

Recovery Strategy for the southern maiden-hair fern (*Adiantum capillus-veneris*) in British Columbia



Prepared by the Southern Maiden-hair Fern Recovery Team



Ministry of
Environment

November 2007

About the British Columbia Recovery Strategy Series

This series presents the recovery strategies that are prepared as advice to the Province of British Columbia on the general strategic approach required to recover species at risk. The province prepares recovery strategies to meet our commitments to recover species at risk under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada – British Columbia Agreement on Species at Risk*.

What is recovery?

Species at risk 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 a species' persistence in the wild.

What is a recovery strategy?

A recovery strategy represents the best available scientific knowledge on what is required to achieve recovery of a species or ecosystem. A recovery strategy outlines what is and what is not known about a species or ecosystem; it also identifies threats to the species or ecosystem, and what should be done to mitigate those threats. Recovery strategies set recovery goals and objectives, and recommend approaches to recover the species or ecosystem.

Recovery strategies are usually prepared by a recovery team with members from agencies responsible for the management of the species or ecosystem, experts from other agencies, universities, conservation groups, aboriginal groups, and stakeholder groups as appropriate.

What's next?

In most cases, one or more action plan(s) will be developed to define and guide implementation of the recovery strategy. Action plans include more detailed information about what needs to be done to meet the objectives of the recovery strategy. However, the recovery strategy provides valuable information on threats to the species and their recovery needs that may be used by individuals, communities, land users, and conservationists interested in species at risk recovery.

For more information

To learn more about species at risk recovery in British Columbia, please visit the Ministry of Environment Recovery Planning webpage at:

<<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>>

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Disclaimer

This recovery strategy has been prepared by the Southern Maiden-hair Fern Recovery Team, as advice to the responsible jurisdictions and organizations that may be involved in recovering the species. The British Columbia Ministry of Environment has received this advice as part of fulfilling its commitments under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada – British Columbia Agreement on Species at Risk*.

This document identifies the recovery strategies that are deemed necessary, based on the best available scientific and traditional information, to recover southern maiden-hair fern populations in British Columbia. Recovery actions to achieve the goals and objectives identified herein are subject to the priorities and budgetary constraints of participatory agencies and organizations. These goals, objectives, and recovery approaches may be modified in the future to accommodate new objectives and findings.

The responsible jurisdictions and all members of the recovery team have had an opportunity to review this document. However, this document does not necessarily represent the official positions of the agencies or the personal views of all individuals on the recovery team.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this strategy. The Ministry of Environment encourages all British Columbians to participate in the recovery of the southern maiden-hair fern.

RECOVERY TEAM MEMBERS

Southern Maiden-hair Fern Recovery Team

Ted Antifeau (Chair), B.C. Ministry of Environment
Gail Berg, B.C. Ministry of Forests and Range (retired)
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RESPONSIBLE JURISDICTIONS

The British Columbia Ministry of Environment is responsible for producing a recovery strategy for the southern maiden-hair fern under the *Accord for the Protection of Species at Risk in Canada*. Environment Canada's Canadian Wildlife Service and Parks Canada Agency participated in the preparation of this recovery strategy.

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EXECUTIVE SUMMARY

The southern maiden-hair fern (*Adiantum capillus-veneris*) is only known in Canada on private lands at Fairmont Hot Springs in the Columbia valley of southeastern British Columbia, more than 1000 km north of its main range. There is one extant population consisting of two extant subpopulations. This species is found on tufa (calcium carbonate) rock faces at the edges of hot mineral water flows, where the hot water creates a warm, humid microclimate. The southern maiden-hair fern subpopulations at Fairmont Hot Springs are very susceptible to subtle changes in hot springs water diversion and temperature changes.

Thought to be extirpated from British Columbia in the 1960s, a southern maiden-hair fern population was found in 1974 at Fairmont Hot Springs, and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated the species as “endangered” in 1984. In 2000, 2001 and 2002, field surveys confirmed the presence of four southern maiden-hair fern sites at Fairmont Hot Springs. Re-assessments by COSEWIC in 1998 and 2000 confirmed the “endangered” designation. This species is listed on the *Species at Risk Act* Schedule 1, and ranked as critically imperiled (S1) in British Columbia.

The goal for southern maiden-hair fern is to maintain a viable and self-sustaining population distributed throughout the present subpopulations to reduce the risk of extirpation from British Columbia.

The objectives for the recovery strategy are to: 1) Maintain a viable subpopulation at two extant sites at Site H and at Site B; 2) To enhance the subpopulation at Site B to increase subpopulation sizes; and to 3) Investigate feasibility of re-establishing subpopulations at sites A and F, and conduct re-introduction trials. If re-establishment is determined to be feasible, initiate transplantation trials at Sites A and F.

