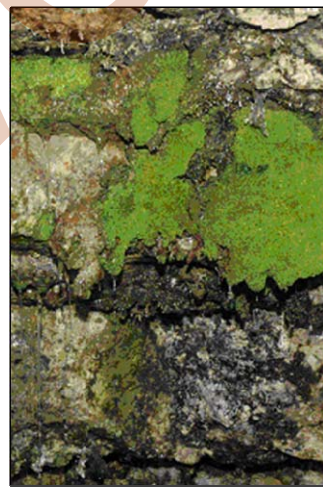


Alberta Porsild's Bryum Recovery Plan 2011-2016



Alberta Species at Risk Recovery Plan No. 19

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PREFACE

Albertans are fortunate to share their province with a diverse variety of wild species. Populations of most species of plants and animals are healthy and secure. However, a small number of species are either naturally rare or are now imperiled because of human activities. Recovery plans establish a basis for cooperation among government, industry, conservation groups, landowners and other stakeholders to ensure these species and populations are restored or maintained for future generations.

Alberta's commitment to the *Accord for the Protection of Species at Risk* and to the *National Framework for the Conservation of Species at Risk*, combined with requirements established under Alberta's *Wildlife Act* and the federal *Species at Risk Act*, has resulted in the development of a provincial recovery program. The overall goal of the recovery program is to restore species identified as *Threatened* or *Endangered* to viable, naturally self-sustaining populations within Alberta. The policy document: *Alberta's Strategy for the Management of Species at Risk (2009-2014)* provides broader program context for recovery activities.

Alberta species at risk recovery plans are prepared under the supervision of the Fish and Wildlife Division, Alberta Sustainable Resource Development. This often includes involvement of a recovery team composed of a variety of stakeholders including conservation organizations, industry, landowners, resource users, universities, government agencies and others. Membership is by invitation from the Director of Wildlife Management, and may include representation from the diversity of interests unique to each species and circumstance. Conservation and management of these species continues during preparation of the recovery plan.

The Director of Wildlife Management provides these plans as advice to the Minister responsible for fish and wildlife management. Alberta's Endangered Species Conservation Committee also reviews draft recovery plans, and provides recommendations to the Minister. Additional opportunities for review by the public may also be provided. Plans accepted and approved for implementation by the Minister are published as a government recovery plan. Approved plans are a summary of the Department's commitment to work with involved stakeholders to coordinate and implement conservation actions necessary to restore or maintain these species.

Recovery plans include three main sections: background information that highlights the species' biology, population trends, and threats; a recovery section that outlines goals, objectives, and strategies to address the threats; and an action plan that profiles priority actions required to maintain or restore the *Threatened* or *Endangered* species. Each approved recovery plan undergoes regular review, and progress of implementation is evaluated. Implementation of each recovery plan is subject to the availability of resources, from within and from outside government.

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EXECUTIVE SUMMARY

Porsild's bryum (*Bryum porsildii* (I. Hagen) Cox & Hedderson)) is a disjunct moss where it is known from British Columbia, Alberta, Newfoundland, and Nunavut. In Alberta, 12 small subpopulations occur in the Rockies from Kananaskis to Willmore Wilderness Park. The nearest population to the Alberta localities are in northern British Columbia and Montana. The species was assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2003 as a *Threatened* species, and also listed as this status under the Newfoundland and Labrador Endangered Species Act in 2005. In Alberta the species was assessed as Endangered based on small population size and declining habitat quality.

Porsild's bryum can be recognized by its brilliant green cushions growing over wet calcareous rock on shaded cliffs. Its growth is limited by slow regeneration and poor dispersal ability, and has narrow habitat (substrate and microsite) requirements, making it vulnerable to habitat alteration. Further surveys and habitat studies are required to better understand habitat requirements and mitigate for potential risks to subpopulations. Although there are no direct threats specified for this moss in Alberta, some subpopulations may be impacted by vehicular road dust related to mining activity, and five other subpopulations may be impacted by recreational activity.

The recovery goal for Porsild's bryum is to ensure long-term persistence of the natural populations in its Alberta range. Recovery strategies are supported by specific actions, including:

1. **Population conservation and management:** Survey habitat in the vicinity of known subpopulations to fine-tune range and develop and implement a monitoring protocol.
2. **Habitat management:** Identify essential habitat, and conduct site risk assessments and detailed habitat studies.
3. **Research:** Improve understanding of habitat requirements and relationship to substrate and water quality, and determine potential effects of dust and vehicular exhaust on Porsild's bryum.
4. **Information and outreach:** Create signs, displays and facts sheets to inform the public, communicate to stakeholders and promote the recovery plan.
5. **Resource acquisition:** Secure funding to support recovery actions.
6. **Plan management:** Review recovery actions on an annual basis, ensure data storage and coordinate other relevant research and recovery efforts.

The duration of the recovery plan is five years, at which time recovery efforts will be reviewed.

