PROPOSED

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Eastern Mountain Avens (*Geum peckii*) in Canada

Eastern Mountain Avens

2010

Environment Canada Environnement 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 the Eastern Mountain Avens (*Geum peckii*) in Canada [Proposed]

2010

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Additional copies can be downloaded from the SAR Public Registry (www.sararegistry.gc.ca/)

Cover illustration: Eastern Mountain Avens on Brier Island, NS. Photo by June Swift

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DECLARATION

This recovery strategy has been prepared in cooperation with the jurisdictions responsible for the Eastern Mountain Avens. Environment Canada has reviewed and accepts this document as its recovery strategy for the Eastern Mountain Avens, as required under the *Species at Risk Act* (SARA). This recovery strategy also constitutes advice to other jurisdictions and organizations that may be involved in recovering the 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 the recovery of this species 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 Environment Canada or any other 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 Eastern Mountain Avens and Canadian society as a whole.

RESPONSIBLE JURISDICTIONS

Federal: Canadian Wildlife Service of Environment Canada, Atlantic Region

Provincial: Nova Scotia Department of Natural Resources

CONTRIBUTORS

This recovery strategy was prepared by Laurel Bernard, Sherman Boates, Crystal Doggett, Samara Eaton, Mark Elderkin, Julie McKnight, Ruth Newell, Gini Proulx, June Swift, and the Atlantic Coastal Plain Flora Recovery Team. Although Eastern Mountain Avens is not one of the group of species classified as Coastal Plain Flora, the relevant expertise of the Recovery Team members make it appropriate for them to act on behalf of this species.

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 the Eastern Mountain Avens. The potential for the 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. The reader should refer to the following sections of the document in particular: description of the species, description of the biological needs of the species, examples of activities that are likely to result in the destruction of the critical habitat and effects on other species.

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

The *Species at Risk Act* (SARA, Section 37) requires the competent minister to prepare recovery strategies for listed extirpated, endangered or threatened species. The Eastern Mountain Avens was listed as Endangered under SARA in June 2003 and under the Nova Scotia Endangered Species Act in 2000. Canadian Wildlife Service - Atlantic Region (Environment Canada) and the Nova Scotia Department of Natural Resources led the development of this Recovery Strategy. This is a five-year recovery strategy spanning 2010-2015. This recovery strategy meets SARA requirements and it also meets the particular requirements of recovery plans under the Nova Scotia Endangered Species Act (1998).

Although Eastern Mountain Avens is not one of the group of species classified as Coastal Plain Flora, the relevant expertise of the Recovery Team members makes it appropriate for them to act on behalf of this species.

The Recovery Strategy was developed in cooperation or consultation with numerous individuals and agencies: the Atlantic Coastal Plain Flora Recovery Team, Province of Nova Scotia (NS), Environment Canada, aboriginal groups; environmental non-government organizations; industry stakeholders; and private landowners.

An initial Recovery Strategy was developed by the Nova Scotia Department of Natural Resources in 2001. This 2010 Recovery Strategy builds on the earlier Strategy, retaining much of the content but including additional information as required under SARA.

EXECUTIVE SUMMARY

Eastern Mountain Avens *(Geum peckii)* is an endangered perennial herb producing small yellow flowers from June to September. The listing of this species is based on its very restricted and disjunct distribution and the considerable threat of destruction to its habitat. The Canadian population is one of only two global populations. The second population occurs in the United States in New Hampshire where the Eastern Mountain Avens appears in the New Hampshire Natural Heritage Inventory (New Hampshire Natural Heritage Bureau, 2006) as a state listed threatened plant species. The goal of this recovery strategy is to protect and maintain extant populations at current or greater levels of abundance with no reduction in the current range.

In Canada, the Eastern Mountain Avens is found in only nine sites; all in Nova Scotia. One site is on Digby Neck and the remainder are on Brier Island. Populations are usually found in boggy habitats where moisture levels can vary considerably. Populations within some sites have declined or disappeared entirely due to habitat loss and degradation.

The recovery activities described in this Recovery Strategy will be carried out in part or in whole within the next five years (2010-2015). The objectives for Eastern Mountain Avens are to: 1. Maintain Eastern Mountain Avens populations at occupied sites; 2. Improve conditions and enhance Eastern Mountain Avens populations at occupied sites; and 3. Improve conditions at previously occupied sites.

These objectives will be achieved through research, monitoring, management, education, and stewardship. Specific recovery approaches include:

- Research
  - Complete identification of critical habitat;
  - Assess how to raise water-table level;
  - Continue genetic studies;
  - Explore methods of population and habitat enhancement;
- Monitoring
  - Monitor known occupied sites;
  - Monitor threats;
  - Confirm distribution data;
  - Monitor habitat characteristics at unoccupied suitable habitat;
- Management
  - Secure or protect relevant habitat;
  - Reduce off-highway vehicle traffic through habitat;
  - Restore pre-drainage water-table levels;
  - Reduce numbers of nesting gulls in the immediate vicinity of Big Meadow Bog;
  - Restore historic species composition to bog;
- Education
  - Provide quality educational materials and opportunities to raise the awareness of Eastern Mountain Avens;

- Stewardship
    - Foster cooperative relationships for Eastern Mountain Avens recovery with landowners, community, off-highway vehicle operators, volunteers (local naturalists, Nature Conservancy of Canada members) and ecotourists.