Four primary strategies have been identified to achieve these objectives:

1. habitat protection/stewardship approach
2. communication and outreach
3. population and water monitoring
4. restoration

Recovery actions could affect the following socio-economic sectors: land development and recreational users. The expected magnitude of these effects is unknown and will be further addressed in the recovery action plan.

No critical habitat, as defined under the federal *Species at Risk Act* (Environment Canada 2004), is proposed for identification at this time. It is expected that critical habitat will be proposed within a recovery action plan following: 1) consultation and development of options with affected land managers; and 2) completion of outstanding work required to quantify specific habitat and area requirements for these species.

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BACKGROUND

Species Assessment Information from COSEWIC

Common Name: Southern maiden-hair fern

Scientific Name: *Adiantum capillus-veneris*

Status: Endangered

Last Examination and Change: May 2000 (no change)

Canadian Occurrence: British Columbia

Reason for Designation: A fern known only from a single spring in southeastern British Columbia where it is threatened by recreational activities and development.

Status History: Designated Endangered in April 1984. Status re-examined and confirmed in April 1998 and in May 2000. Last assessment based on an existing status report.

Description of the Species

The southern maiden-hair fern is a member of the *Adiantaceae* family. It is a delicate, drooping, pale-green fern of wet, calcareous, rocky sites with short (15–30 cm) fronds on a black stipe (leaf stalk) and rachis (main stalk); the few pinnae (leaflets) are divided into widely separated, fan-shaped pinnules (secondary leaflet) with crescent-shaped indusia (covering over the sporangia) at regular intervals along pinnule margins (Figure 1). The rhizome (underground stem) is short and creeping with slender, brown scales.

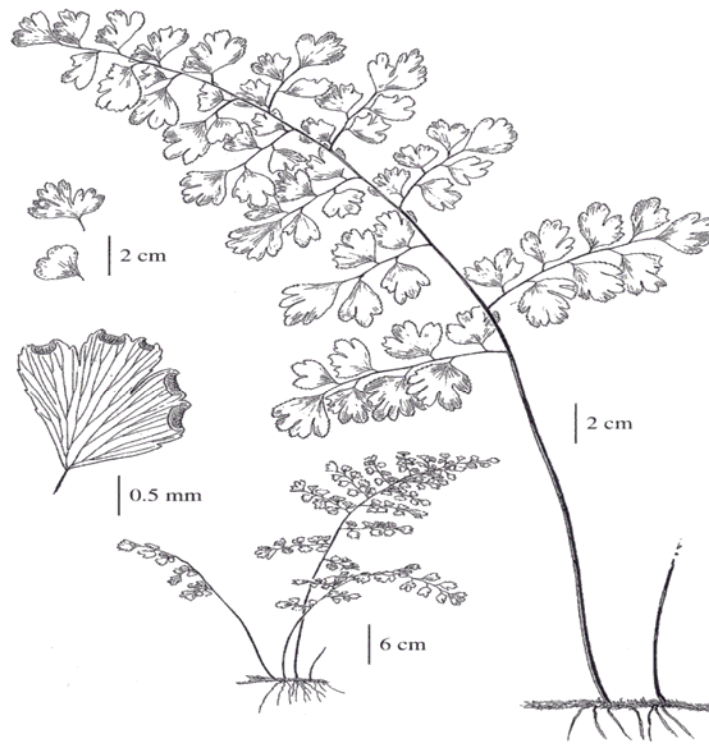


Figure 1. Line-drawing of southern maiden-hair fern (*Adiantum capillus-veneris*) showing fern frond with rhizome on the right, and leaflet detail in the upper left (Douglas *et al.* 2002).

Populations and Distribution

Globally, the southern maiden-hair fern is widely distributed in warm regions, including the southern United States, Mexico, South America, South Africa, Australia, and parts of Eurasia.

Southern maiden-hair fern is common across the southern United States (Figure 2; Lellinger 1985). Disjunct populations are found north to British Columbia and South Dakota (Paris 1993). The species is ranked as secure both globally (G5) and in the United States (N5) by NatureServe (2007). Its status is not ranked in 15 states where it occurs, and is ranked as apparently secure, vulnerable, or imperiled in seven states. It is critically imperiled (S1) in South Dakota, and presumed extirpated from Virginia. It is ranked as critically imperiled within Canada (N1) and British Columbia (S1), where it is also on the B.C. Conservation Data Centre's "Red list." In most of its range, southern maiden-hair fern occurs on shaded, moist rocky sites on porous, calcareous rock, including tufa, masonry, and other soft limy rocks (Wherry 1978).

