

Photo: Shirley Denton

Horsetail Spike-rush

(Eleocharis equisetoides) in Ontario

Ontario Recovery Strategy Series

Recovery strategy prepared under the *Endangered Species Act, 2007*

Natural. Valued. Protected.

About the Ontario Recovery Strategy Series

This series presents the collection of recovery strategies that are prepared or adopted as advice to the Province of Ontario on the recommended approach to recover species at risk. The Province ensures the preparation of recovery strategies to meet its commitments to recover species at risk under the Endangered Species Act (ESA) and the Accord for the Protection of Species at Risk in Canada.

What is recovery?

Recovery of species at risk 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 a species' persistence in the wild.

What is a recovery strategy?

Under the ESA, a recovery strategy provides the best available scientific knowledge on what is required to achieve recovery of a species. A recovery strategy outlines the habitat needs and the threats to the survival and recovery of the species. It also makes recommendations on the objectives for protection and recovery, the approaches to achieve those objectives, and the area that should be considered in the development of a habitat regulation. Sections 11 to 15 of the ESA outline the required content and timelines for developing recovery strategies published in this series.

Recovery strategies are required to be prepared for endangered and threatened species within one or two years respectively of the species being added to the Species at Risk in Ontario list. There is a transition period of five years (until June 30, 2013) to develop recovery strategies for those species listed as endangered or threatened in the schedules of the ESA. Recovery strategies are required to be prepared for extirpated species only if reintroduction is considered feasible.

What's next?

Nine months after the completion of a recovery strategy a government response statement will be published which summarizes the actions that the Government of Ontario intends to take in response to the strategy. The implementation of recovery strategies depends on the continued cooperation and actions of government agencies, individuals, communities, land users, and conservationists.

For more information

To learn more about species at risk recovery in Ontario, please visit the Ministry of Natural Resources Species at Risk webpage at: www.ontario.ca/speciesatrisk

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ADOPTION OF RECOVERY STRATEGY

The *Endangered Species Act, 2007* (ESA) requires the Minister of Natural Resources to ensure recovery strategies are prepared for all species listed as endangered or threatened on the Species at Risk in Ontario (SARO) List. Under the ESA, a recovery strategy may incorporate all or part of an existing plan that relates to that species.

Horsetail Spike-rush is listed as endangered on the SARO List. The species is also listed as endangered under the federal *Species at Risk Act* (SARA). Environment Canada prepared the Recovery Strategy for Horsetail Spike-rush in Canada in October, 2006 to meet their requirements under the SARA. This recovery strategy is hereby adopted under the ESA. With the additions indicated below, the enclosed strategy meets all of the content requirements outlined in the ESA.

1.0 Area for Consideration in Developing a Habitat Regulation

Under the ESA, a recovery strategy must include a recommendation to the Minister of Natural Resources on the area that should be considered in developing a habitat regulation. A habitat regulation is a legal instrument that prescribes an area that will be protected as the habitat of the species. The recommendation provided below will be one of many sources considered by the Minister when developing the habitat regulation for this species.

Section 2.6.1 of the federal recovery strategy provides an identification of critical habitat (as defined under the SARA). Identification of critical habitat is not a component of a recovery strategy prepared under the ESA. However, it is recommended that the areas of critical habitat identified in Section 2.6.1 be considered when developing a habitat regulation under the ESA.

APPENDIX

Recovery Strategy for the Horsetail Spike-rush (*Eleocharis equisetoides*) in Canada

Horsetail Spike-rush



October 2006



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 (http://www.sararegistry.gc.ca/the_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. 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 SARA Public Registry (<http://www.sararegistry.gc.ca/>) and the Web site of the Recovery Secretariat (http://www.speciesatrisk.gc.ca/recovery/default_e.cfm).

**Recovery Strategy for the Horsetail Spike-rush (*Eleocharis
equisetoides*) in Canada**

October 2006

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Additional copies:

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DECLARATION

This recovery strategy has been prepared in cooperation with the jurisdictions responsible for the horsetail spike-rush. Environment Canada has reviewed and accepts this document as its recovery strategy for the horsetail spike-rush, as required under the *Species at Risk Act*. 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.

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 horsetail spike-rush and Canadian society as a whole.

RESPONSIBLE JURISDICTIONS

Environment Canada – Ontario Region

AUTHORS

This recovery strategy was prepared by Holly Bickerton, Biological Consultant.