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1.1 Species Assessment Information from COSEWIC

Date of Assessment: May 2000

Common Name: Eastern Mountain Avens

Scientific Name: *Geum peckii*

COSEWIC Status: Endangered

Reason for Designation: A highly disjunct species occurring in a few sites at the northern edge of its range in North America. Some populations have undergone substantial declines due to habitat drainage and successional changes.

Canadian Occurrence: NS

COSEWIC Status History: Designated Endangered in April 1986. Status re-examined and confirmed Endangered in April 1999 and May 2000.

1.2 Description of the Species

The Eastern Mountain Avens (*Geum peckii)* is a rhizomatous perennial herb that produces attractive sunny yellow flowers from June to September. The shiny leaves are compound and consist of one large, rounded, terminal leaflet and several smaller lateral leaflets. The leaves are clustered around the plant's base while a separate flowering stalk (20 – 40 cm tall) carries one to five small (1-3 cm across), five-petaled yellow blooms.

Figure 1. *Geum peckii* illustration from Holmgren, 1998.

1.3 Populations and Distribution

Global and National Status
Global Status: G2 Imperiled (NatureServe, 2006)
Canada: National Status: N1 Critically Imperiled (NatureServe, 2006)
United States: National Status: N2 Imperiled (NatureServe, 2006)

Provincial and State Status
Nova Scotia, Canada: S1 Critically Imperiled (NatureServe, 2006)
New Hampshire, United States: S2 Imperiled (NatureServe, 2006)

Eastern Mountain Avens occurs only in eastern North America. It is known from two disjunct locations: Digby County, in Nova Scotia (NS), Canada and Mount Washington, in the Presidential Range of the White Mountains of New Hampshire, USA (Figure 2). These locations are the only two known in the world. The species was reported in Maine (Gleason and Cronquist, 1991); however, there are no records to substantiate this report.

Figure 2. Global distribution of the Eastern Mountain Avens (*Geum peckii*)

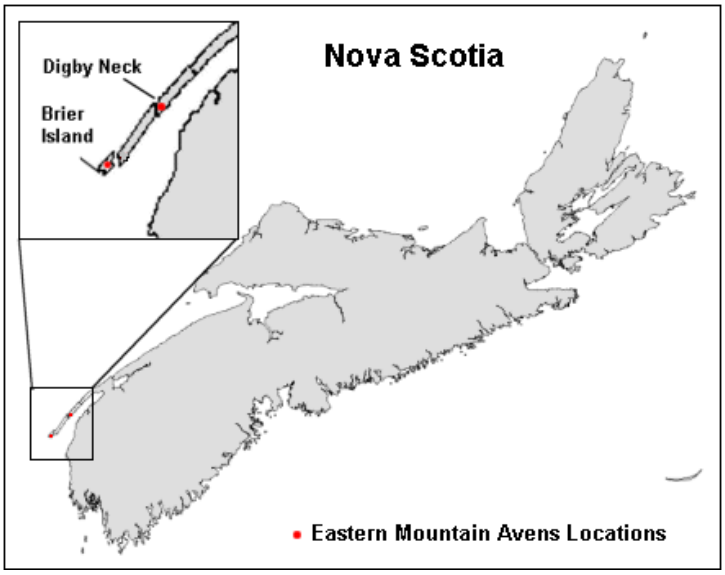

Figure 3. Distribution of Eastern Mountain Avens (*Geum peckii*) in Nova Scotia, Canada

As of 2006, there are 24 known sites with Eastern Mountain Avens in New Hampshire (New Hampshire Natural History Bureau, 2006). Surveys in 2008 confirmed nine sites with Eastern Mountain Avens in NS. These sites were found on Brier Island and in the East Ferry area of Digby Neck in Digby County, south-western NS (Figure 3).

On Brier Island, Eastern Mountain Avens occurs: at Green Head, along Gull Rock Road, in Big Meadow Bog, at Little Pond, along the Camp Road, at Western Light, and at Gooseberry. The site at Digby Neck was discovered in 1997 and is situated in a bog south of Harris Lake on the outskirts of East Ferry (Newell and Proulx, 1998).

Population sizes and trends

Within the nine known sites in NS, there are approximately 19 stands of Eastern Mountain Avens. The largest stand contained 1327 plants, but most stands had less than 300 plants and many had less than 65 plants. Based on 2008 survey data, the total population of Eastern Mountain Avens in NS is estimated to be 2624 plants (NS DNR unpublished data). Keddy (1986) estimated the Canadian population to be a minimum of 5450 plants in 1986.

Table 1: Population data at sites and stands (1986-2008).