At Fairmont Hot Springs where the one extant population (with two extant subpopulations) occurs, southern maiden-hair fern has never been observed more than 10–40 cm from hot, running, mineral rich water. The original subpopulation at the bathhouse occurs on a low tufa wall (1.8 m high) in a sheltered trench. This trench was excavated in about 1911 to permit construction of a stone bathhouse, which is still informally used. Nearby, hot springs water creates a continuously very warm, very humid microclimate. Southern maiden-hair fern grows

here with a few other vascular plant species. Two larger, more vigorous subpopulations, which were discovered in 2000 and 2001, grow alongside pools. The fourth subpopulation occurs below a seepage bank.

In 2002, an extensive survey of rare plants at the Fairmont Hot Springs property resulted in the confirmation of four subpopulations of southern maiden-hair fern (Table 1). The original subpopulation at the bathhouse (Site A in Table 1) had declined to two fronds. Of the newly found subpopulations, the upper slope subpopulation (Site B) had 36–50 fronds located on a small bank above a hot springs pool. The midslope subpopulation (Site F) had only two healthy fronds, among dried plants, at a mostly dry hot springs seepage site. The latter site seemed to have dried up considerably since October 2001, when over 500 fronds were found at the site (T. Antifeau, pers. comm., 2005). The lower slope subpopulation (Site H) had about 33,600 fronds on a narrow bench with significant tufa buildup in a flat hot springs seepage area (Figure 3).

The number of fronds at these four subpopulations totals approximately 33 700. Monitoring of fronds at Site A indicates that the frond size has declined markedly and the plants appear to be suffering from reduced hot water flow and increased competition from other herbaceous species (Brunton 1984). It is believed that the decreased flow changed the microclimate around the colony, resulting in a lower carrying capacity for the site as well as a decline in the reproductive ability of the fern. As the other three subpopulations have just recently been discovered, little is known about their history.

The bathhouse (Site A) and midslope (Site F) subpopulations of southern maiden-hair fern at Fairmont Hot Springs are small and were declining; as of 2005, they were extirpated. Hydrological studies are required to determine whether the current hot spring water supplying these sites has been affected in any way. The two other remaining southern maiden-hair fern subpopulation localities (Sites B and H), apparently have sufficient natural hot water flow at adequate temperatures to allow persistence of the subpopulations.