ACKNOWLEDGMENTS

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STRATEGIC ENVIRONMENTAL ASSESSMENT

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 on 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 horsetail spike-rush. 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: 1.3 Needs of Horsetail Spike-rush; 2.9 Effects on Other Species; and 2.10 Recommended Approach for Recovery Implementation.

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 SARA public registry:

http://www.sararegistry.gc.ca/plans/residence_e.cfm

PREFACE

The horsetail spike-rush (*Eleocharis equisetoides*) is under the management jurisdiction of Environment Canada (Canadian Wildlife Service – Ontario Region). The *Species at Risk Act* (SARA, Section 37) requires the competent minister to prepare recovery strategies for listed extirpated, endangered, or threatened species. The horsetail spike-rush was assessed as Endangered by COSEWIC in November 2000 and listed under SARA in 2003. The Canadian Wildlife Service – Ontario Region, Environment Canada, led the development of this recovery strategy. The strategy meets SARA requirements in terms of content and process (Sections 39–41). The Ontario Ministry of Natural Resources reviewed this document. Although the species is currently under the sole jurisdiction of Environment Canada, the Ontario Ministry of Natural Resources will be engaged in the recovery process and all recovery decisions if the species is discovered off federal lands.

EXECUTIVE SUMMARY

Horsetail spike-rush (*Eleocharis equisetoides*) is an aquatic plant in the sedge family that is found primarily within the Atlantic and Gulf coastal plains and is known from a single location in Canada. Little is understood about the specific biological requirements of this species, which grows in organic substrate in a pond between forested dunes at Long Point National Wildlife Area in southwestern Ontario.

The sole occurrence of horsetail spike-rush in Canada lies within a federally protected area, and there are no demonstrated anthropogenic threats to the species or its habitat. Possible threats include invasion by the common reed (*Phragmites australis*), a susceptibility to stochastic impacts, browsing by white-tailed deer (*Odocoileus virginianus*), changes in water levels, and genetic loss.

Critical habitat for this species is identified as the area occupied by the stand of culms and the shoreline buttonbush (*Cephalanthus occidentalis*) – red osier dogwood (*Cornus stolonifera*) thicket swamp community in which it occurs. The extent of the shoreline community should be mapped.

The recovery of horsetail spike-rush is considered technically and biologically feasible. The recovery goal is to maintain the single known occurrence of horsetail spike-rush at or near its recorded areal extent of 5–10 m². Recovery objectives include:

- monitoring the population and suspected threats, to assess trends and severity of threats;
- investigating common reed management methods and implementing appropriate responses;
- investigating seed viability, archiving techniques, and rhizome propagation, and, if considered feasible, collecting and preserving seeds or propagating rhizomes;
- completing critical habitat mapping and ensuring critical habitat protection;
- investigating and verifying any reported new locations of horsetail spike-rush; and
- determining the tolerance of horsetail spike-rush to water-level fluctuation, the minimum viable population and the viability of the extant site, and, the extent to which loss of genetic diversity poses a threat to the species.

A number of specific actions and evaluation methods are also outlined within the strategy.

This approach to the recovery of horsetail spike-rush will not have any anticipated negative effects on other species at risk. Management of common reed may have an impact on other species, but this may be minimized through the selection of a non-chemical control method.

An action plan will be developed for horsetail spike-rush by 2008.

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APPENDIX 1 Subnational Ranks of Horsetail Spike-rush in the United States

SPECIES ASSESSMENT INFORMATION FROM COSEWIC

Date of Assessment: November 2000

Common Name: Horsetail Spike-rush

Scientific Name: *Eleocharis equisetoides*

COSEWIC Status: Endangered

Reason for Designation: A perennial herb found at one site where it likely represents a single clonal individual occupying less than 10 square metres of pond shoreline.

Canadian Occurrence: Ontario

COSEWIC Status history: Designated Endangered in November 2000. Assessment based on a new status report.