Site	Stand	Keddy (1986)	Newell & Proulx (1998)[a]	Brown (2003)[a]	Swift (2005)	Proulx (2006), Swift (2006)	Porter & Noel (2007)	NSDNR & ACCDC (2008)
Green Head	GH1	1,000+	-	-	-	-	-	112
	GH2	<1,000	-	-	-	-	-	37
	GH3	<1,000	-	-	-	-	-	0
	GH4	<1,000	-	-	-	-	-	113
	GH5	<1,000	-	-	-	-	-	61
Gull Rock Road	GR1	<1,000 (x4)[b]	-	2,026	134	113	-	274
	GR2	<1,000	-	-	-	-	-	0
Big Meadow	BM1	0	-	1,200	-	-	-	1,327
	BM2	1,000+	-	252	-	-	-	-
	BM3	1,000+	-	186	-	-	-	0
	BM5	1,000+	-	800	-	-	-	21
	BM6	1,000+	-	-	-	-	102[c]	242[c]
Central Brier	CB1	-	-	-	-	-	-	8
	CB2	-	-	-	-	-	-	13
Little Pond	LP	<1,000	-	-	-	-	-	-
Camp Road	CR	-	-	1,789	"significant decline"	190	-	166
Western Light	WL	<1,000	-	-	-	-	6	6[d]

Site	Stand	Keddy (1986)	Newell & Proulx (1998)[a]	Brown (2003)[a]	Swift (2005)	Proulx (2006), Swift (2006)	Porter & Noel (2007)	NSDNR & ACCDC (2008)
Gooseberry Cove	GC	-	-	-	-	-	-	~200
Harris Lake	HL	-	300	-	-	"same area of occupancy"	-	44
TOTAL		5450 (min)						2,624

[a] These surveys counted individual rosettes, rather than clumps and flowering stems as were counted in 2008.
[b] Keddy (1986) mapped four separate populations of under 1000 plants within this site
[c] Porter and Noel (2007) found their 102 plants within a slightly different area than was covered in 2008. Their numbers are added to the 140 plants observed in 2008 to get the overall total of 242.
[d] Not checked in 2008, number based on Porter and Noel (2007) survey.

1.4 Needs of the Eastern Mountain Avens

1.4.1 Habitat needs

Eastern Mountain Avens habitat in NS appears to differ greatly from the New Hampshire populations. In New Hampshire, it occurs in alpine meadows and streamsides (Newell, 2002). In NS, it is found at sea level near the coast in boggy terrain and can occur under a variety of moisture regimes, from sphagnum bogs with small channels of open water to sphagnous depressions and even occasionally in dry depressions on mineral soil (Keddy 1986). Eastern Mountain Avens requires relatively undisturbed soil; any alteration to surface soils can negatively impact the plant's survival.

1.4.2 Pollination

Small flies are considered to be the pollinator of Eastern Mountain Avens, with each flower producing approximately 50 seeds. Zinck (1996) determined the flowers to be protogynous (prior to pollen ripening, the female's stigma becomes receptive) and herkogamous (spatial separation of male and female organs). Self-pollination has been experimentally shown to produce seeds but the number of seed yielded in this manner is fewer than yielded by cross-pollination (Zinck 1996).

1.4.3 Ecological role

Eastern Mountain Avens is part of a community of bog vegetation that is unique in Canada, and is found only in NS. Big Meadow Bog, the largest habitat location for Eastern Mountain Avens is also home to other rare plant species including various orchids, curly grass fern (*Schizea pussilla*) and northern dwarf birch (*Betula michauxii*) (Brown, 2003). The occurrence of both shrubby ciniquefoil (*Pontentilla fructicosa*) and deergrass (*Scirpus caespitosus*) has been noted wherever Eastern Mountain Avens occurs (Zinc 1996). There is limited research on Eastern Mountain Avens and, therefore, its specific ecological role is not well known.

1.4.4 Limiting factors

In NS, Eastern Mountain Avens is biologically limited by the following factors:

- small population size and globally limited distribution;
- requirement for specific hydrologic conditions in bogs;
- inability to compete for habitat.

1.5 Threats

The threat categories, general threats, and specific threats known, or anticipated, to impact the survival of Eastern Mountain Avens are:

Changes in ecological dynamics or natural processes

- alteration of surface or ground hydrology
  - drainage ditch creation
- soil nutrification
  - establishment of gull colony

Habitat loss or degradation

- scarification (alteration to surface soil)
  - vehicle traffic
  - development
- fire
  - burning

Disturbance or persecution

- human-caused mortality
  - picking, collecting, trampling (tourism)

1.5.1 Drainage ditches

In 1985, four of the five largest stands stretched along the full length of Big Meadow Bog (Newell, 2002). Two drainage ditches were dug in 1953 stretching between Big Pond and the village of Westport on Brier Island in an effort to alter the landscape to support agriculture, (Brown, 2003; Newell, 2002). The farming initiatives were abandoned but the drainage ditches remain today, resulting in a water-table thought to be lowered by about 10 to 20 cm (Brown, 2003).

The change in hydrological conditions (lowering of the water-table) caused by the drainage ditches is thought to have had the following consequences on Big Meadow Bog habitat:

- The perimeter of the ditch became unsuitable habitat for Eastern Mountain Avens ;
- the bog became suitable habitat for nesting gulls; and
- Species composition was altered (addition of species that proceeded to encroach on Eastern Mountain Avens habitat) (Brown 2003, Newell 2002).

As a result of these factors, by the 1980s most of the Eastern Mountain Avens on Big Meadow Bog occurred on the margins of the bog where suitable conditions persisted (Brown 2003).

1.5.2 Gull colony

Prior to the drainage ditches, Big Meadow Bog did not provide dry nesting habitat for gulls. The bog drainage caused by the ditches provided the opportunity for a gull colony to establish. A large population of Herring (*Larus argentatus)* and Great Black-backed Gulls (*Larus marinus*) has increased the amount of nutrients in the soil. This enriched substrate has lead to an increase in the growth of weed seeds and encroaching shrub and tree vegetation including non-bog herb species such as grasses, *Rubus* spp., Fireweed (*Epilobium angustifolium*), and others (Maass, 1992).