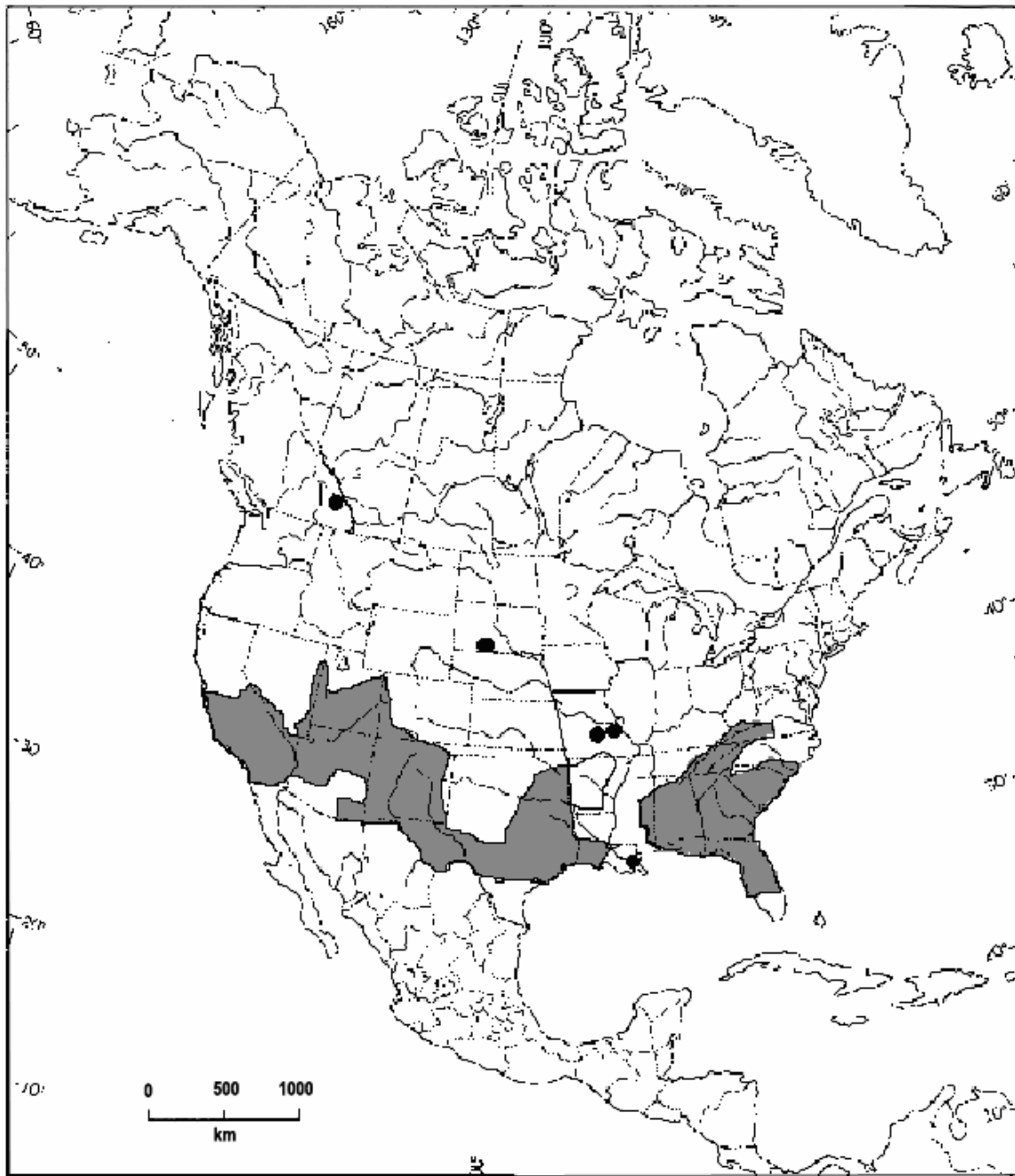


Figure 2. Distribution of southern maiden-hair fern in North America (Paris 1993).

Table 1. Subpopulation data for southern maiden-hair fern in Canada

Subpopulations at Fairmont Hotsprings	Year	Subpopulation data/comments	Reference
Several sites	1888	Abundant	St. Maur 1890
Several sites	Up to 1940	Abundant	Various
No sites	1960s	Presumed extirpated	Brunton 1984
Single colony (Site A)	1974	Small colony; occupied 3 m ² , was producing spores	J.D. Lafontaine in Brunton 1984
Single colony (Site A)	1982	68 stunted vegetative fronds over 0.4 m ²	Brunton 1984
Single colony (Site A)	1996	16 sterile fronds on 4 plants	G. Douglas, pers. obs., 1996
Four extant colonies	2000 and 2001	2001: 500 fronds at Site F	Southern maiden-hair fern Recovery Team
Four extant colonies - Site A - Site B - Site F - Site H	2002	A: 2 fronds B: 36–50 fronds/0.5 m ² F: 2 healthy fronds, rest dried (in 2 patches) H: ca. 33,600 fronds/18 m ²	Douglas and Penny 2002
Three extant colonies - Site A - Site B - Site F - Site H	2003	A: 1 frond B: 60 fronds F: 0 fronds (extirpated) H: 30,000+ fronds/18 m ²	Douglas and Smith 2003
Two extant colonies - Site A - Site B - Site F - Site H	2005	0 fronds Extant (few fronds) 0 fronds Extant (few fronds)	Antifeau (pers. comm., 2005)



Figure 3. Southern maiden-hair fern at Site H. (Photo by Larry Halverson).

Needs of the Southern Maiden-hair Fern

Habitat and biological needs

Southern maiden-hair fern requires a restricted habitat — a very humid, continuously warm microclimate on a porous, highly calcareous substrate. In Canada, such habitats are rare (McDonald *et al.* 1981). The only known Canadian southern maiden-hair fern population occurs at Fairmont Hot Springs in British Columbia, more than 1000 km north of its main range. In this northern location, southern maiden-hair fern requires a rock substrate of tufa over which hot water from natural hot springs flows. The other widely disjunctive station in North America is in the Black Hills, South Dakota, and also occurs at a hot spring (Dorn and Dorn 1972). The species requires very humid, warm (year-round) calcareous sites, probably with little competition from other plants, to survive in these disjunct northern locations (Brunton 1984).

The climate is classified as a Koppen climate, type H, Highland climate (Strahler 1969). No data are available on the region's macroclimate. The local hot spring climate at Fairmont Hot Springs is modified by hot springs water having a temperature of 48.9°C (Macdonald *et al.* 1981). This microclimate is warm year-round and humid. Hoshizaki (1970) states that southern maiden-hair fern can withstand winter temperatures to 28°F (−2°C) occasionally, but dies when temperatures decline below 0°F (−18°C). Temperatures at the site stay above −18°C year-round, and probably are considerably warmer than that since little evidence of winter dieback has been noted. Recent water temperatures at the southern maiden-hair fern sites, measured by L. Halverson (pers. comm., 2003), had readings of 29, 31, 38, and 25–30°C at Sites A, B, F, and H, respectively. The

fronds of southern maiden-hair fern at Site A were reported to be smaller in 1982 than in 1977 — perhaps indicating poorer growth because of lower water temperatures (Brunton 1984). McDonald *et al.* (1981) states that the water at Fairmont Hot Springs has a pH of 7.0, and is without the strong hydrogen sulfide odour so evident at other British Columbia and Alberta hot springs.