1.0 INTRODUCTION

1.1 Provincial and Federal Status

In November 2007, the Minister of Sustainable Resource Development approved the listing of the Porsild's bryum (*Bryum porsildii* (I. Hagen) Cox & Hedderson)) as *Endangered* in Alberta on the recommendation of the Alberta Endangered Species Conservation Committee (ESCC). This designation was based primarily on its small area of occupancy at isolated sites (fragmented populations), and continuing decline in habitat quality. The species shows wide geographical separation from other occurrences in Canada and the U.S. Recommendations from the ESCC, and approved by the Minister, specified that a recovery plan should be developed in order to set goals, objectives, strategies and management actions necessary to guide the management of this species during the next five years.

In November 2003, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated Porsild's bryum as *Threatened* nationally, based on small population size, severe fragmentation, and a decline in habitat quality. The species is not yet protected under the *Species at Risk Act* (SARA).

1.2 Recovery Team

The Alberta Porsild's Bryum Team (hereafter referred to as the Team) was initiated by the Director of Wildlife Management, who provides operational guidance on Species at Risk initiatives on behalf of the Minister. Led by a species lead from the Alberta Fish and Wildlife Division (FWD), the primary responsibility of the Team is to provide recommendations for recovery of Porsild's bryum, by outlining recovery strategies and actions in the Alberta Porsild's Bryum Recovery Plan (hereafter referred to as the Plan). The Alberta Fish and Wildlife Division oversees implementation of the Plan by facilitating and encouraging involvement of appropriate and interested parties, including members of the Team. The team lead is responsible for updating the Plan and evaluating and reporting on the progress of recovery actions.

The Plan is a dynamic document. The initial life span of the Plan is five years, during which the Team will meet at least annually to review and update it as required. During the fifth year of the Plan, the team lead will review its content to determine whether or not the goal and objectives are being achieved, and what revisions and updates are needed. This decision may be influenced by accomplishments over the previous five years, new data, new information on the species status, and any need for amendments to actions. The team lead may reconvene the team for assistance in this exercise if warranted.

The Team is a small group that represents relevant interests within Alberta. The Team consists of members from the following organizations: Alberta Sustainable Resource Development (Fish and Wildlife Division), Alberta Tourism, Parks and Recreation (Parks Division), University of Alberta (Department of Renewable Resources/Devonian Botanical Garden), and Teck Coal Limited (Cardinal River Operations).

2.0 SPECIES BIOLOGY

Porsild's bryum is a moss (Bryophyta, Musci), belonging to the family Bryaceae, a group that, worldwide, may encompass 1000 species. In Alberta, the genus *Bryum* consists of approximately 25 species that are distinguished by their short tufted growth form, a well developed double row of peristome teeth, and a mainly pendant spore capsule (sporangium). The leaves have short to long rectangular basal cells and median cells that are rhomboidal or hexagonal in shape, and a single midrib that often extends as an apiculus (a small slender point). A differentiated leaf margin is characteristic, as is a red seta (the stalk supporting the sporangia).

Porsild's bryum can be recognized by its brilliant green cushions growing over wet calcareous rock on shaded cliffs. The bright green cushions are punctuated by a sparkly aspect not seen in other species (Figure 1). Close inspection reveals small, erect plants (0.3-1 cm tall) with stems and branches that are green in their upper portion, but becoming red-brown with age in the lower portion of the stems. The leaves are wide spreading to recurved (bent back) and ovate with a short leaf tip (apiculus). When sporangia are present, they are ovoid and produced on a short (4-11 mm) seta that raises the sporangia just beyond the leaves (Figure 2). While most species of the genus have two rows of peristome teeth, Porsild's bryum has only one row; the second is believed to have been reduced through the course of evolution.

Dry plants of Porsild's bryum appear very different than wet or moist ones. When dry, the leaves are contorted or shriveled and are darker green than when wet.



Figure 1 . *Bryum porsildii* (bright green cushions, growing on calcareous rock overhang. Note the seepage and 'sparkly' aspect of the moss (Willmore Wilderness Park, photo ©René J. Belland 2005).

2.1 Reproduction

Porsild's bryum is a moss belonging to the plant group Bryophyta (the bryophytes). They are characterized by a distinctive alternation of generation life cycle in which the gametophytic (gamete producing) generation is dominant with a parasitic sporophytic (spore producing) generation. Spores produced by a sporophyte are essential for dispersal and subsequent colonization of moss species to found new colonies. Fertilization of an egg enclosed in a specialized archegonia is required to produce a sporophyte, and occurs when sperm are released from antheridia to the environs outside the plant. Sperm fertilization can only occur in the presence of water as the sperms swim in a film of water to reach the archegonia. Moreover, the maximum distance that motile sperm can swim is estimated to be about 10 cm (Longton 1976). Dioecous species like Porsild's bryum, where the sperm and egg are produced on different plants are less likely to produce sporophytes than species in which the sperm and egg are produced on the same plant (monoecious).



Figure 2. Close-up of *Bryum porsildii*, showing sporangia emergent from the leaves. (Whitehorse Creek campground, photo ©René J. Belland 2008.)