1.5.3 Vehicle traffic

Off-Highway vehicles (OHVs) can readily access bogs and have the ability to alter species composition due to the trampling and scarification effect of solitary or repeated travel, and create deep ruts that alter the surface soil and surface or ground hydrology. However, some OHV activity in habitat surrounding Eastern Mountain Avens may actually afford short-term benefits through limiting competition from shrubs and allowing for establishment of Eastern Mountain Avens. A survey in 2005 recorded that Eastern Mountain Avens were growing heavily in a once used OHV path where a fallen tree now prevents access to the stand (Swift 2005).

1.5.4 Development

There is concern that the sub-division of land adjacent to Big Meadow Bog may result in landscape alteration for future housing/cottage development.

Alteration of surface soils during roadside ditching destroyed a stand at the Gull Rock Road site in 1988 (Newell 2003).

1.5.5 Burning

Although occasional burning in habitat surrounding Eastern Mountain Avens may actually limit competition from shrubs, repetitive burning is detrimental. Forest fires or fires for burning brush in Eastern Mountain Avens habitat may destroy the plants and cause degradation of habitat.

1.5.6 Tourism

Increased tourism on Brier Island also represents a potential threat to Eastern Mountain Avens, but at the moment it is unknown how much damage may be occurring or might occur in the future due to picking, collecting or trampling (Keddy 1986; Newell 2002). Although most bog sites are fairly inaccessible, as the popularity of Brier Island increases, Eastern Mountain Avens may become more vulnerable to visitors and cottage development (Newell 2002).

1.6. Actions Already Completed or Underway

NSDNR and the Nature Conservancy of Canada (NCC) have been actively involved in recovery efforts for Eastern Mountain Avens. NSDNR maintains a Geographic Information System (GIS) database of survey data. This data is provided by NSDNR staff and dedicated volunteers.

In 1998, the NCC purchased lands on Brier Island to protect Eastern Mountain Avens. The NCC has been conducting some stewardship activities on their lands and educating the public since 2001. The Brier Island Management Committee (BIMC) was formed in 2001. This group may offer advice on general management issues within the NCC Brier Island property and may be key to community involvement; solving disputes and issues, and promoting stewardship initiatives. NCC has developed education plans on local flora and fauna for the local school, and fenced off OHV trails from use with the assistance of OHV users. Their 2003 report 'Big Meadow Bog and *Geum peckii*: Preliminary Restoration Plan' outlines strategies for the conservation and recovery of Eastern Mountain Avens at the Big Meadow Bog site, some of which are incorporated into this recovery strategy. In this report, the collection of baseline habitat data for Big Meadow Bog was suggested and in 2003, the following parameters were recorded: peat depth, detailed hydrology, and species composition.

1.7. Knowledge Gaps

Biological / ecological research requirements

The pH requirements of Eastern Mountain Avens are unknown at present, but this knowledge would help direct surveys at new locations.

A genetic study (Paterson & Snyder 1999) found that Eastern Mountain Avens and *Geum radiatum* (a morphologically similar species) are separate species and recommended a population-level genetic analysis. The relatedness of the two disjunct populations of Eastern Mountain Avens in New Hampshire and NS is unknown at present and may prove useful knowledge to restore the population in NS.

Little is known about reproductive strategies of Eastern Mountain Avens in Nova Scotia and this too, is a conspicuous void in recovery knowledge.

Habitat restoration and enhancement feasibility

Research and experimental trials are required to ensure the appropriate decisions are made to restore the habitat for Eastern Mountain Avens in Big Meadow Bog.

Threat clarification research requirements

The impacts of development and tourism are not fully understood and further empirical investigations would be useful to ensure proper analysis and ranking of threats.

2. RECOVERY

2.1. Recovery Feasibility

Ecological and technical feasibility of species recovery

Recovery of Eastern Mountain Avens is technically and biologically feasible as determined by the test for determining the feasibility of recovery.

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

Experimental crosses revealed healthy reproduction through both cross-pollination and self-pollination.

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

Habitat is available in Nova Scotia and approximately 20% of the known Canadian stands are on land owned by the NCC, which means that a significant portion of habitat is potentially accessible for conservation and habitat management.

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

Most of the threats have the potential to be eliminated or minimized.

4. Recovery techniques exist or can reasonably be expected to be developed to achieve the recovery goal. YES

Recovery techniques exist, such as habitat restoration and transplantation, which have been successfully carried out in other situations (although not with Eastern Mountain Avens in particular).

2.2. Recovery Goal

The goal of this recovery strategy is to protect and maintain extant populations at current or greater levels of abundance with no reduction in the current range.

2.3. Recovery Objectives

1) Maintain populations at occupied sites

Rationale: Current sites must be protected as a strong population base for recovery efforts.

2) Improve conditions and enhance populations at occupied sites

Rationale: Improve habitat where Eastern Mountain Avens is known to occur to help stands flourish. Techniques such as active vegetation management, seed banking, and transplantation may be considered if deemed feasible.

3) Improve conditions at previously occupied sites

Rationale: At least three stands of Eastern Mountain Avens have been lost due to ditching, trampling, habitat disturbance, and encroaching vegetation. Once recovery efforts are undertaken to restore habitat or remove disturbance, nearby populations may repopulate the area.