The Canadian occurrence for this species is within the Continental Range of Rocky Mountain Trench section of the Cordilleran Region (Bostock 1967). These mountains are characterized by linear ranges with huge cliffs and carbonate strata (Bostock 1970). The Fairmont Hot Springs site is on massive tufa deposits over dolomite bedrock at approximately 1000 m above sea level on the western flank of the steep-sided, glaciated mountains. The site was glaciated repeatedly during the Wisconsin era, although the exposed tufa surface was built up after the glaciation. A series of underground hot water springs, rich in calcium carbonate, run through the tufa deposit. The site slopes steeply to the west–southwest. There is no soil development, since the rate of tufa deposition exceeds that of soil formation. The sites are entirely porous calcium-carbonate rock, precipitated from the hot springs water.

The deposition of additional tufa at the Fairmont Hot Springs sites creates further habitat adjacent to the springs but also destroys some areas where southern maiden-hair fern may grow. The species seems capable of colonizing such situations rapidly and may require this change. The continued formation of bare rock face at the hot springs by tufa precipitation from the mineral spring water may allow this rapid colonizer to escape competing vascular plants. The sites are sparsely vegetated, except for older flows, which are covered with a rich diversity of shrubs and herbs. Historically, southern maiden-hair fern was common, but not dominant, within the confines of the Fairmont Hot Springs location. Early reports by Eastham (1949) suggest that it was dominant along hot spring runnels at sites no longer in existence. The survival of southern maiden-hair fern depends totally on a constant flow of hot water from the Fairmont Hot Springs.

Observations indicate that the flow of hot springs water on the property has always been a dynamic phenomenon. Therefore, all tufa-dependent vascular plants can be expected to have dramatic population fluctuations over time. Although southern maiden-hair fern can apparently withstand physical alteration to its growing site, alterations to its humid, continuously warm microclimate could be fatal.

Ecological role

There is no known ecological role.

Limiting factors

Southern maiden-hair fern reproduces from spores as well as vegetatively. Both sterile and fertile fronds have been observed at Fairmont between 1977 and 2002, although there were no fertile fronds in 1982. At that time, Brunton (1984) suggested that there was no outbreeding and that “inbreeding and cloning were unknown.” It is currently unknown what type of propagation is predominant. Vegetative growth has been reported to potentially occur rapidly in the species, covering areas of approximately 2 m² in less than 15 years (Brunton 1986). Overall, when hot

water sources are abundant, southern maiden-hair fern reproduces quickly and abundantly. Without hot mineral water at the Fairmont Hot Springs sites, the species dies out very quickly (Brunton 1984).

The fronds wilt quickly at first frost (Brunton 1984), although southern maiden-hair fern is reported to survive occasional winter temperatures as low as -2°C (Hoshizaki 1970). The fern likely only occurs at Fairmont Hot Springs because of the presence of hot spring water, which ameliorates the local microclimate and creates the tufa substrate. Without the hot water, the fern probably could not survive at this latitude.

Threats

Description of the threats

Three factors have been identified as potential threats to the southern maiden-hair fern population, all related to human activities: (1) habitat loss and degradation through the alteration of hot springs water flow; (2) habitat loss and degradation due to physical development; and (3) collection and trampling. These three factors may contribute to the loss and degradation of the habitat critical to the fern's survival. Other potential threats to the southern maiden-hair fern population at Fairmont Hot Springs are unknown. The effects of disease, pests, and pathogens have not been observed, and hybridization is unknown in the genus *Adiantum* (Hoshizaki 1970).

1. Alteration of hot spring water flow

Maintenance of hot spring water flow is required to ensure survival of the population of southern maiden-hair fern, as the resulting microclimate is what allows the species to survive so far north of its usual range. Any mechanical development (e.g., enlargement of trenches, water ways, diversion of natural spring waters, or further development of the resort) conducted without careful planning and measures to avoid disrupting the hot spring hydrology could have negative effects on the southern maiden-hair fern sites at Fairmont Hot Springs.

The president of Fairmont Hot Springs Resort indicates that the current enclosed piping of the natural spring water to present-day recreational pools has been in place since the 1960s, but this piping is far from and of no obvious threat to the known southern maiden-hair fern population. Hydrological studies may be required to understand and maintain underground hot water flow to prevent alteration of water flow to the southern maiden-hair fern population.