1. BACKGROUND

1.1 Description

Horsetail spike-rush is an aquatic, perennial plant in the sedge family (Cyperaceae). It has unbranched, green aerial stems (“culms”) 50–100 cm in height and 3–5 mm in diameter, which are round in cross-section. Horsetail spike-rush is, in part, distinguished from other spike-rushes within its range by relatively stout culms that are at least the same thickness as its mature terminal spikelets. Another distinctive characteristic is the presence of internal, cross-partitioning membranes inside the culm. The plant does not have leaf blades, but instead has narrow, papery scales at the base of the culm. Horsetail spike-rush begins flowering in late spring and fruits from July to October. Fruits are held within a terminal spikelet of 15–40 mm in length, which is covered in light brown scales dotted purple on the inside. The small fruits are oval-shaped and flattened to triangular, with a long protrusion extending from one end. Horsetail spike-rush also reproduces clonally by underground rhizomes. Technical descriptions and illustrations are available in Voss (1972), Gleason and Cronquist (1991), and Holmgren (1998).

1.2 Populations and Distribution

Horsetail spike-rush is primarily a species of the southern Atlantic and Gulf coastal plains, also occurring locally at the northern extent of its range along the southern Great Lakes. It is considered globally apparently secure (G4) (NatureServe 2006). It has been recorded in 23 American states, but is considered rare (S1–S3) in 13 of these and historical (SH) or extirpated (SX) in another five (Appendix 1).

In Canada, horsetail spike-rush is known from a single occurrence at Long Point National Wildlife Area in southwestern Ontario (Reznicek and Catling 1989; Sutherland 2000). It is considered critically imperiled (S1) in Ontario (Natural Heritage Information Centre 2005) and this occurrence represents less than 1% of the species' global population (Sutherland 2000). Long-term trends within this single population are unknown owing to an absence of data from earliest accounts. While the number of culms and areal extent of the population of this plant fluctuated somewhat between surveys in 1988 and 2004 (Table 1), this may indicate annual variation only, due in part to natural changes in water level. The recent (2004) drop in the number of culms is not considered to be an indicator of serious decline, as the areal extent had not changed greatly, and water levels were unusually high that year (M. Oldham, pers. comm. 2005). Owing to the clonal nature of this species, it is also possible that the occurrence represents only a single plant.

Table 1. Population Data for horsetail spike-rush on Long Point, Ontario

Year	Collector/observer	Population/plant numbers	Area (m ²)
1953	Landon	No estimate	No estimate
1956	Soper & Dale	No estimate	No estimate
1960	Landon	No estimate	No estimate
1988	A.A.Reznicek <i>et al.</i>	Approximately 12 culms	1
1993	D. Sutherland	151 culms (91 fruiting)	6
1999	A.A. Reznicek & M. Oldham	Approximately 100 culms (10 fruiting)	8–10
2004	M. Oldham, A.A. Reznicek, & J. Robinson	19 culms (9 fruiting)	5–10

Sources: Sutherland (2000); Oldham (2004).

In 1999, a possible new location was reported at Turkey Point Provincial Park but no specimen or photograph exists to document this finding. The plant was not located again in spite of considerable searching at the reported location by botanists familiar with the species (M. Oldham, pers. comm. 2005). The nearest recorded populations of horsetail spike-rush are at least 200 km east of Long Point in Monroe County, New York, and over 300 km west in Washtenaw County, Michigan (Young and Weldy 2005; Michigan Natural Features Inventory 2006).



Figure 1 Extant Canadian population of horsetail spike-rush

1.3 Needs of Horsetail Spike-rush

1.3.1 Habitat and biological needs

In Ontario, horsetail spike-rush on Long Point grows in sandy organic muck along the south-facing shoreline of an inland pond (Sutherland 2000). The pond lies between two stabilized dune ridges near the tip of Long Point and is affected by natural processes. Horsetail spike-rush is considered an aquatic species, growing in water between 4 and 35 cm deep. Like many other Atlantic coastal plain species, it may be tolerant of periodic water level fluctuations (Schneider 1994), although its specific tolerance limits have not been studied.

The shoreline community at this location is dominated by buttonbush (*Cephalanthus occidentalis*) and red-osier dogwood (*Cornus stolonifera*). Other species observed growing in association with horsetail spike-rush include water bulrush (*Scirpus subterminalis*), Small's spike-rush (*Eleocharis smallii*), grass-leaved pondweed (*Potamogeton gramineus*), long-leaved pondweed (*Potamogeton nodosus*), common coontail (*Ceratophyllum demersum*), slender naiad (*Najas flexilis*), bulhead pond-lily (*Nuphar variegatum*), northern wild rice (*Zizania palustris*), and slender sedge (*Carex lasiocarpa*). A complete list of vascular plants recorded for this pond site can be found in Sutherland (2000).