2.4. Approaches Recommended to Meet Recovery Objectives

2.4.1 Recovery planning

The recovery strategies outlined in this section will facilitate the achievement of the recovery objectives. Recovery approaches are identified as research, monitoring, management, education, and stewardship. The Action Plan associated with this Recovery Strategy will include a detailed and prioritized schedule for these activities.

Table 2. Recovery planning table: recovery approaches for Eastern Mountain Avens in Canada. Priorities are defined as: Urgent = top priority action, without which population will decline; Necessary = needed to evaluate and guide recovery actions; Beneficial = beneficial if urgent actions are already underway.

Priority	Broad Approach/ Strategy	Objective Addressed	General Steps	Effect
RESEARCH				
Urgent	● Complete identification of critical habitat	1, 2	~ See Schedule of studies	Increases knowledge base, guides recovery actions, and management decisions
Urgent	● Assess how to raise water-table level	All	~ Gather information and design experimental trials to assess how to restore the pre-drainage water-table level	May provide protection from some threats
Beneficial	● Continue genetic studies	All	~ Sample plants in NS and in New Hampshire	Clarifies the possibility of human-assisted rescue from New Hampshire
Beneficial	● Explore methods of population and habitat enhancement	All	~ Determine feasibility for seed banking and transplanting within the Atlantic population	Guides management and recovery efforts
			~ Identify other possibilities for enhancement	Determines potential for population augmentation/ expansion

Priority	Broad Approach/ Strategy	Objective Addressed	General Steps	Effect
MONITORING				
Necessary	● Monitor known occupied sites	All	~ Develop reliable, repeatable, long-term monitoring tools and techniques to locate, monitor and assess	Enables determination of population trends, evaluation of recovery efforts and guides recovery efforts
Necessary	● Monitor threats	All	~ Document presence, severity, and effects of threats	Assesses success of efforts to eliminate and reduce threats
Necessary	● Confirm distribution data	1	~ Surveys of south-western NS	Increases capacity to protect and enhance
Beneficial	● Monitor habitat characteristics at unoccupied suitable habitat	3	~ Track changes in hydrology and species composition	Increases capacity to foster population enhancement
MANAGEMENT				
Necessary	● Secure or protect relevant habitat	All	~ Acquire habitat	Allows for easier implementation of recovery actions
Necessary	● Reduce off-highway vehicle traffic through habitat	All	~ Map main trails with OHV riders, highlight any areas that may cause significant threat	Gives drivers ownership in recovery solutions
			~ Work with riders to re-route trails to less vulnerable area and discourage off-trail riding.	Reduces threat to Eastern Mountain Avens habitat
Urgent	● Restore pre-drainage water-table levels	All	~ Take action based on the results of research.	Enhances habitat and helps maintain current distribution, higher water-table may discourage gulls
Necessary	● Reduce numbers of nesting gulls in the immediate vicinity of Big Meadow Bog	All	~ Observe effects of raising water level by above action. ~ If necessary, undertake further discouragement measures	Helps maintain existing sites and potential future sites and may make habitat less suitable for encroaching vegetation
Necessary	● Restore historic species composition to bog	All	~ Observe effects of raising water level, if that occurs ~ If necessary, use active vegetation management to re-instate sphagnum-dominated cover.	Restores habitat conditions and interactions
EDUCATION				
Necessary	● Provide quality educational materials and opportunities to raise the awareness of Eastern Mountain Avens	All	~ Create communications plan to support recovery efforts and solicit support for Eastern Mountain Avens and/or restoration of its habitat	Raises the public profile of Eastern Mountain Avens

Priority	Broad Approach/ Strategy	Objective Addressed	General Steps	Effect
STEWARDSHIP				
Necessary	● Foster cooperative relationships for Eastern Mountain Avens recovery with landowners, community, OHV riders, volunteers and ecotourists	All	~ Engage groups and individuals in the recovery process ~ Search for local and historical information and resources to assist in bog restoration ~ Encourage voluntary stewardship agreements	Increases capacity of recovery efforts beyond researchers

2.4.2 Narrative to support recovery planning table

Research

Complete identification of Critical Habitat

It is essential that the habitat needs of Eastern Mountain Avens be understood. Eastern Mountain Avens offers a particular challenge because, of the two global populations, one occurs in an alpine community while the second population (Canada's) occurs at sea level in boggy terrain. Research must be undertaken to identify habitat requirements crucial to Eastern Mountain Avens survival and to confirm if the 100 m zone established to maintain and protect the hydrology of the site for Eastern Mountain Avens and to protect the native vegetation community is sufficient or can be reduced (see schedule of studies).

Assess how to raise water table level

Raising the water-table in Big Meadow Bog to the height before construction of the drainage ditches may reverse the negative impacts on Eastern Mountain Avens habitat. However, more information and experimental trials will be necessary before a decision to do so is reached. Research should be designed and carried out at Big Meadow Bog to assess how to restore the pre-drainage water-table level and to understand whether doing so will restore habitat for Eastern Mountain Avens. Based on the results of this research, management actions will be recommended.

