-rush (*Eleocharis tuberculosa*)	Water-pennywort (*Hydrocotyle umbellata*)	Redroot (*Lachnanthes caroliniana*)	Golden Crest (*Lophiola aurea*)	Plymouth Gentian (*Sabatia kennedyana*)	Sweet Pepperbush (*Clethra alnifolia*)	Long's Bulrush (*Scirpus longii*)	Greenish-White Sedge (*Carex longii*)	Joe-pye-weed (*Eupatorium dubium*)	Spreading Panic-Grass (*Panicum dichotomiflorum var puritanorum*)	Northeastern Bladderwort (*Utricularia resupinata*)	Woods-Rush (*Juncus subcaudatus (Juncus subcaudatus var. planisepalus)*)	Thread-Like Naiad (*Najas gracillima*)	Alder (*Alnus serrulata*)	Buttonbush (*Cephalanthus occidentalis*)	Water-willow (*Decodon verticillatus var. laevigatus*)	*ISpikerush (Eleocharis flavescens var. olivacea (Eleocharis olivacea var. olivacea))*	Grassleaf Rush (*Juncus marginatus*)	Redtop Panic-Grass (*Panicum longifolium (Panicum rigidulum var. pubescens)*	Fringed Orchid (*Platanthera flava var. flava*)	Dwarf Chain Fern (*Woodwardia areolata*)	**Total # of High Priority Species**	**Total Number of Species**
Tusket	Wilsons Lake	1		1			1		1	1	1										1	1	1	**6**	**9**
Tusket	Gillfillan Lake	1					1				1					1					1	1	1	**3**	**7**
Tusket	Agard Lake	1					1														1			**2**	**3**
Tusket	Salmon Lake	1									1			1								1		**3**	**4**
Tusket	Bennetts Lake	1					1				1										1	1	1	**3**	**6**
Tusket	Raynards Lake	1																						**1**	**1**
Tusket	Pleasant Lake	1									1													**2**	**2**
Tusket	Sloans Lake	1																						**1**	**1**
Tusket	Lac de l'Ecole						1		1		1										1	1	1	**3**	**6**
Medway	Ponhook Lake				1	1			1							1	1				1	1		**3**	**7**
Barrington	Great Pubnico		1										1										1	**2**	**3**
Medway	Little Ponhook				1	1			1		1													**3**	**3**
Mersey	Kejimkujik Lake			1								1				1	1		1		1			**2**	**6**
Tusket	Kegeshook						1				1									1	1	1		**2**	**5**
Medway	Fancy Lake					1																		**1**	**1**
Medway	Cameron Lake				1										1	1	1				1			**2**	**5**

COSEWIC Status		E	T	T	T	T	T	SC	SC																
NS DNR General Status Rank		R	R	R	R	R	R	R	R	R	R	R	R	U	U	Y	Y	Y	Y	Y	Y	Y	Y		
Watershed	**Site**	Pink Coreopsis (*Coreopsis rosea*)	Tubercled Spike-rush (*Eleocharis tuberculosa*)	Water-pennywort (*Hydrocotyle umbellata*)	Redroot (*Lachnanthes caroliniana*)	Golden Crest (*Lophiola aurea*)	Plymouth Gentian (*Sabatia kennedyana*)	Sweet Pepperbush (*Clethra alnifolia*)	Long's Bulrush (*Scirpus longii*)	Greenish-White Sedge (*Carex longii*)	Joe-pye-weed (*Eupatorium dubium*)	Spreading Panic-Grass (*Panicum dichotomiflorum var puritanorum*)	Northeastern Bladderwort (*Utricularia resupinata*)	Woods-Rush (*Juncus subcaudatus (Juncus subcaudatus var. planisepalus)*)	Thread-Like Naiad (*Najas gracillima*)	Alder (*Alnus serrulata*)	Buttonbush (*Cephalanthus occidentalis*)	Water-willow (*Decodon verticillatus var. laevigatus*)	*ISpikerush (Eleocharis flavescens var. olivacea (Eleocharis olivacea var. olivacea))*	Grassleaf Rush (*Juncus marginatus*)	Redtop Panic-Grass (*Panicum longifolium (Panicum rigidulum var. pubescens)*)	Fringed Orchid (*Platanthera flava var. flava*)	Dwarf Chain Fern (*Woodwardia areolata*)	**Total # of High Priority Species**	**Total Number of Species**
Medway	Beartrap Lake				1	1										1	1							**2**	**4**
Medway	Hog Lake				1	1										1	1							**2**	**4**
Tusket	Lake Fanning						1				1											1		**2**	**3**
Medway	Shingle Lake					1											1							**1**	**2**
Tusket	Pearl Lake						1									1					1	1	1	**1**	**5**
Medway	Molega Lake				1											1	1				1	1		**1**	**5**
Tusket	Third Lake						1														1	1	1	**1**	**4**
Tusket	Travis Lake						1														1		1	**1**	**3**
Barrington	Harpers Lake		1															1						**1**	**2**
Tusket	Canoe Lake							1																**1**	**1**
Tusket	Louis Lake							1																**1**	**1**
Roseway	Gold Lake		1																					**1**	**1**
Roseway	Western Lake		1																					**1**	**1**
Meteghan	Belliveau Lake							1																**1**	**1**
Medway	Mill Lake							1																**1**	**1**
Medway	Mudflat Lake							1																**1**	**1**
Medway	Pretty Mary							1																**1**	**1**
Tusket	Kempt Snare						1																	**1**	**1**
Medway	Moosehorn								1															**1**	**1**
Barrington	Barrington		1																					**1**	**1**
TOTAL		**7**	**5**	**2**	**5**	**6**	**11**	**6**	**7**	**1**	**9**	**1**	**1**	**1**	**1**	**8**	**7**	**1**	**1**	**1**	**13**	**11**	**8**	**63**	**113**