Very little is known about the specific biological requirements of horsetail spike-rush, beyond a general identification of its current habitat. Horsetail spike-rush occurs rarely throughout northeastern North America and is presumably of limited distribution in Canada because of climate. The possibility that this occurrence represents very few or perhaps even a single plant suggests that the genetic diversity of this population may be very low, which may limit its long-term viability.

Like other members of the genus *Eleocharis*, horsetail spike-rush is presumably wind-pollinated. European studies have demonstrated that seeds of *Eleocharis* species can be dispersed in the fecal matter of migratory waterbirds (Charalambidou and Santamaria 2005). Propagules of a number of common wetland plants (including *Scirpus* spp., *Eleocharis* spp., and *Chenopodium* spp.) can also remain viable following waterbird gut passage (De Vlaming and Proctor 1968; Holt-Mueller and van der Valk 2002). Waterbirds may therefore be responsible for transporting propagules of this species.

1.3.2 Ecological role

The specific role that the species may play within the ecosystem (e.g., providing food or shelter to other organisms) has not been identified.

1.3.3 Limiting factors

It is not known whether reproductive factors or life history is biologically limiting in any way.

1.4 Threats

Currently, there are few threats that affect horsetail spike-rush and its habitat, as the only Canadian occurrence of the species is within an infrequently accessed area inside a national wildlife area. The habitat is considered secure, and the surrounding area is subject mainly to natural processes. Property adjacent to the national wildlife area and relatively close to the species' occurrence has recently been purchased by the Nature Conservancy of Canada (H. Arnold, pers. comm. 2005), but the lands are still used by the various joint landowners for outdoor recreational pursuits. This may cause some disturbance to any potential habitat present on these adjacent lands. However, it does not directly impact the known occurrence or its current habitat.

Six potential threats to the species and its habitat have been identified; however, none of these has currently been demonstrated as having a negative impact on the species in Canada. Threats are listed in estimated order of probability and significance.

1.4.1 Invasion by common reed (*Phragmites australis*)

The invasive common reed (*Phragmites australis*) is expanding on Long Point National Wildlife Area, as it has in the entire Great Lakes region. It has been recently observed in the pond where horsetail spike-rush occurs (M. Oldham, pers. comm. 2005). It has not been reported from this

site in the past, in spite of its distinctive appearance (e.g., Sutherland 2000). The dense stand is within several hundred metres of the location of horsetail spike-rush (M. Oldham, pers. comm. 2005). Common reed may reduce a site's species richness, due to its ability to form dense, monospecific stands that crowd out other plant species and reduce structural habitat diversity for wetland birds (Mal and Narine 2004). Its further spread probably poses the most serious threat to horsetail spike-rush habitat.

1.4.2 Susceptibility to stochastic impacts

The threats due to environmental stochasticity have not been studied and are virtually impossible to quantify. In general, evidence indicates that stochastic impacts may increase as population size decreases (Lande 1993). With only one Canadian occurrence, the very small areal extent of this occurrence (5–10 m²) and number of individuals may make it extremely vulnerable to loss, even in a single, unpredictable chance event (e.g., disease, storm, flood). The rare occurrence of the species throughout northeastern North America also means that recolonization is unlikely. Stochastic processes that would affect this population are natural processes. For example, the extirpation during the Holocene (5700–2800 BP) of localized populations of horsetail spike-rush in Indiana, which has been demonstrated via the pollen record, was likely due to rapid climate drying (Jackson and Singer 1997).

1.4.3 Herbivory

High populations of white-tailed deer (*Odocoileus virginianus*), in the absence of natural levels of predators, have been a problem at Long Point in the past; however, ongoing deer management has successfully reduced the population on the Point (J. Robinson, pers. comm. 2005). Evidence of direct deer herbivory on horsetail spike-rush at this site has not been observed to date (J. Robinson, D. Sutherland, and M. Oldham, pers. comm. 2005), and the population persisted even when deer numbers were high. On Long Point, the horsetail spike-rush population is buffered from the shoreline by dense shrubs and may be inaccessible to deer. However, deer herbivory has been observed on other species of *Eleocharis* (D. Sutherland, pers. comm. 2005), and it may be considered a possible threat. Herbivory by beavers (*Castor canadensis*) and muskrats (*Ondatra zibethicus*) is also possible, but has not been observed.