Notwithstanding the difficulties inherent in producing sporophytes, the Alberta population of Porsild's bryum nonetheless frequently produces sporophytes. Cleavitt (2000a) reports that about 11% of the 50 colonies censused at three sites had sporophytes, and ASRD & ACA (2006) reported sporophytes at seven of the 12 extant Alberta subpopulations.

2.2 Distribution

Porsild's bryum belongs to a suite of moss species that show wide gaps in their North American distribution. In Canada, the species occurs at isolated locations in Alberta, British Columbia,

Ellesmere Island, and Newfoundland. Elsewhere in North America, Porsild's bryum occurs in Michigan (Keweenaw Peninsula), Montana, Colorado, and Alaska. The distribution pattern (Figure 3) is believed to reflect ice extent during the last glaciation, such that species may have survived the last glaciation in unglaciated enclaves in both eastern and western North America (Belland 1987).

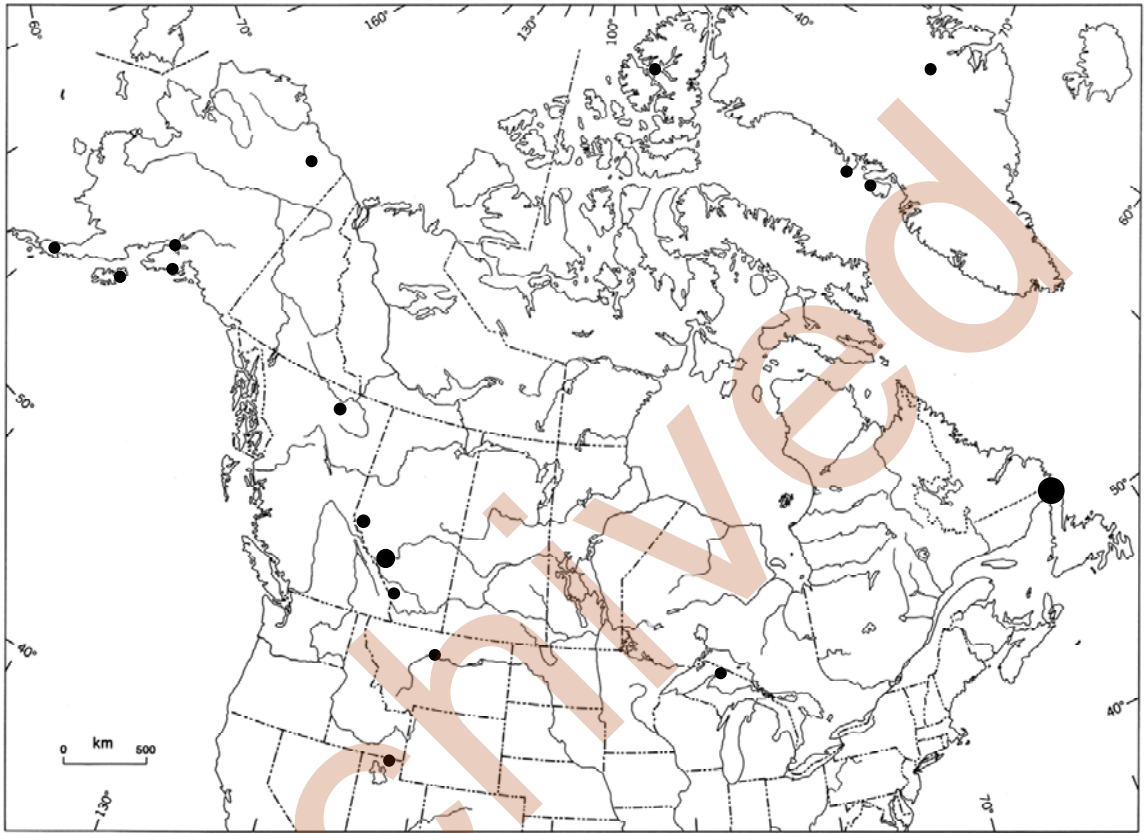


Figure 3. The North American distribution of Porsild's bryum (*Bryum porsildii* (I. Hagen) Cox & Hedderson) The Newfoundland dot covers 6 sites. Adapted from the map in COSEWIC (2003).

In Alberta, the species occurs in the Rocky Mountains in three general areas: Kananaskis Country (Bow Valley Wildland Park and Evan-Thomas Provincial Recreation Area), the Mountain Park and Whitehorse Creek area (including Whitehorse Wildland Park and Whitehorse Creek Provincial Recreation Area) near Cadomin, and Willmore Wilderness Park (Figure 3). In addition to these, the species is known to have occurred in Jasper National Park, in the vicinity of the Snake Indian River. This latter locality was discovered in 1828 by Thomas Drummond but has not been relocated since, despite intensive searches by R.J. Belland and P. Achuff.