2. Physical development

Individual plants and habitat could be damaged by construction activities or expansion of resort facilities including buildings or bathing pools. With knowledge of southern maiden-hair fern sites, any maintenance of existing facilities or future expansion of the resort facilities can be planned to include protection of southern maiden-hair fern habitat. The owners of the property are aware of the fern sites.

3. Collection and trampling or inadvertent site damage

Since the sites are not protected by fencing, there is a danger of trampling from human traffic or collection of the species.

Actions Already Completed or Underway

The property at Fairmont Hot Springs is privately owned. The management and stewardship responsibility of the property rests with the owners. At present, no formal conservation plans are in place in relation to southern maiden-hair fern habitat. Discussion on stewardship agreements with the property owners is underway, and the owners have assisted the recovery team in exploring other sites and conducting fieldwork on the existing sites.

To date, there have been no formal recovery efforts taken. However, the landowners have been contacted and alerted to the presence and importance of the species and sites. They have been cooperative and receptive to suggestions toward protecting the sites.

The Southern Maiden-hair Fern Recovery Team has been established to carry out the actions recommended in this recovery strategy.

Knowledge Gaps

To accurately identify recovery objectives and activities, the following areas should be investigated:

- additional inventory for other populations of southern maiden-hair fern, or potential suitable habitat;
- research on reproduction requirements, and longevity, and habitat attributes such as water temperature, substrate type and pH, humidity, etc.;
- research on species biology, including demography, population trend, and genetics;
- research on ground water flow and geothermal characteristics of the habitat; and
- research on translocation methodology.

RECOVERY

Recovery Feasibility

Recovery of southern maiden-hair fern is considered technically and biologically feasible. Being an early succession species in the hot springs habitat, southern maiden-hair fern can reproduce quickly, and individuals capable of reproduction are available. With the current habitats available, this species is not likely to increase in population number or size; however, the available habitats where thermal spring water flows are adequate to support the species. If recovery actions, to be fully developed in cooperation with the landowners, are successful, the threats outlined can be mitigated. A high recovery priority needs to be given to this species. It could easily be extirpated unless mitigative and protective measures are initiated. If the sites and thermal spring flows remain undisturbed, subpopulations should remain stable. The primary recovery techniques relate to threat reduction, and are known to be effective: maintenance of habitat and associated conditions, and preventing damage to individual plants.

Recovery Goal

The goal for southern maiden-hair fern is to maintain a viable and self-sustaining population distributed throughout the known subpopulations to reduce the risk of extirpation from British Columbia.

Recovery Objectives

The objectives to be done in conjunction with the landowners, are to (refer to Table 1 in previous section for sites):

The objectives for the recovery are to:

- 1) Maintain a viable subpopulation at two extant sites at Site H and at Site B;
- 2) To enhance the subpopulation at Site B to increase subpopulation sizes; and to
- 3) Investigate feasibility of re-establishing subpopulations at sites A and F, and conduct re-introduction trials. If re-establishment is determined to be feasible, initiate transplantation trials at Sites A and F.

Approaches Recommended to Meet Recovery Objectives

Four primary strategies are suggested to ensure that the recovery objectives are met and threats are addressed.

Table 2 summarizes the threats, broad strategies, and recommended approaches for the objectives. The following are the four main broad strategies:

Habitat protection and stewardship

All subpopulation localities where southern maiden-hair fern occurs or recently occurred could be included as potential components of landowner stewardship agreements. The establishment of stewardship agreements and information exchange with the property owners are necessary to the success of any recovery actions, and require the cooperation of the landowners. The recovery team should be available to offer advice to the landowners to help them make informed decisions.

The recovery team, in conjunction with the landowners, needs to assess the desirability and the methods of providing physical protection for the plant subpopulations. This could include such actions as installing fencing, or other barriers to prevent access to the sites or the development of interpretive trails at some of the sites.

Communication and outreach

The recovery team, in conjunction with the landowners, will assess the desirability of establishing signage and interpretative trails, as well as the need for educational material on the species for the general public. As well, an interpretive centre or display at the resort's commercial pools should be considered, in conjunction with the landowners.

Population and water monitoring

Regular monitoring will help determine survival and growth of individuals in all known subpopulation localities. The subpopulation parameters should be monitored at all sites at Fairmont Hot Springs. The health of all subpopulations should also be determined and monitored; this includes the effects of disease, pests, and pathogens; competition by other vascular plants; and alterations in the flow of hot spring water due to natural and artificial causes. Water characteristics should be monitored regularly.