1.4.4 Water level elevation or stabilization

Beaver activity has been reported within the pond in the past and may cause short- to medium-term changes in water levels. Like other shoreline emergent species that are relicts of Atlantic coastal plains (see Reznicek 1994), horsetail spike-rush is probably adapted to fluctuating water levels. It is possible that prolonged stabilization of water levels may threaten this species. However, while many annual Atlantic coastal plain species require water level fluctuations in order to germinate (Keddy and Reznicek 1982), it is also possible that horsetail spike-rush's perennial rootstocks may buffer it against such changes to the hydroperiod.

1.4.5 Loss of genetic diversity

Reductions in population size can reduce the number of alleles in a population and decrease the overall genetic variability of populations over time, thus lowering individual fitness and population viability. Immigration of pollen or seeds from nearby populations can reduce the likelihood of allele loss, introducing variation to a small population (Young *et al.* 1996). The Long Point population of horsetail spike-rush may be vulnerable to genetic loss, owing to its small size and the fact that pollen transfer and seed immigration from distant populations are likely very low. It is unknown whether one small patch of culms will be sufficient to maintain individual fitness and population viability over the long term. There is no information on this threat, and therefore it is speculative.

1.4.6 Climate change

Climate change may threaten horsetail spike-rush if its current, narrow habitat preference in Ontario becomes unsuitable. The effects of climate change may lead to an alteration in the moisture regime of the area or a shift in winter temperatures, which may impact the species' survival.

1.5 Actions Already Completed or Under way

The tip of Long Point is subject to natural processes, and active management for horsetail spike-rush has not occurred. Ongoing management of deer populations should continue to maintain a sustainable deer population while protecting biodiversity.

1.6 Knowledge Gaps

Research important to the Canadian population is identified in Table 2 (see section 2.5). However, because of the almost complete lack of ecological research on this species in North America, any basic ecological research (reproduction, seed viability, etc.) would be helpful in managing this species. Below are significant areas where further information is required and research questions that would help refine the goals and objectives:

- *Threat identification:* What are the real versus perceived threats at this site and at others in its range? How does population vary with water level? Is horsetail spike-rush vulnerable to herbivory? Do muskrats pose a threat to the survival of the species?
- *Ecology:* What is the range of tolerance of horsetail spike-rush to water level fluctuations? What biotic and abiotic factors explain the habitat preferences of this species? How long do seeds persist in the seed bank, and what are their germination requirements? How far is pollen able to travel? Is this species able to self-pollinate? What is the role of the species in the ecosystem, e.g., as a food source or host?
- *Genetics:* What is the genetic variability within this occurrence? Is there evidence of gene flow between this population and others in the northeastern United States?

- *Recruitment and demographics*: What are the recruitment rate and demographic structure of the Ontario population? What is the probable demographic viability of this population? How many individuals of this species are required to ensure long-term viability, and how much habitat do they require?

2. RECOVERY

2.1 Rationale for Recovery Feasibility

The recovery of horsetail spike-rush is technically and biologically feasible. The only historically documented population in Canada still exists. Although survey data are insufficient to identify a population trend or recruitment rate, successive recent visits suggest that the number of culms and area of occupancy remain stable. There are individuals within the species' North American range that are capable of reproduction. However, the feasibility of reintroduction is not known. The current habitat may be assumed to be sufficient for the species' requirements, since it was first recorded here in 1953, and no other supporting populations are known from southwestern Ontario, in spite of intensive botanical exploration. There are only a few recognized threats to the species, and most of these can be monitored with a view to taking proactive measures should imminent threats to the viability of the extant population become apparent. Active recovery techniques are not currently regarded as necessary, because the known habitat and estimated population of horsetail spike-rush are not believed to be in decline.

It should be recognized that horsetail spike-rush is naturally very rare in Canada, and it is not known whether its current population or supporting natural processes are sufficient for it to persist over the long term. However, available evidence suggests that a goal of maintaining its single natural occurrence is likely attainable.

2.2 Recovery Goal

The long-term recovery goal is to maintain the single known occurrence of horsetail spike-rush at or near its recorded areal extent of 5–10 m².