2.3 Population Size and Trend

Twelve subpopulations of Porsild's bryum are known from Alberta. ASRD & ACA (2006) documented 10 subpopulations: one in Kananaskis Country and nine at the town of Mountain Park/Whitehorse Creek area (see Appendix 2 in ASRD & ACA, 2006). Two additional subpopulations were found in Willmore Wilderness by R.J. Belland and J. Gould during surveys for the species in 2005: Casket Creek and unnamed creek in a range west of Persimmon Range (hereafter called the "Persimmon" subpopulation).

The Alberta population is the largest known in Canada. There are no data available to establish long term habitat or population trends for the species in Alberta. However, while many of the subpopulations are relatively recently discovered (the majority since 1994), some subpopulations have persisted since their discovery. Such examples include the Whitehorse Creek campground subpopulation (discovered 1966), the Cadomin subpopulation (discovered 1984) and the Ribbon Creek (Kananaskis Country) subpopulation (discovered 1982).

ASRD & ACA (2006) documented population sizes for the Alberta ESCC status report, and compared them to those reported in COSEWIC (2003). ASRD & ACA (2006) noted discrepancies in the size and numbers of colonies at some of the Whitehorse Creek subpopulations, which seemed to show a decrease between 2002 and 2004. However, ASRD & ACA (2006) noted that the difference could be attributed to variations in measurement technique, or that the subpopulation identifiers were inadvertently reversed. In any case, ASRD & ACA (2006) noted that subpopulation sizes could still be compared, and that the 2004 population showed a decrease relative to 2002. The decrease was attributed to drought in the Whitehorse Creek area between 2000 and 2002 (COSEWIC 2003).

Some information is available showing short term population trends that may be attributed to disturbance by drought and ice scouring. Studies by Cleavitt (2002a, b) show the species to be resilient to short-term drought, for instance winter drought. Nevertheless, decrease in sizes of some subpopulations at Whitehorse Creek between 2000 and 2002 were attributed to drought that persisted in the area through to 2004 (ASRD & ACA, 2006).

2.4 Biological Limiting Factors

The following descriptions of the limiting factors of Porsild's bryum are excerpted from the recovery strategy for the species in Newfoundland (Belland and Limestone Barrens Species at Risk Recovery Team 2006).

At least four intrinsic factors of the biology and ecology of Porsild's bryum limit the species (COSEWIC 2003). They include low/slow regeneration, limited dispersal ability, and narrow substrate requirement. These are detailed further below. In addition, while not explicitly listed as a factor by COSEWIC (2003), the narrow habitat specificity of the species is also important. Details of the autecology of Porsild's bryum can be found in Cleavitt (2001, 2002a, 2002b).

Regeneration. Regeneration requires specific conditions that are not well understood. In regeneration experiments, Cleavitt (2002a) found that although the species produced sporophytes (spore producing structures) commonly in most populations, experimental germination of spores

was usually very low: 56% on agar under controlled conditions and 0% on natural substrates in natural situations. Asexual reproduction by fragments was more successful under field conditions (25% regeneration) but much less so in the laboratory (8%). Common production of spores does not guarantee successful reproduction.

Dispersal ability. Although COSEWIC (2003) cites limited dispersal ability of the species as a limiting factor, the evidence for this is indirect and based on the higher viability of fragments stored in air rather than in water. The argument is that since the species is always associated with streams or seepage (i.e., running water), then its most likely mode of dispersal would be via water. Since fragment viability in water is low, it is surmised that dispersal ability must also be low.

Narrow substrate requirements. Porsild's bryum was previously considered to belong to a group of mosses collectively known as "copper mosses", characterized by their association with soils/rock that show higher than normal heavy metal concentration. Indeed, Shacklette (1967) documented one Alaskan population of Porsild's bryum growing on basalt, a rock that typically has higher than average heavy metal concentrations. Published details of the species substrate requirement show, however, that Porsild's bryum occurs mainly on calcareous substrates although the species can occur on a wide diversity of rock types, including limestone, sandstone, basalt and shale (Brassard & Hedderson 1983; COSEWIC 2003). Moreover, Cleavitt (2001) has demonstrated that the species may be a true "calciphile", indicating that it has a physiological intolerance to acidic rock types.

Narrow microsite requirement. The species also has restricted microsite requirements. In all sites where it is found, the species occurs in microsites that are kept damp or wet from either seepage or splash (Brassard & Hedderson 1983). Cleavitt (2002a) notes also that, at her study sites, the microsites become dry with the onset of winter freezing, an observation noted earlier by Flowers (1973) for populations in Utah. This suggests that the species may be physiologically adapted to, and even require, a period of winter desiccation.

3.0 THREATS

COSEWIC (2003) lists two main threats to Porsild's bryum in the Cadomin area of Alberta: 1) changes in upstream hydrology, through siltation of streams from excessive off-road vehicle use in headwaters, and 2) impact from road development for the Cheviot mine on the subpopulation called 'Mac1', which, at the time of the report, was the largest contiguous population of the species in Canada. ASRD & ACA (2006) note that the concerns expressed in the early report (COSEWIC 2003) regarding the impact of road development eliminating *Bryum porsildii* sites did not materialize. However, ASRD & ACA (2006) state that heavy haul road traffic occurs less than 100 m from four subpopulations, and that while the effects of road dust and exhaust are unknown, it is well documented that bryophytes are sensitive to pollution (Rao 1982).