APPENDIX 6: ACPF SPECIES ON MEDIUM PRIORITY LAKES

Medium priority was assigned to 23 lakes that contained one or more non-legally listed Red ranked species 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	U	U	U	U	U	U	Y	Y	Y	Y	Y	Y	Y	Y		
Watershed	**Site**	Greenish-White Sedge (*Carex longii*)	Joe-pye-weed (*Eupatorium dubium*)	Large Mash Bedstraw (*Galium obtusum spp. Obtusum*)	Spreading Panic-Grass (*Panicum dichotomiflorum var puritanorum*)	Marsh Mermaiid-Weed (*Proserpinaca palustris var. palustris*)	Poison Sumac (*Toxicodendron vernix*)	Northeastern Bladderwort (*Utricularia resupinata*)	Howe Sedge (*Carex atlantica ssp. Capillacea*)	Woods-Rush (*Juncus subcaudatus (Juncus subcaudatus var. planisepalus)*)	Thread-Like Naiad (*Najas gracillima*)	Spotted Pondweed (*Potamogeton pulcher*)	Coastal-Plain Blue-Eyed-Grass (*Sisyrinchium fuscatum*)	Common Buttonbush (*Cephalanthus occidentalis*)	Water-Willow (*Decodon verticillatus var. laevigatus*)	Capitate Spikerush (*Eleocharis flavescens var. olivacea (Eleocharis olivacea var. olivacea)*)	Grassleaf Rush (*Juncus marginatus*)	Redtop Panic-grass (*Panicum longifolium (Panicum rigidulum var. pubescens)*)	Fringed Orchid (*Platanthera flava var. flava*)	SilkyWillow (*Salix sericea*)	Dwarf Chain-Fern (*Woodwardia areolata*)	**Total # of High Priority Species**	**Total Number of Species**
Sissabo/Bear	Lake Midway							1															1	1
Roseway	West Horseshoe							1															1	1
Tusket	Ellenwood Lake		1																1				1	2
Meteghan	Salmon River Lake							1															1	1
Tusket	Parr Lake		1															1	1	1			1	4
LaHave	Rhodenizer Lake					1						1											2	2
Mersey	Lake Rossignol	1		1																			2	2
Tusket	Gavels Lake	1				1																	2	2
Roseway	Lake John				1									1	1		1	1			1		1	6
Roseway	Welshtown Lake				1																		1	1
Grand	Barren Hill Lake							1															1	1
Medway	Telfer Lake						1								1								1	2
Annapolis	Cedar Lake								1	1					1								2	3
Mersey	Grafton Lake										1					1		1		1			1	4