Restoration

The recovery team will consider the feasibility and requirement for transplantation of southern maiden-hair fern at existing sites if subpopulations are no longer viable. If required, the recovery team will determine where suitable habitat is available that can be protected through stewardship agreements or other mechanisms.

An *ex situ* program for southern maiden-hair fern may be considered, including the preservation of genetic stock.

Recovery planning table

Table 2. Recovery planning table

Priority	Threats addressed	Broad strategy to address threat	Recommended approaches to meet recovery objectives
Objective 1: To maintain a viable subpopulation of southern maiden-hair fern at two extant Sites H and B.			
Objective 2: To enhance the subpopulations at Site B to increase subpopulation sizes.			
Necessary	Alteration of hot spring water flow; physical development	Habitat protection / stewardship	<ul style="list-style-type: none"> • Complete studies required to characterize and identify critical habitat. • Initiate landowner stewardship agreements for the protection of existing populations and habitats and management of water flow. • Provide landowners with information on the process and financial benefits of the Eco Gifting program and conservation covenants.
Necessary	Collection and trampling	Communication and outreach	<ul style="list-style-type: none"> • In collaboration with landowners, assess desirability (benefits and risks) of establishing signage/interpretive trails. • In collaboration with landowners, assess necessity of erecting fencing or other physical barrier to prevent access to sites.
Beneficial	Habitat loss and degradation (all)	Population and water monitoring	<ul style="list-style-type: none"> • Implement a program to establish baseline information and monitor. • Changes in size, density, and distribution of all extant populations. • Reproduction, survival, and growth. • Population health including the effects of disease, pests, pathogens, competition, and flow of hot spring water. • Water characteristics including temperature, chemistry, flow, etc.
Objective 3: To investigate feasibility of re-establishing subpopulations at sites A and F, and conduct re-introduction trials. If re-establishment is determined to be feasible, initiate transplantation trials at Site A and F.			
Beneficial	Habitat loss and degradation	Restoration	<ul style="list-style-type: none"> • Consider the feasibility and requirement for transplantation at existing sites if populations are no longer viable. • If required, ensure suitable habitat is available and can be protected through stewardship agreements or other means. • Consider the necessity, costs, and benefits of <i>ex situ</i> conservation of the species, including preservation of genetic stock and use of an interpretive centre.

Performance Measures

Performance measures should include:

- Increases in subpopulation size, number, or subpopulation trend at Site H and Site B.
- Enhancement of subpopulation at Site B is determined to be feasible, and population enhancement is initiated.
- Re-establishment of subpopulations at Site A and F is determined to be feasible, and re-introduction trials are initiated.

Critical Habitat

Identification of the species' critical habitat

The *Species at Risk Act* defines critical habitat as “the habitat that is necessary for the survival or recovery of southern maiden-hair fern” (Environment Canada *et al.* 2004).

No critical habitat can be identified for southern maiden-hair fern in Canada at this time, due to a lack of information. It is expected that critical habitat will be identified following completion of outstanding work required to quantify specific habitat and area requirements for the species, as outlined in the schedule of studies below. In addition, there is a need for consultation and development of stewardship options with affected landowners.

Recommended schedule of studies to identify critical habitat

The following outlines the additional research required to identify critical habitat for this species:

1. Identify habitat attributes (e.g., soil texture, soil and water chemical properties, plant cover, water temperature) and population parameters (e.g., growth, reproduction, and survival rates). Suggested completion by 2010.
2. For each occupied habitat, determine ground water flow and geothermal characteristics of the habitat and effects of any hydrological changes. Suggested completion by 2010.
3. Using established survey and mapping techniques (applied during phenologically appropriate periods), establish the distribution and delimit the boundaries of all occupied habitats. Suggested completion by 2010.
4. Identify anticipated threats to habitat areas and recommend general or specific measures that can be employed to protect them from such threats. Suggested completion by 2010.
5. Through experimental trials, test the suitability of high-ranking sites for plant translocations/reintroductions. Suggested completion by 2010.

Existing and Recommended Approaches to Habitat Protection

The species is found at one location on private land with two known subpopulations. As such, a stewardship approach will continue to be taken when working with the landowners to protect this species. To date, the landowners have been cooperative.

Stewardship approach

For successful implementation of species at risk protection, there will be a strong need to engage in stewardship on a variety of land tenures, and in particular on private land. Stewardship involves the voluntary cooperation of landowners to protect species at risk and the ecosystems they rely on. The preamble to the federal *Species at Risk Act* (SARA) recognizes that “stewardship activities contributing to the conservation of wildlife species and their habitat

should be supported” and that “all Canadians have a role to play in the conservation of wildlife in this country, including the prevention of wildlife species from becoming extirpated or extinct.” The *Canada – British Columbia Agreement on Species at Risk* also recognizes that: “stewardship by land and water owners and users is fundamental to preventing species from becoming at risk and in protecting and recovering species that are at risk” and that “cooperative, voluntary measures are the first approach to securing the protection and recovery of species at risk.”