2.3 Recovery Objectives (next five years)

1. Annually monitor the number of culms and suspected threats (*Phragmites* spread, water levels, herbivory) in order to assess trends and severity of threats over five years.
2. Investigate common reed removal methods, and, if necessary, control or remove common reed in an adaptive management framework.
3. Investigate seed viability and archiving techniques, and, if considered feasible, collect and preserve horsetail spike-rush seeds. Investigate the feasibility of rhizome harvesting, and implement as appropriate.

4. Complete critical habitat mapping, and ensure its protection.
5. Investigate and verify any reported new locations of horsetail spike-rush in Canada.
6. Determine the tolerance of horsetail spike-rush to water level fluctuation, the minimum viable population and viability of the extant site, and the extent to which loss of genetic diversity poses a threat to the species.

2.4 Rationale for Goals and Objectives

The recovery goals and objectives reflect the fact that the sole occurrence is protected through federal legislation, and natural processes within the national wildlife area are largely intact.

Horsetail spike-rush is naturally rare in Canada, likely remaining here as a relict Atlantic coastal plain species at the close of the last glaciation (Reznicek 1994; Jackson and Singer 1997). There is no evidence to suggest that any other occurrence of this species has been extirpated from Canada within European history. This population has been known from this site for several decades; assuming that conditions remain the same, it is reasonable to assume that it will persist here. Attempting to increase the area of occupancy, number of locations, or population abundance is therefore not recommended. Similarly, aiming to “delist” horsetail spike-rush as a species at risk is unrealistic, as it has probably been extremely rare in Canada since pre-European times. Given the very restricted occurrence of this species, archiving seeds or propagation from rootstock would protect the population against extirpation in the event of a severe and unforeseen impact.

Managing *Phragmites* spread near this site is recommended in spite of uncertainty as to whether *Phragmites* represents a threat. This is because controlling *Phragmites* while abundance is low is more likely to be effective.

2.5 Approaches Recommended to Meet Recovery Objectives

Strategies intended to reduce or eliminate threats are listed in Table 2. Strategies include monitoring, inventory, habitat management, habitat mapping, and research. They are focused on identifying, refining, and managing threats.

Table 2. Recovery Planning Table

Priority	Objective No.	Broad approach/ strategy	Threat addressed	General steps	Outcomes (measurable targets)
High	1	Monitoring	Common reed invasion Water level Deer herbivory Stochastic impacts	<ul style="list-style-type: none"> Establish an annual monitoring method to determine: <ul style="list-style-type: none"> trends in the number of culms and fruiting culms; <i>Phragmites</i> spread; population relative to water level change; and evidence of deer herbivory. Analyze results, and take action when required. 	<ul style="list-style-type: none"> Monitoring method developed, and monitoring conducted annually.
Medium	2	Habitat management	Common reed invasion	<ul style="list-style-type: none"> Investigate possible methods for control of <i>Phragmites</i> on Long Point. If required, select method and control. (Monitor as above.) 	<ul style="list-style-type: none"> <i>Phragmites</i> absent from pond or maintained at 2005 levels and not perceived as a threat to horsetail spike-rush.
Medium	4	Habitat mapping	All threats	<ul style="list-style-type: none"> Complete mapping of critical habitat for horsetail spike-rush. 	<ul style="list-style-type: none"> Mapping completed.
Medium	3	Research	Stochastic impacts	<ul style="list-style-type: none"> Investigate feasibility of archiving seeds of horsetail spike-rush. If feasible, collect and archive seed using suitable methods. Investigate the potential success of rhizome propagation, to use if required. 	<ul style="list-style-type: none"> Seeds collected and properly archived, if feasible and appropriate. Rhizomes propagated, if necessary.
Low	6	Research Habitat management	Water level	<ul style="list-style-type: none"> Determine the thresholds of tolerance of horsetail spike-rush to water level fluctuations. Recommend water level management if required. 	<ul style="list-style-type: none"> Thresholds identified.
Low	6	Research	Stochastic impacts	<ul style="list-style-type: none"> Complete demographic studies to determine the minimum viable population size of horsetail spike-rush and viability of extant population. 	<ul style="list-style-type: none"> Minimum viable population known. Viability of extant site estimated.
Low	6	Research	Stochastic impacts	<ul style="list-style-type: none"> Complete studies to determine seed viability/set, current reproductive strategy utilized by the species, seed dispersal. 	<ul style="list-style-type: none"> Reproductive capacity of extant site estimated.