ASRD & ACA (2006) list an additional threat, recreational traffic, as a threat to the Kananaskis Country subpopulation (Ribbon Creek) and to some of the Whitehorse Creek subpopulations. The effects of human activities are particularly noteworthy at the Ribbon Creek waterfall, a visitor attraction along a popular trail. Human activities in the area of the falls have denuded the cliff face of all plants at the base of the rock overhang. At the Whitehorse Creek Provincial Recreation Area and Whitehorse Wildlands Park, trails run close to Porsild's bryum sites and

three of the waterfalls that support the species are destinations for hikers and other recreational enthusiasts. Finally, the most vulnerable subpopulation (Whitehorse campground) grows on a large, overhanging boulder between two campsites within the campground, and frequently serves as a site for shelter or campfires.

4.0 KNOWLEDGE GAPS AND INFORMATION NEEDS

Having studies completed in several research areas would increase our understanding of Porsild's bryum's biology, especially in the areas of its distribution, habitat, and substrate ecology. These research foci are relevant to the conservation of the species, and would aid in determining the species' needs as well as predicting potential sites where this species might occur.

4.1 Habitat Requirements

Research is needed to determine the specific habitat requirements of the species. While Porsild's bryum is restricted mainly to shaded microsites that are continually irrigated and near waterfalls in the upper montane and lower subalpine zones, some of the subpopulations occur at lower elevations (e.g., Ribbon Creek), or at microsites not associated with waterfalls and where the colonies are only intermittently irrigated (Whitehorse Creek campground). Full characterization of the species habitat is necessary to help define its essential habitat and to effectively manage the species.

4.2 Substrate Preferences

Both COSEWIC (2003) and ASRD & ACA (2006) emphasize the importance of the substrate type in the biology of the species. Although the species occurs on a wider range of substrate types throughout its world range, it appears that in Alberta, Porsild's bryum is a calciphile (Cleavitt 2001). Furthermore, ASRD & ACA (2006) note that the species may be associated with the presence of heavy metals possibly associated with coal or mineral deposits in a region. Research is needed to more precisely characterize the substrate ecology of Porsild's bryum, by analyzing substrate from all Alberta sites where the species is known, and also associating the species with local geology. This research would help determine whether substrate, and particularly the presence of heavy metals, is a limiting factor in the species distribution and abundance. The outcome of this research would also direct potential searches for the species in other regions where coal seams are known (e.g., Grande Cache/Willmore Wilderness).

4.3 Hydrology, Water Chemistry and Turbidity

As ASRD & ACA (2006) noted, the dependence of Porsild's bryum on stream or seepage habitats, combined with its inherent sensitivity to microsite conditions, implies that the species may be particularly vulnerable to hydrological changes, and changes in water chemistry and turbidity. Evidence of the former was noted in COSEWIC (2003), which attributed a decrease in size of some Whitehorse creek subpopulations to drought conditions in the area from 2000-2002. Moreover, ASRD & ACA (2006) emphasized the potential deleterious effects of turbidity in the

health of subpopulations located downstream from mining or recreational activities. Research is needed to compare the water chemistry and turbidity among streams downstream from human activity, as well as to further understand the species biology as it relates to water chemistry and turbidity as limiting factors.

4.4 Effects of Dust and Exhaust

At least four subpopulations are found within close proximity (< 100 m) from a busy, recently constructed, coal mining haul road. It is well known that mosses are sensitive to dust and pollution from vehicular exhaust (Rao 1982). Their effects could have serious long term consequences on the health and sizes of nearby subpopulations. Research should be conducted to evaluate the effects of dust and pollution on subpopulations, and investigate methods to mitigate these effects if the overall recovery goal of long-term stability of the population is to be achieved.

5.0 RECENT RECOVERY AND CONSERVATION EFFORTS

Recent recovery and conservation work since the ESCC report by ASRD & ACA (2006) has focused on inventory and targeted searches for potential habitat and new subpopulations. This work was conducted in 2005 by R.J. Belland and J. Gould and in 2007 by R.J. Belland and P. Achuff. The 2005 work was centered in Willmore Wilderness Park and involved identification of potential sites with ground-truthing of the most promising sites, resulting in two additional subpopulations.

Surveys conducted in 2007 by Belland and Achuff centered on Jasper National Park, particularly the front ranges in the Lower Athabasca drainage. One particular goal was searching for the 1828 Drummond site near the junction of the Athabasca and Snake Indian Rivers. In addition, several sites in the Miette Valley (Fiddle River and tributaries) were searched, as well as potential sites in the Snake Indian River and tributaries, and the Snaring River from Highway 16 to its junction with the upper Miette River.

