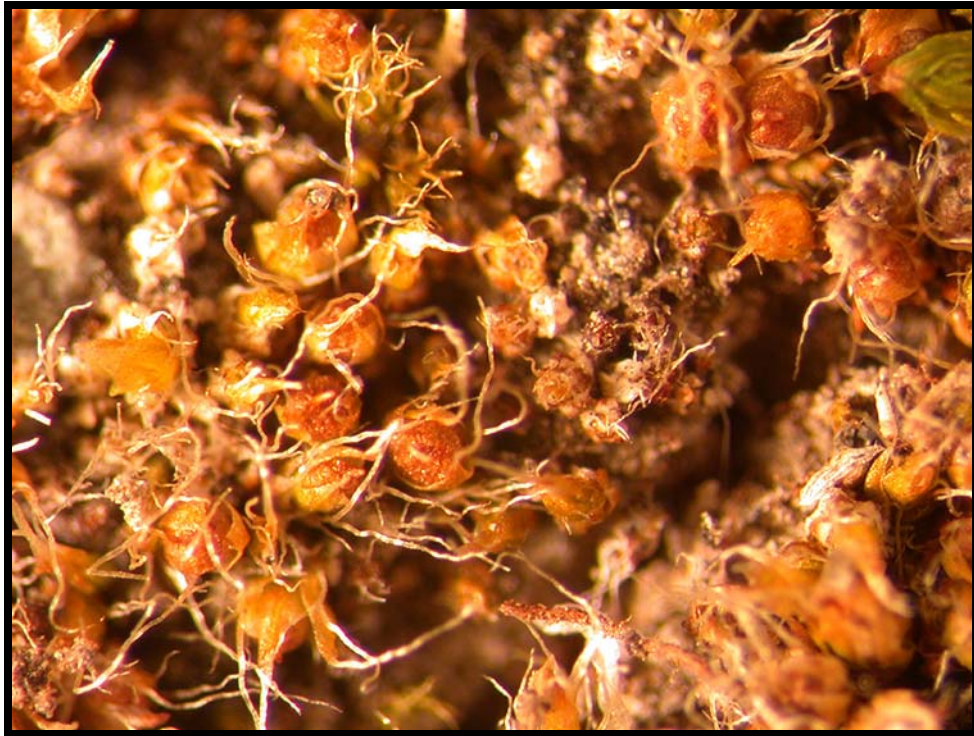


Recovery Strategy for alkaline wing-nerved moss (*Pterygoneurum kozlovii*) in British Columbia



Prepared by the British Columbia Bryophyte Recovery Team



Ministry of
Environment

August 2009

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 its 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' survival 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; 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 British Columbia Bryophyte 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 alkaline wing-nerved moss 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 alkaline wing-nerved moss.

RECOVERY TEAM MEMBERS

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The British Columbia Ministry of Environment is responsible for producing a recovery strategy for alkaline wing-nerved moss under the *Accord for the Protection of Species at Risk in Canada*. Environment Canada's Canadian Wildlife Service participated in the preparation of this recovery strategy.

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EXECUTIVE SUMMARY

Alkaline wing-nerved moss (*Pterygoneurum kozlovii*) was designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Threatened in November 2004, and is listed on the federal *Species at Risk Act* (SARA) Schedule 1. Its current known range in British Columbia is based on 28 occurrence records, of which 6 are likely extirpated. The species is found near wetlands along the margins of alkaline ponds and sloughs in semi-arid regions. Alkaline wing-nerved moss is a small perennial moss that grows as small clumps or turfs amongst low-growing vascular plant vegetation.

Potential threats to the survival of this species are habitat loss and/or degradation, caused by livestock presence, urban and/or highway development, ATV and other vehicle use, and potentially competition from invasive alien plants.

The recovery goal for this species is to maintain all known populations of alkaline wing-nerved moss in British Columbia.

The recovery strategy has the following objectives for the next five years:

- I. To secure long-term protection for the known populations and habitats of alkaline wing-nerved moss;
- II. To determine the levels of real and potential threats to this species and its habitat and to mitigate their effects;
- III. To address knowledge gaps (e.g. habitat requirements; biological attributes; ecological factors) for this species.
- IV. To confirm the distribution of the alkaline wing-nerved moss (including new locations), and to reliably determine population trends.