Priority	Objective No.	Broad approach/ strategy	Threat addressed	General steps	Outcomes (measurable targets)
Low	6	Research	Genetic diversity	<ul style="list-style-type: none"> • Answer outstanding genetics research questions: <ul style="list-style-type: none"> ○ Determine the genetic variability within this population. ○ Determine whether genetic erosion, genetic drift, or inbreeding depression is affecting horsetail spike-rush. ○ Identify the extent to which this may jeopardize population viability over time. 	<ul style="list-style-type: none"> • Genetic variability known, and extent to which loss of genetic diversity poses a threat known.
As needed	5	Inventory	Stochastic impacts	<ul style="list-style-type: none"> • Investigate new discoveries of horsetail spike-rush when reported. • Survey Turkey Point to confirm presence/absence of 1999 record. 	<ul style="list-style-type: none"> • All new reports investigated.

2.6 Critical Habitat

2.6.1 Identification of the species' critical habitat

The critical habitat for horsetail spike-rush is being identified, to the extent possible, in the recovery strategy. Further identification and refinement of the critical habitat will take place following the completion of the schedule of studies and will be included in the action plan. Critical habitat includes the known area of occupancy and the marsh community on Long Point in which it occurs. The buttonbush – red osier dogwood wetland community where horsetail spike-rush occurs should be described and mapped to the level of ecosite type following the *Ecological Land Classification for Southern Ontario* (Lee *et al.* 1998), which is a standard protocol for vegetation community mapping in Ontario. However, critical habitat will be limited to the pond complex that the species inhabits and will not extend to adjacent wetland areas unless new occurrences of horsetail spike-rush are discovered.

The minimum area of critical habitat required to maintain a viable population of horsetail spike-rush is not known, since there is no information on what number of individuals represents a viable population or its specific requirements. Given its historically low abundance in Canada in spite of the apparent presence of similar habitat, the extent of this vegetation community is unlikely to be limiting the population's long-term viability. Since the recovery goal is to maintain the occurrence at or near its recorded extent (see above), it will be assumed in the absence of other evidence that the natural habitat it currently occupies will be sufficient to maintain it at these levels.

Critical habitat for horsetail spike-rush includes the inland pond where it grows in sandy organic muck along the south-facing shoreline. The pond lies between two stabilized dune ridges near

the tip of Long Point National Wildlife Area. Horsetail spike-rush is considered an aquatic species, growing in water between 4 and 35 cm deep. The shoreline community at this location is dominated by buttonbush and red-osier dogwood. Other species observed growing in association with horsetail spike-rush include water bulrush, Small's spike-rush, grass-leaved pondweed, long-leaved pondweed, common coontail, slender naiad, bulhead pond-lily, northern wild rice, and slender sedge.

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

There are no demonstrated human activities that are likely to destroy critical habitat at this single location. All possible threats at this site are the result of natural processes.

2.6.3 Schedule of studies to identify critical habitat

To further refine the critical habitat definition, the studies described in Table 3 should be completed.

Table 3. Schedule of studies

Description of activity	Expected results	Completion date
Annual monitoring of the number of culms and areal extent of horsetail spike-rush	Understanding of the demographics of the species' occurrence	Ongoing
Mapping of critical habitat of horsetail spike-rush and its marsh community	Full identification and mapping of all known critical habitat	2007
Mapping of critical habitat for confirmed new locations of horsetail spike-rush (if any) within a year of its confirmation	Full identification and mapping of all known critical habitat	Ongoing

However, since critical habitat is protected from threats to its survival due to its location within a National Wildlife Area intensive demographic studies are not urgent. No specific timelines are therefore suggested for these research questions.

2.7 Existing and Recommended Approaches to Habitat Protection

All critical habitat for horsetail spike-rush known in Canada is in a national wildlife area. Ninety days after the final version of this strategy is included in the public registry, a description of the critical habitat will be published in the *Canada Gazette*. The prohibitions under SARA (Section 58) will then apply after a period of 90 days following the description in the *Canada Gazette*. This will complement existing protection in Long Point National Wildlife Area (McKeating 1983) under the *Canada Wildlife Act*. No land acquisition or policy approaches are required unless new sites are discovered. Protecting habitat at this site is related only to managing threats if required.