6.0 RECOVERY STRATEGY

6.1 Biological and Technical Feasibility of Recovery

The recovery of Porsild's bryum is considered feasible; currently known threats to this species can be mitigated. Since the habitat of the species has no direct economic value, viable subpopulations can be maintained in balance with surrounding land use activities.

6.2 Guiding Principles

The conservation and management of Porsild's bryum in Alberta will be guided by the following principles:

- The conservation of Porsild's bryum is possible and it is important to maintain this rare species for its intrinsic value.
- The loss of habitat and individuals of Porsild's bryum is undesirable and preventable.
- Lack of information or scientific certainty should not impede implementation of actions believed to be necessary to achieve the goals of this recovery plan.
- The recovery process will be guided by the concept of adaptive management, whereby specific actions are implemented, evaluated, and improved upon on an iterative basis.
- This plan recognizes that humans will continue to engage in activities that contribute to economic growth or recreation in areas where Porsild's bryum occurs. The plan will therefore strive to identify effective and feasible recovery strategies.
- This recovery plan is based on the assumption that all stakeholders within Porsild's bryum range, including all affected branches of government, share responsibility for Porsild's bryum recovery. Commitment and action by all of these parties will be important to achieve Porsild's bryum recovery.
- A cooperative approach with land managers, landowners, industry, the general public and other agencies is essential to the success of this recovery plan. This includes shared stewardship, compatible land use and local commitment to management initiatives.

6.3 Recovery Goal

Our current knowledge of Porsild's bryum suggests that the species has always been rare and has mainly existed as relatively small populations. For this reason, the recovery goal for Porsild's bryum is **to ensure long-term persistence of all current natural populations, and maintain population size, at all sites within its Alberta range.**

6.4 Recovery Objectives

The specific objectives that will lead to the long-term conservation of Porsild's bryum in Alberta are as follows:

1. Ensure the continued existence of required habitat by implementing measures that safeguard known sites through the prevention, elimination, or mitigation of human activities that might significantly impact habitat.
2. Further our understanding of the population biology, trends, and distribution of Porsild's bryum, to assist in the long-term conservation of this moss.
3. Establish a monitoring program to measure success of recovery activities and to track population dynamics that may be related to natural or human-caused environmental changes.

4. Prepare educational materials to foster appreciation of endangered and rare mosses in Alberta.

6.5 Strategies for Recovery

There are several strategies necessary for the recovery and conservation of Alberta's Porsild's bryum population. Recovery actions undertaken over the next five years (2010-2015) will fall under these larger strategies, described below.

6.1.1 Population Conservation and Management

To best manage populations of Porsild's bryum in Alberta, more basic information about the species' occurrences are needed. Further inventory of potential habitats or specific regions is recommended to complete the database of occupied sites. In addition, monitoring of population sizes and trends, as well as measuring reproductive success at individual sites on an ongoing basis is needed to assess the success of the recovery plan.

6.1.2 Habitat Management and Protection

The definition of essential habitat is required for all sites to delineate the habitat needs of the species and guide management of lands surrounding the Porsild's bryum sites. Moreover, defining essential habitat will assist with habitat regulation under the federal Species at Risk Act (SARA). Since all of the identified threats to the species are linked to human activities at or near the species sites, then protecting the essential habitat from deleterious activities will be necessary. This will be accomplished by working cooperatively with stakeholders, the Alberta Parks Division, non-government agencies, and the general public to provide balanced solutions to conservation of the species.

6.1.3 Research

Research will focus on gathering information necessary for the conservation of Porsild's bryum. This will include information about the species' reproduction and dispersal, general habitat needs, substrate requirements, water chemistry, and potential effects of dust.

6.1.4 Information and Outreach

Increasing public awareness of the importance of *threatened* and *endangered* species that are not "charismatic megafauna" will be an important facet of conservation of plants in general and mosses such as Porsild's bryum specifically. Communicating the existence of, and habitat needs for, Porsild's bryum will be a significant and important step forward in the conservation of this species.

6.1.5 Resourcing

Financial and other support is a requisite to successful recovery effort. Thus effort will be made to secure logistical, financial, and in-kind support to assist in the implementation of the plan.

6.1.6 Legislation

Provincial legislation to protect Porsild's bryum and its habitat is recommended.

6.1.7 Plan Management and Administration

The Team will meet annually (or more frequently if required) to discuss progress and ensure that the objectives outlined in this plan are being implemented. They will also monitor and evaluate the effectiveness of conservation activities for Porsild's bryum and ensure that new information on this species is disseminated to resource managers in a timely manner.