No critical habitat can be identified for alkaline wing-nerved moss in Canada at this time. It is expected that critical habitat will be proposed following the completion of outstanding work required to quantify specific habitat and area requirements for the species, further research on the biology of the species, and monitoring of populations to determine population trends. Consultation with affected land owners and managers will also be necessary.

Approaches to achieve the recovery objectives are: habitat management, habitat protection, stewardship, inventory and monitoring, and scientific research.

An action plan will be completed by 2013.

TABLE OF CONTENTS

RECOVERY TEAM MEMBERS.....	iii
AUTHOR	iii
RESPONSIBLE JURISDICTIONS	iii
ACKNOWLEDGEMENTS	iii
EXECUTIVE SUMMARY	iv
BACKGROUND	1
Species Assessment Information from COSEWIC.....	1
Description of the Species	1
Populations and Distribution	3
Needs of the alkaline wing-nerved moss	7
Habitat and biological needs	7
Ecological role	8
Limiting Factors	8
Threats.....	8
Threat classification.....	8
Description of the threats	10
Actions Already Completed or Underway.....	11
Knowledge Gaps.....	11
RECOVERY	11
Recovery Feasibility.....	11
Recovery Goal	12
Rationale for the Recovery Goal.....	12
Recovery Objectives	12
Approaches Recommended to Meet Recovery Objectives.....	13
Recovery planning table.....	13
Performance Measures.....	14
Critical Habitat.....	14
Recommended schedule of studies to identify critical habitat	14
Existing and Recommended Approaches to Habitat Protection.....	15
Effects on Other Species	15
Socioeconomic Considerations	15
Recommended Approach for Recovery Implementation.....	16
Statement on Action Plans	16
REFERENCES.....	17

LIST OF TABLES

Table 1. Population data for alkaline wing-nerved moss in British Columbia.....	6
Table 2. Threat classification table for alkaline wing-nerved moss.	8
Table 3. Technical and biological feasibility for recovery of alkaline wing-nerved moss.	12
Table 4. Recovery planning table for alkaline wing-nerved moss.....	13

LIST OF FIGURES

Figure 1. Illustrations of the alkaline wing-nerved moss.....	2
Figure 2. Mature plants and capsules of the alkaline wing-nerved moss.....	3
Figure 3. Distribution of alkaline wing-nerved moss in North America.	5
Figure 4. Distribution of alkaline wing-nerved moss in British Columbia	

BACKGROUND

Species Assessment Information from COSEWIC

Date of assessment: November 2004

Common name: Alkaline Wing-nerved Moss

Scientific name: *Pterygoneurum kozlovii* Laz.

Status: Threatened

Reason for designation: This species, restricted in North America to western Canada, is globally imperiled or rare. Canada possesses the great majority of documented locations. The species typically grows on soil among grasses and sedges along the margins of alkaline ponds and sloughs in semi-arid regions of Canada. It has been confirmed at only 13 sites from 24 reported in south central British Columbia. There is one unconfirmed site in Saskatchewan. About half of all the known sites are subject to impacts from people and domestic animals. Of the British Columbia sites, 6 have apparently been lost to urban development, highway improvement, and trampling by cattle, implying that decline in habitat quality and extent are presently impacting the species.

Canadian occurrence: British Columbia, Saskatchewan.

COSEWIC Status history: Designated Threatened in November 2004. Assessment based on a new status report.

Description of the Species

This description is based on COSEWIC (2004), McIntosh (1986, 1989), and Zander (2007). The alkaline wing-nerved moss is a small, 2 - 3 mm tall, perennial moss that grows as small clumps or, sometimes, short turfs. Young plants and leaves are light green to yellow-green. The leaves are about 1 mm long, and are concave and usually somewhat twisted above, wrapping around each other to protect the maturing capsule (structure that produces spores) as they grow. They lose much of their colour with age exposing the mature sporophyte behind them. Two, sometimes three irregular flaps, or lamellae, are present on the inside of the upper midrib of the leaves (Figure 1). This midrib usually extends beyond the apex of the leaf, especially on upper leaves, forming a clear, smooth to weakly toothed hair-tip, giving larger colonies a somewhat greyish appearance. The alkaline wing-nerved moss is autoicous, with both male and female structures present on each plant. In the late spring and early summer, round, golden-brown capsules become obvious within the leaves (Figure 2). The capsules, which resemble small eggs, are characterized by having no opening for spore release; the capsule wall disintegrates after maturity to release the spores. Figure 1 illustrates key features of the alkaline wing-nerved moss and Figure 2 is a cluster of plants with maturing sporophytes.