Continue genetic studies

When Paterson and Snyder (1999) studied whether *Geum peckii* and *Geum radiatum* were separate species, genetic sampling proved the species to be distinct. They recommended population level genetic analysis to identify genetic variation and conservation importance. Understanding the relatedness of the NS and New Hampshire populations would clarify the rescue potential from the New Hampshire population and may therefore guide management actions.

Explore methods of population and habitat enhancement

More information is required before decisions can be made regarding transplanting Eastern Mountain Avens. Possible habitat enhancement methods may also be explored with the intent that such strategies could play a greater role in recovery efforts when the Recovery Strategy is reviewed in 2015.

Monitoring

Monitor known occupied sites

A set of reliable, repeatable, long-term monitoring tools and techniques should be developed to assess the status of Eastern Mountain Avens and the success of recovery efforts.

Monitor threats

As part of site monitoring, observations of threats should also be recorded including presence and count of gulls, encroachment of competing plants, etc.

Confirm distribution data

Reported incidental observations of Eastern Mountain Avens in NS should be confirmed and mapped. Identification materials will be available to naturalists and residents of Brier Island; Digby Neck; and where possible, within Southwest NS, to facilitate opportunistic sightings.

Monitor habitat characteristics at historical and unoccupied suitable habitat

The NCC Big Meadow Bog and *Geum peckii:* Preliminary Restoration Plan (2003) recorded baseline information on water level conditions in Big Meadow Bog. These conditions should continue to be measured at prescribed times. These data will be necessary to evaluate enhancement of habitat if action is taken to raise the water-table. In addition to tracking changes in hydrology, species composition should also be tracked.

Management

Secure or protect relevant habitat

Wherever possible, Eastern Mountain Avens habitat (extant and historical) should be acquired or protected. Many of the recovery actions proposed to enhance habitat may not be possible given the current diverse private ownership at some sites.

Reduce off-highway vehicle traffic through habitat

The Recovery Team and other conservation partners should work with OHV operators to establish mutually acceptable re-routing of trails away from Eastern Mountain Avens stands. Educational materials should also be provided so the local riders may inform visiting riders why off-trail riding is a threat to Eastern Mountain Avens.

Restore pre-drainage water-table levels

If research indicates that raising the water-table in Big Meadow Bog will be beneficial to Eastern Mountain Avens, the management actions implicated as most likely to succeed in restoring pre-drainage water-table levels should be implemented.

Reduce numbers of nesting gulls in the immediate vicinity of Big Meadow Bog

Gulls have appeared in Big Meadow Bog as a result of the drainage ditches lowering the water-table, making the habitat suitable for nesting. Gulls have nutrified the soil, making it suitable for species that compete with Eastern Mountain Avens, and have trampled habitat. It is possible that if a suitable action to raise the water-table is undertaken, the gulls may leave or be reduced. Counts should be taken to monitor the impact of the suitable action on the gulls. If an action is

not chosen or that action does not result in a reduction of the gulls, further discouragement measures may be explored.

Restore historic species composition to bog

Research will dictate if action should be taken to raise the water-table and by what means. If the water-table does rise, the effects of raising the water level on species that were not historically present in the bog should be monitored. It may be necessary to explore using active vegetation management to re-instate sphagnum-dominated cover.

Education

Provide quality educational materials and opportunities to raise the awareness of Eastern Mountain Avens

The target audience for education should be easy to identify for Eastern Mountain Avens because the known distribution area in NS is relatively small. A communications plan should be created to support recovery efforts and solicit stewards for Eastern Mountain Avens and/or restoration of its habitat.

Stewardship

Foster cooperative relationships for Eastern Mountain Avens recovery with landowners, community, OHV riders, volunteers and ecotourists

To date, an active role has been taken by naturalists, local residents, OHV operators, and organizations such as NCC. The resulting activities have led to the discovery of Eastern Mountain Avens stands, re-routing of OHV trails to protect the plant, as well as purchase of land to conserve habitat. The information and input that local residents can provide may prove invaluable to decisions that must be made regarding habitat restoration and conservation. In addition, voluntary stewardship agreements should be developed with private landowners to protect Eastern Mountain Avens stands occurring on their land.

2.5 Evaluation

Section 46 of SARA requires that the competent minister report on the progress towards meeting the objectives of the recovery strategy every five years. Table 3 highlights those performance measures that will be evaluated within five years of the final recovery strategy being posted on the SAR Public Registry.

Table 3. A summary of the performance measures for evaluating the success of each strategy / approach.

Strategy / Approach	Performance Measures for Evaluation
RESEARCH	
• Complete identification of Critical Habitat (schedule of studies)	• Federal identification of Eastern Mountain Avens Critical Habitat enhanced
• Confirm distribution data	• Number of known sites and stands • Area of NS searched (km^2)
• Genetic studies	• Genetic variation results available
• Explore methods of population and habitat enhancement	• Enhancement methods are identified
MONITORING	
• Monitor known occupied sites	• Each site monitored at least every two years.
• Monitor threats	• Changes in threats are monitored
• Monitor habitat characteristics at historical and unoccupied suitable habitat	• Measure of how similar habitat is to historical (pre drainage ditches) state
MANAGEMENT	
• Secure or protect relevant habitat	• Land is acquired where feasible and possible
• Reduce off-highway vehicle traffic through habitat	• Re-routing of OHV trails away from EMA habitat
• Restore pre-drainage water-table levels	• If deemed necessary and feasible, increased water-table level based on 2003 baseline data
• Reduce numbers of nesting gulls in the immediate vicinity of Big Meadow Bog	• Reduce number of nesting gulls at targeted sites
• Restore historic species composition to bog	• Data records of native and non-native vegetation
EDUCATION	
• Provide quality educational materials and opportunities to raise the awareness of Eastern Mountain Avens	• Eastern Mountain Avens material is presented • Stewardship communication pieces (website, identification card or brochure) are available
STEWARDSHIP	
• Foster cooperative relationships with landowners, community, OHV riders, volunteers, and ecotourists	• Number of volunteers, membership of the BIMC • Voluntary involvement in recovery activities and planning