7.0 ACTION PLAN

7.1 Population Conservation and Management

1. Further inventory will be conducted to search for and identify additional subpopulations in the vicinity of known subpopulations, and to further fine-tune our understanding of the species' range in Alberta. Areas of particular interest have been identified as the following:
 - Along creeks downstream from known occupied sites, as the species' diaspores may disperse by water and may have colonized nearby downstream sites.
 - Two waterfalls in the Bloodroot Creek valley northwest of Grande Cache may offer potential habitat for Porsild's bryum.
 - Larger areas not yet fully explored, such as the front ranges from Kananaskis Country north to Cadomin and Kananaskis south to Waterton Lakes National Park.
2. Researchers from government agencies, non-government organizations, and/or universities will undertake development of protocols to monitor population size and trends of the subpopulations of Porsild's bryum in Alberta. Minimally, the number and size of colonies should be included in the data collection. Volunteer stewardship will be incorporated into monitoring where possible (e.g., through the *Adopt-a-Plant Alberta* program). Site-specific monitoring recommendations are as follows:
 - For sites with known direct threats (Ribbon Creek, Whitehorse Creek campground, Mountain Park and all subpopulations affected by the haul road), intensive monitoring should be conducted every two years. Further, at sites where subpopulations may be affected by dust from the haul road, the monitoring protocol must include measuring the amount of dust and its effects. Similarly, at sites impacted by recreational activities for which mitigation is not possible, the protocol needs to be designed to measure the impact of campfires and climbing (bouldering).

- For sites with no currently known threats, intensive inventory should be conducted to accumulate baseline data (e.g., at Willmore Wilderness sites). Further visitation at these sites should occur every five years. In all cases, the first priority should focus on establishing baseline population parameters for all subpopulations.

7.2 Habitat Management and Protection

Items 1 and 2, and possibly 3, will occur concurrently with habitat surveys and monitoring. Identifying essential habitat (1) is a priority.

1. Identify essential habitat for Porsild's bryum and develop and deliver maps denoting them to resource managers (e.g., Alberta Parks Division, Alberta Fish and Wildlife Division, Alberta Public Lands and Forests Division). These maps will be used as a basis for permitting land use or for mitigating the effects of such use. Identification of essential habitat may also lead to setback recommendations for industrial activity around subpopulations.
2. Assess and quantify risk to all known sites (listed in ASRD & ACA 2006).
3. Conduct habitat studies: each site will require a detailed habitat description (rock type and composition, rock pH, water quality, vegetative cover, etc).
4. Work cooperatively with stakeholders, landowners, and the general public to identify and mitigate or eliminate risks.
5. Work with Alberta Parks Division on the following initiatives:
 - Identify solutions that prevent recreational use of cliffs beside the waterfalls at Ribbon Creek. Solutions could include signs warning the public of the safety risk and sensitivity of plant communities.
 - At the Whitehorse Creek campground, identify solutions that prevent campfires being lit under the boulder where Porsild's bryum resides, and prevent climbing on the boulder. Solutions could include closure of adjacent campsites, reclamation around the boulder, and signage.
6. Work with Teck Coal to identify and minimize the effects of the haul road (i.e., dust, and possibly other pollutants) on the subpopulations found adjacent to the road (in Mountain Park and near Whitehorse Creek). This may require monitoring of airborne dust levels and effects on water quality at each site, and spraying the road adjacent to the subpopulations with an environmentally sensitive dust-suppressant.

7.3 Research

Work with researchers to prepare research plans/proposals that will support and facilitate the conservation of Porsild's bryum. The research should focus on:

1. Understanding Porsild bryum's habitat requirements with the aim of determining factors that contribute to the species' rarity;
2. Understanding the relationship of the species to substrate and water quality; and
3. Determining potential effects of dust and vehicular exhaust on Porsild's bryum.

7.4 Information and Outreach

1. Work with Alberta Fish and Wildlife Division and Parks Division to communicate and promote the importance of mosses in the natural environment to the general public and other stakeholders. These may take the form of signs near subpopulations in provincial parks (i.e., Ribbon Creek and Whitehorse Creek), displays at interpretative centres (e.g., Kananaskis Visitor Centre), and possibly interpretive brochures.
2. Alberta Fish and Wildlife Division will develop a fact sheet on Porsild's bryum. The fact sheet will be available to the public and stakeholders on the Species at Risk website, and as hard copies through the Alberta Sustainable Resource Development Information Centre.
3. Alberta Fish and Wildlife Division will provide information to all stakeholders or provincial agencies that have Porsild's bryum on their lands, or whose activities may affect current known subpopulations. Information will be provided on how to identify and conserve the species and its habitat.
4. Alberta Fish and Wildlife Division will make the recovery plan available to the public and stakeholders on the Species at Risk website, and as hard copies through the Alberta Sustainable Resource Development Information Centre.

7.5 Resourcing

Agencies represented on the recovery team will annually approach funding agencies, industry, government agencies, and non-government organizations to participate in, or to provide funding or in-kind funding to implement the recovery plan.

7.6 Legislation

It will be important to recognize and act upon any provincial government legislative changes that may be necessary for the long-term conservation of Porsild's bryum.

7.7 Plan Management and Administration

1. Alberta Fish and Wildlife Division will convene the Alberta Porsild's Bryum Recovery Team at least once per year. At these meetings, the team will review progress on implementation of the plan and the effectiveness of the recovery actions. The Chair of the recovery team will

provide an annual report to the Director of Wildlife Management that details progress on implementation of the plan.