NS DNR General Status Ranks		R	R	R	R	R	R	R	U	U	U	U	U	Y	Y	Y	Y	Y	Y	Y	Y		
Watershed	**Site**	Greenish-White Sedge (*Carex longii*)	Joe-pye-weed (*Eupatorium dubium*)	Large Mash Bedstraw (*Galium obtusum spp. Obtusum*)	Spreading Panic-Grass (*Panicum dichotomiflorum var puritanorum*)	Marsh Mermaiid-Weed (*Proserpinaca palustris var. palustris*)	Poison Sumac (*Toxicodendron vernix*)	Northeastern Bladderwort (*Utricularia resupinata*)	Howe Sedge (*Carex atlantica ssp. Capillacea*)	Woods-Rush (*Juncus subcaudatus (Juncus subcaudatus var. planisepalus)*)	Thread-Like Naiad (*Najas gracillima*)	Spotted Pondweed (*Potamogeton pulcher*)	Coastal-Plain Blue-Eyed-Grass (*Sisyrinchium fuscatum*)	Common Buttonbush (*Cephalanthus occidentalis*)	Water-Willow (*Decodon verticillatus var. laevigatus*)	Capitate Spikerush (*Eleocharis flavescens var. olivacea (Eleocharis olivacea var. olivacea)*)	Grassleaf Rush (*Juncus marginatus*)	Redtop Panic-grass (*Panicum longifolium (Panicum rigidulum var. pubescens)*)	Fringed Orchid (*Platanthera flava var. flava*)	SilkyWillow (*Salix sericea*)	Dwarf Chain-Fern (*Woodwardia areolata*)	**Total # of High Priority Species**	**Total Number of Species**
Lahave	Wentzells Lake												1						1			1	2
Mersey	Mud Lake								1						1							1	2
Meteghan	Sears (Bay) Lake											1										1	1
Gaspereau	Mud Lake Bog									1												1	1
Tusket	Lily Lake								1													1	1
Musquodoboit	Jennings Lake									1												1	1
-	Ethel Lake (St. Paul Island)								1													1	1
Medway	Charlotte Lake										1											1	1
Roseway	Beaverdam Lake								1													1	1
MEDIUM PRIORITY TOTAL		2	2	1	2	2	1	4	5	3	2	2	1	1	4	1	1	3	3	2	1	**15**	25
HIGH + MEDIUM TOTAL		**3**	**11**	**1**	**3**	**2**	**1**	**5**	**5**	**4**	**3**	**2**	**1**	**8**	**5**	**2**	**2**	**16**	**14**	**2**	**9**	**80**	**140**

APPENDIX 7: WATERSHEDS CONTAINING LEGALLY LISTED ACPF SPECIES

The legally listed high priority ACPF species that occur in each of the 11 high priority watersheds in NS.

COSEWIC Status	E	E	T	T	T	T	T	SC	SC	SC	SC	
Watershed	***Coreopsis rosea*** (Pink Coreopsis)	***Drosera filiformis*** (Thread-leaved Sundew)	***Eleocharis tuberculosa*** (Tubercled Spike-rush)	***Hydrocotyle umbellata*** (Water-pennywort)	***Lachnanthes caroliniana*** (Redroot)	***Lophiola aurea*** (Golden Crest)	***Sabatia kennedyana*** (Plymouth Gentian)	***Clethra alnifolia*** (Sweet Pepperbush)	***Juncus caesariensis*** (New Jersey Rush)	***Lilaeopsis chinensis*** (Eastern Lilaeopsis)	***Scirpus longii*** (Long's Bulrush)	**Total # Species in Watershed**
Tusket	√			√			√	√		√		**5**
Medway					√	√		√		√	√	**5**
Roseway		√	√			√				√	√	**5**
Mersey				√		√					√	**3**
Barrington & Clyde			√									**1**
LaHave										√		**1**
Meteghan								√				**1**
Little River						√						**1**
Phillip										√		**1**
Grand									√			**1**
Sydney/Mira									√			**1**
Total # Watershed with Each Species	**1**	**1**	**2**	**2**	**1**	**4**	**1**	**3**	**2**	**5**	**4**	

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

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
Sutton J.	Ongoing	Masters Thesis	Reproductive ecology and genetics of *Sabatia kennedyana* 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 *Coreopsis rosea* and *Hydrocotyle umbellata.*
Dawe C. E. & Reekie E. G.	in press	Journal	The effects of flooding regime on the growth and development of *Hydrocotyle umbellata.*
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 *Sabatia kennedyana* population in NS.
Lusk J. M.	2006	Masters Thesis	The impacts of hydrological alterations on *Hydrocotyle umbellata* and *Coreopsis rosea* 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 *Coreopsis rosea* populations in NS and Massachusetts.
Dawe C. E.	2006	Honours Thesis	The effects of flooding regime and subzero temperatures on *Hydrocotyle umbellate*.
Trant A. J.	2005	Masters Thesis	The effects of lakeshore development on pollinator visitation rates and seed bank composition for *Sabatia kennedyana*, and the role of stewardship in the recovery process.
Brittain C.	2005	KNP Report	Monitoring report for *Hydrocotyle umbellata* populations in KNP.
Vasseur L.	2005	KNP Report	Research report assessing spatial and temporal trends of *Hydrocotyle umbellata* 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 *Sabatia kennedyana*.
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 *Drosera filiformis*.
Eaton S. T. & Boates J. S.	2002	NS DNR Publication	Assessment of the anthropogenic threats to ACPF in the Tusket River Watershed.
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	Reproductive biology of *Sabatia kennedyana*.

Author(s)	Date	Type of Publication	Research
		Thesis	
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 *Scirpus longii*.
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.