2.6 Critical Habitat

2.6.1 Identification of the species' critical habitat

Eastern Mountain Avens is a unique species known to occur in two disjunct locations with distinctly different habitats; an alpine location in the United States and boggy terrain in NS. Eastern Mountain Avens populations in NS have been the subject of survey effort since 1985 and it is unlikely that more populations will be discovered. However any newly discovered sites and stands would be identified as critical habitat in order to better achieve the recovery goal. Section 2.6.3 outlines studies that will continue or be initiated to better describe Critical Habitat.

Critical habitat is identified as the nine known sites with Eastern Mountain Avens. In general terms, Eastern Mountain Avens in NS occurs near the coast in bogs, sphagnus depressions, and occasionally in dry depressions on mineral soil and regularly co-occurs with shrubby ciniquefoil (*Pontentilla fructicosa*) and deergrass (*Scirpus caespitosus*) (Newell 2002). Alterations of hydrology and/or the native vegetation community by mechanical, chemical or other means are documented as causing decline to Eastern Mountain Avens. Thus, as a precautionary measure, Critical Habitat is identified as: the wetlands where the species currently occurs (and previously occurred) and a 100 m zone landward of the edge of these wetlands. The purpose for including the 100 m zone is to maintain and protect the hydrology of the site for Eastern Mountain Avens and to protect the native vegetation community. The schedule of studies for Critical Habitat will include confirmation or alteration of the 100 m zone.

Appendix A indicates the general location of known occupied sites of Eastern Mountain Avens. Appendix B, giving the coordinates and directions to the Eastern Mountain Avens sites and stands, has been removed from the public document to protect the species and its habitat.

2.6.2 Examples of activities likely to result in destruction of critical habitat

An activity is detrimental to Critical Habitat when it alters conditions such that the capacity of that Critical Habitat to contribute to the survival or recovery of the species would be compromised.

Some examples of activities that may result in the destruction of Critical Habitat include, but are not limited to:

- alteration of surficial soil through activities such as ditching, bulldozing, excavation, raking, shovelling, trampling, indiscriminate use of herbicides;
- deliberate setting of fires;
- alteration of surficial or ground hydrology through activities including channelization, alteration to natural drainages.

2.6.3 Schedule of studies to identify critical habitat

An Action Plan for this species will be completed within two years of the final version of this document being posted on the SAR Public Registry (see section 2.10). The results of the studies below will be incorporated into the Action Plan. If studies, in addition to those described in Table 4, are needed to refine the identification of critical habitat they will be addressed in the Action Plan.

Table 4. Schedule of studies to identify critical habitat.

Study to be undertaken	Specific Steps	Timeline
Ensure that distribution and population have been identified to the extent possible	• Compile list of key habitat characteristics necessary for Eastern Mountain Avens	Results to be reported in Action Plan
	• Network with provincial volunteer survey programs to support opportunistic discoveries	
	• Visit and document reported sightings or habitats identified as appearing ideal	
Delineation of wetlands	• Map wetlands and include 100 m zone landward of edges.	Results to be reported in Action Plan
Clarify habitat needs and characteristics	• Determine what characteristics permit Eastern Mountain Avens to exist in a non-alpine habitat	Ongoing; Results to be reported in Action Plan
	• Habitat Mapping	
	• Better define physical features of habitat that may limit recovery	
Confirm or adjust recommendation of 100 m of Critical Habitat surrounding wetlands	• Assess distance needed to protect the hydrology and the native vegetation community of the site	Ongoing; Results to be reported in Action Plan

2.7 Existing Habitat Protection

Under the Nova Scotia Endangered Species Act (NSESA), the province of NS may designate "core habitat", which is defined in the act as "*specific areas of habitat essential for the long-term survival and recovery of endangered or threatened species*". The process for designating core habitat is not yet developed as the emphasis as been on other existing and tested tools for habitat protection. The relationship between the identification of "Critical Habitat" under SARA and the designation of "core habitat" under the NSESA, and the implications for protection are yet to be determined.

Eastern Mountain Avens core habitat, if designated under the Nova Scotia Endangered Species Act, can be protected by some specific regulations. In 1988 the NCC purchased a Brier Island property encompassing roughly 20% of known Eastern Mountain Avens stands (NSDNR unpublished data).

In 2003, the NCC prepared a report entitled, 'Big Meadow Bog and *Geum peckii:* Preliminary Restoration Plan', and has been actively monitoring the site and communicating with the landowners of other sites. All of the sites not within the NCC owned parcel of land occur on privately owned land. In 2003, owners of the private Brier Island properties were supportive of bog restoration and allowed NCC access to their properties to conduct research (Brown 2003). The NCC may pursue acquisition of more land on Brier Island or at the Digby Neck – East Ferry site if the appropriate conditions or opportunities arise (Bernard, per. comm. 2006).