If the species is discovered on private or provincial lands, the Ontario Ministry of Natural Resources will be engaged in updating the recovery strategy.

2.8 Performance Measures

Recovery can be considered successful in 2011 if the following have been met:

- Objective 1 — Annual monitoring data show that the areal extent, number of culms, and number of fruiting culms (or other indicators, as outlined in a monitoring method) have remained stable or increased.
- Objective 1 — Monitoring has determined whether herbivory or changes in water level appear to be affecting the number of culms (i.e., threats have been confirmed), and, if this is the case, possible actions have been investigated and implemented as appropriate.
- Objective 2 — Stands of common reed and other invasive aquatic plants are absent from the pond or at least have not expanded from 2005 levels and do not pose an immediate threat to the habitat of horsetail spike-rush.
- Objective 3 — Long-term seed storage and viability and/or rhizome propagation have been investigated and, if feasible, undertaken.
- Objective 4 — Critical habitat has been mapped at all extant locations within a year after discovery for new locations and by 2007 for Long Point National Wildlife Area.
- Objective 4 — Protection of horsetail spike-rush has been incorporated into any new management plans or other relevant documents for Long Point National Wildlife Area, and area managers remain involved with recovery decisions and activities.
- Objective 5 — New reports of horsetail spike-rush at other Canadian locations have been investigated and, if present, incorporated into recovery efforts.
- Objective 6 — Research activities carried out and research results have been considered to improve management activities.

2.9 Effects on Other Species

Negative impacts on other native species are not anticipated through the completion of the proposed recovery activities, which focus mainly on retaining natural ecological function of the immediate area and monitoring the population of horsetail spike-rush.

However, this strategy recommends the control of common reed; depending upon the methods used, this may have implications for other native plant or animal species living on or near these stands. Investigating non-chemical or biological control methods may help to reduce this potential impact. Although the herbicide Rodeo[®] is used widely in U.S. Atlantic coastal marshes

for the control of *Phragmites* (Marks *et al.* 1993; Mal and Narine 2004), it is not currently licensed for use in Canada.

No other species at risk are known to co-exist with horsetail spike-rush, so the activities recommended in the strategy are unlikely to have any effect on other species at risk.

2.10 Recommended Approach for Recovery Implementation

A single-species approach to recovery is being proposed because of the limited distribution of horsetail spike-rush and because no other species at risk co-exist with it. Integrating these goals, objectives, and actions into vegetation or ecosystem management plans for Long Point National Wildlife Area is recommended.

2.11 Statement of When One or More Action Plans in Relation to the Recovery Strategy Will Be Completed

An action plan will be completed for horsetail spike-rush by 2008.

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APPENDIX 1 SUBNATIONAL RANKS OF HORSETAIL SPIKE-RUSH IN THE UNITED STATES

State	S-Rank ^a
Alabama	SNR
Arkansas	SH
Connecticut	S1
Delaware	S2
Florida	SNR
Georgia	S3
Illinois	SX
Indiana	S1
Louisiana	SNR
Maryland	S1
Massachusetts	SX
Michigan	S3
Mississippi	S3S4
Missouri	SH
New Jersey	S1
New York	S2
North Carolina	S3
Rhode Island	S2
South Carolina	SNR
Tennessee	S1
Texas	SNR
Virginia	S1
Wisconsin	SX

^a Subnational ranks are assigned by each state's (or province's) Conservation Data Centre. They are not legal designations, but reflect the relative rarity of the species within that jurisdiction.

- S1** Extremely rare; usually 5 or fewer occurrences in the state/province or very few remaining individuals; often especially vulnerable to extirpation.
- S2** Very rare; usually between 5 and 20 occurrences in the state/province or with many individuals in fewer occurrences; often susceptible to extirpation.
- S3** Rare; usually between 20 and 100 occurrences in the province; may have fewer occurrences, but large number of individuals in some populations; may be susceptible to large-scale disturbances.
- S4** Apparently secure; uncommon but not rare; some cause for long-term concern due to declines or other factors.
- SH** Historically known from the state/province, but not verified recently (typically not recorded in the state/province in the last 20 years).
- SX** Apparently extirpated, with little likelihood of rediscovery. Typically not seen in the state/province for many decades, despite searches at known historic sites.
- SNR** Not ranked.

Source: NatureServe (2006).