2. The Alberta Conservation Information Management System (ACIMS), in cooperation with the Alberta Fish and Wildlife Division (Headquarters) and Alberta Parks Division will ensure that all research activities are properly permitted and coordinated each year, in order to maximize benefits from research and to keep the recovery team informed of ongoing research.
3. The Chair of the Alberta Porsild's Bryum Recovery Team will communicate with other recovery team leads to ensure that recovery actions for the bryum complement, where possible, the recovery of any other provincially or federally listed species.
4. All survey data will be submitted to ACIMS for incorporation into the database. ACIMS, in cooperation with Alberta Parks Division and other agencies and researchers, will enter all accumulated bryum data in their database following each survey season.

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8.0 TIMETABLE FOR IMPLEMENTATION AND SCHEDULE OF COSTS

The following table provides a schedule for implementation of individual recovery actions as proposed in this recovery plan, and provides an estimate of cost where possible. It is anticipated that a variety of agencies will participate in the funding and implementation of these activities. Costs are not provided for activities that are part of the daily operations of the identified agencies (*). Costs associated with team members' expenses to attend recovery team meetings are also not included, but represent valued and necessary contributions associated with implementation of the recovery plan.

Recovery Plan Section	Activity	Lead Agency	Cost (thousands/year)					Total
			2011-12	2012-13	2013-14	2014-15	2015-16	
Population Conservation and Management								
7.1 (1)	Surveys/Inventory	FWD, PD	15	15	15			45
7.1 (2)	Monitoring protocol development and establishment	FWD, PD, UR	7	15	15	15		52
			22	30	30	15		97
Habitat Management								
7.2(1,2,3)	Identify essential habitat, and conduct site risk assessments and detailed habitat studies	FWD, PD, RT	5	5	5			15
7.2(4,5,6)	Human activity mitigation	FWD, PD, Tech	1					
			6	5	5			16
Research								
7.3 (1)	Habitat Requirements	FWD, PD, UR		20	20			40
7.3 (2)	Substrate and water quality	FWD, PD, UR		10	10	10		30
7.3 (3)	Effects of dust and exhaust	FWD, PD, UR, Teck		10	10	10		30
				40	40	20		100
Information and Outreach								
7.4 (1)	Signs and displays	PD		5				5
7.4 (2)	Fact Sheets	FWD	1				0.5	1.5
7.4 (3, 4)	Communicate with stakeholders and promote plan	FWD	0.5					0.5
			1.5	5			0.5	7
Resource Acquisition								
7.5	Secure Funding	FWD, RT	0.5	0.5	0.5	0.5		2
			0.5	0.5	0.5	0.5		2
Plan Management								
7.7 (1)	Team meetings and report	FWD, RT	0.5	0.25	0.25	0.25	0.25	1.5
7.7 (2)	Research coordination	FWD, PD, UR						
7.7 (3)	Communication with other recovery efforts	FWD, PD						
7.7 (4)	Data storage and management	PD, ACIMS	0.5	0.25	0.25	0.25	0.25	1.5
			0.5	0.25	0.25	0.25	0.25	1.5
TOTAL			30.5	80.75	75.75	35.75	0.75	223.5

Lead Agencies: Alberta Fish and Wildlife Division (FWD), Parks Division (PD), Alberta Conservation Information Management System (ACIMS), Recovery Team (RT), University Researcher(s) (UR), Teck Coal (Teck)

9.0 SOCIO-ECONOMIC CONSIDERATIONS

The small area over which Porsild's bryum occurs should limit the potential socio-economic impacts of implementation of the recovery plan. The recovery plan recognizes the value of the landscape for recreation and industrial development. It is hoped that stakeholder involvement will aid in minimizing or mitigating socio-economic cost associated with implementation of the plan. Potential economic costs to industrial stakeholders may include minor restrictions on resource extraction and shared costs for monitoring dust and water quality levels. Potential costs to recreational users are also minimal and might include reduced accessibility to the rock faces associated with popular waterfalls or accessibility to boulders traditionally used for shelter or campfires.

There are social benefits that may be realized from implementation of the recovery plan. The outreach actions will lead to increased public awareness of a natural resource (mosses) that while, not obvious, are an integral aspect of the natural environment of Alberta. Increased public awareness may lead to increased enjoyment of the diversity of the Alberta flora and increased opportunity for ecotourism in the rocky mountain area.

10.0 PLAN EVALUATION AND AMENDMENT

The life of this plan is 5 years. The Alberta Porsild's bryum Recovery Team will conduct an annual review of the plan. The purpose of these annual reviews is to monitor the implementation of the plan and to determine the effectiveness of recovery actions. The Chair of the recovery team will provide an annual report to the Director of Wildlife Management that details progress on the implementation of the plan. Recovery plans are considered "living" documents and can be amended during these reviews. At the end of 5 years, the recovery team will meet again to determine where any other amendments are required, prior to the plan being renewed for another 5 years. The team may determine that the existing recovery plan is suitable, in need of minor edits, or in need of major revision.

11.0 LITERATURE CITED

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