2.8 Effects on Other Species

Species that have become established in Big Meadow Bog due to the habitat conditions provided by the drainage ditch (such as gulls) may be displaced due to the efforts to restore habitat by raising the water-table. The displacement of gulls at sites is beneficial to Eastern Mountain Avens and will not be harmful to gull populations overall. Species that have similar habitat needs to Eastern Mountain Avens that have been pushed to the marginal edges of the bog should benefit from habitat restoration efforts. Research and monitoring efforts will be minimally invasive and should have no significant negative effects on other species. Educational, stewardship and threat mitigation efforts are expected to benefit the majority of native species in the area.

2.9 Recommended Approach for Recovery Implementation

A single species approach is recommended because Eastern Mountain Avens is distinct with respect to habitat requirements and threats in this area of NS.

2.10 Statement on Action Plan

An action plan detailing the steps necessary to achieve the objectives, knowledge gaps, and schedule of studies presented in this recovery strategy for Eastern Mountain Avens will be developed within two years of the final posting of the Recovery Strategy.

3. REFERENCES

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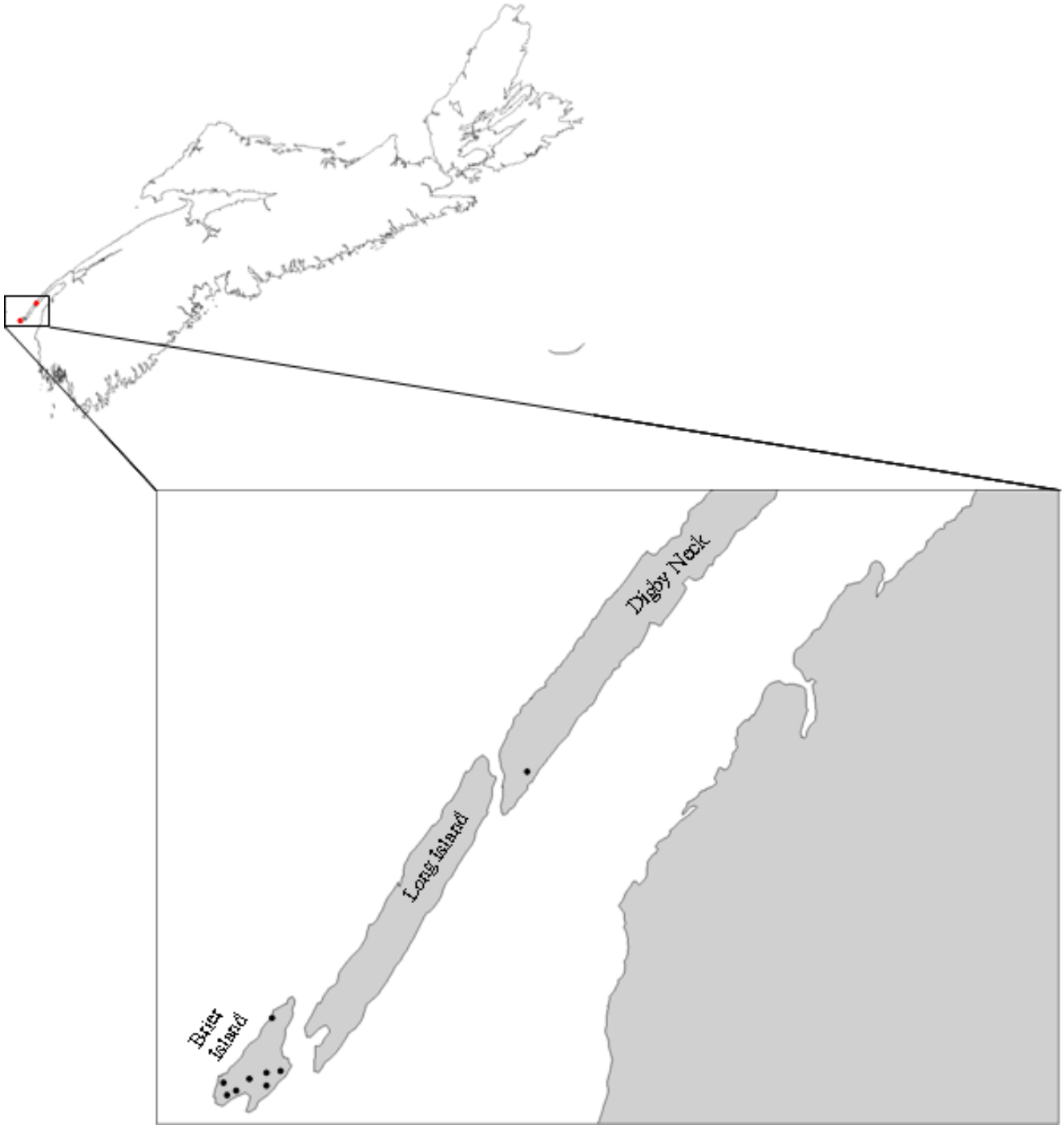
APPENDIX A

Known sites with Eastern Mountain Avens (*Geum peckii*) as of August 2008. Nova Scotia Department of Natural Resources, 2008



APPENDIX B

This appendix has been removed from the public document to protect the species and its habitat.