Stewardship approach for private lands

Since many species at risk occur only or predominantly on private lands, stewardship efforts will be the key to their conservation and recovery. To successfully protect many species at risk in British Columbia, there will have to be voluntary initiatives by landowners to help maintain areas of natural ecosystems that support these species of risk. Examples of this stewardship approach include following guidelines or best management practices to support species at risk; voluntarily protecting important areas of habitat on private property; establishing conservation covenants on property titles; eco-gifting of private property, in whole or in part; and selling private property to protect certain ecosystems or species at risk. For example, both government and non-governmental organizations have successfully partnered with private landowners to conserve private lands in B.C.

Effects on Other Species

Many plant species are associated with southern maiden-hair fern on the Fairmont Hot Springs property. Any efforts to conserve southern maiden-hair fern are believed to be positive for maintenance of these species over the long term.

Common associated plant species include *Juniperus horizontalis* (creeping juniper), *Epipactis gigantea* (giant helleborine), *Dichanthelium acuminatum* var. *fasiculatus* (western witch grass), *Carex scirpoidea* (single-spike sedge), *Muhlenbergia glomerata* (marsh muhly), *Arctostaphylos uva-ursi* (kinnikinnick), *Aster laevis* (smooth aster), *Toxicodendron rydbergii* (poison ivy), and *Rosa acicularis* (prickly rose).

Of the eight rare vascular plant taxa inventoried on the Fairmont Hot Springs Resort property in 2002; seven are considered Red or Blue-listed in British Columbia (Table 3). This is the only site known in the province for southern maiden-hair fern, *Muhlenbergia andina* (foxtail muhly), and *Scirpus pallidus* (pale bulrush). The remaining taxa are not restricted to this area of the province. Giant helleborine, which occurs at six of the eight rare plant sites at the Fairmont Hot Springs Resort (see Table 1), has been listed as *Special Concern* by COSEWIC (Brunton 1984; White and Douglas 1998b), and is on Schedule 3 of the federal *Species at Risk Act*. All rare plant sites at the Fairmont Hot Springs location are influenced by the hot springs and occur on moist to dry tufa formations.

Table 3. Provincial and national status of eight rare plants inventoried at Fairmont Hot Springs Resort in 2002 (BC Conservation Data Centre Species and Ecosystem Explorer 2007)

Plant	B.C. status	National rank/status
Southern maiden-hair fern (<i>Adiantum capillus-venerus</i>)	Red	Endangered (SARA)
Enander's sedge (<i>Carex lenticularis</i> var. <i>dolia</i>)	Blue	N2N3 (imperiled- vulnerable to extirpation or extinction)
Beaked spike-rush (<i>Eleocharis rostellata</i>)	Blue	N3 (vulnerable to extirpation or extinction)
Giant helleborine (<i>Epipactis gigantea</i>)	Blue	Special Concern (SARA)
Foxtail muhly (<i>Muhlenbergia andina</i>)	Red	N1 (critically imperiled)
Marshy muhly (<i>Muhlenbergia glomerata</i>)	Blue	N5 (widespread, abundant, and secure)
Little bluestem (<i>Schizachyrium scoparium</i>)	Red	N4N5 (apparently secure to widespread, abundant)
Pale bulrush (<i>Scirpus pallidus</i>)	Red	NNR (not ranked nationally)

In addition to rare vascular plants, there is at least one other rare element at Fairmont Hot Springs. The Vivid Dancer dragonfly (*Argia vivida*), Red-listed by the B.C. Conservation Data Centre, is known from the site. The hot springs have not been intensively searched for other invertebrates, thus it is possible that other rare insects or molluscs are present.

Socioeconomic Considerations

Recovery actions could potentially affect the following socio-economic sectors: land development and recreational users. The expected magnitude of these effects is unknown and will be further addressed in the recovery action plan.

Recommended Approach for Recovery Implementation

Southern maiden-hair fern currently is found only at one location in Canada. The approach for recovery is a single-species strategy. There is potential to work with the East Kootenay Conservation Program (EKCP). The EKCP is a collection of 41 groups and agencies in the East Kootenay that develop and implement a strategy to promote habitat and ecosystem management for private land that complements management of Crown land in the region.

Statement on Action Plans

In consultation with the landowners, an action plan will be developed for southern maiden-hair fern by the year 2010.

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