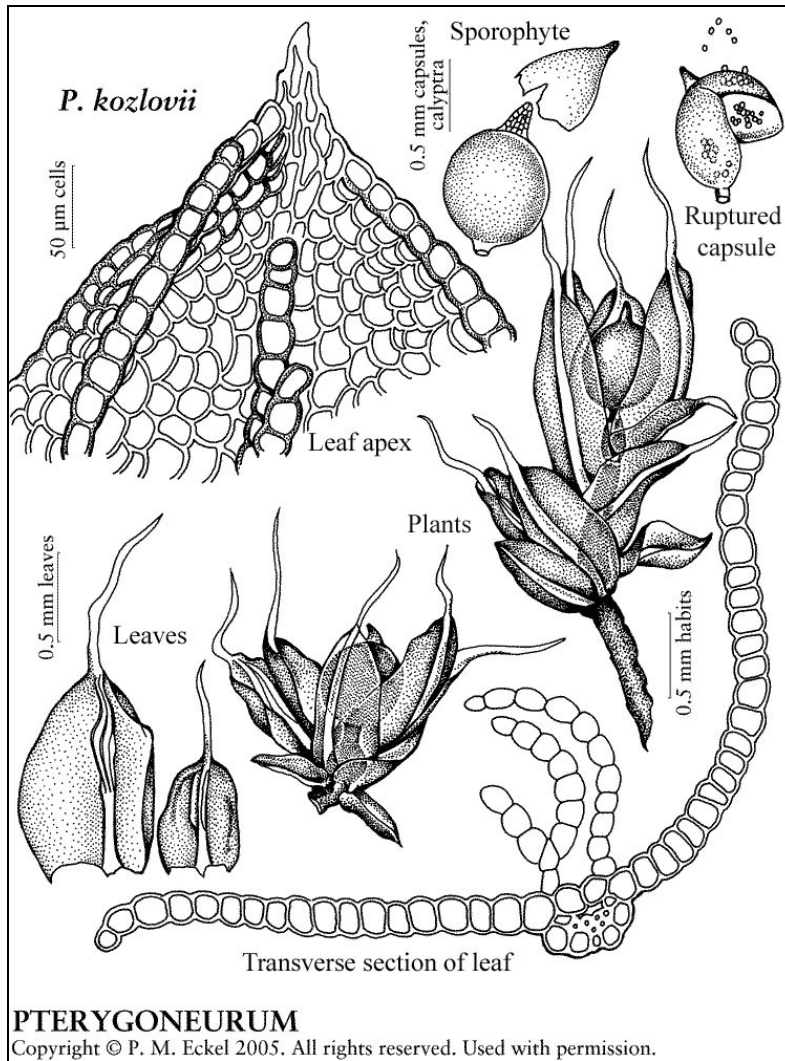


Figure 1. Illustrations of the alkaline wing-nerved moss (from Zander 2007; used with permission of the artist, P. M. Eckel).



Figure 2. Mature plants and capsules of the alkaline wing-nerved moss (~20x magnification; photo by T. McIntosh).

Populations and Distribution

Alkaline wing-nerved moss was first reported for North America by McIntosh (1986). It has a disjunct distribution in the northern hemisphere reported from western North America and central Europe, where it is found in the Czech Republic, Slovakia (formerly Czechoslovakia), and Ukraine (Zander 2007). It has recently been confirmed from Mongolia (Zhao et al. 2008). Its range in North America includes British Columbia (B.C.), Alberta, and Saskatchewan. The Alberta occurrence was not listed by Zander (2007) as it was found there after the publication of this work (McIntosh 2007) and after the COSEWIC status report in 2004. It may also be present in North Dakota but this is unconfirmed (COSEWIC 2004).

Globally, NatureServe Explorer (2008) lists alkaline wing-nerved moss as G2G3 (impaired to vulnerable to extirpation or extinction). It is considered endangered or rare in Mongolia (COSEWIC 2004) and is not ranked in the other European locations. Alkaline wing-nerved moss is listed by NatureServe as S2 for B.C., S1 for Saskatchewan, and not yet ranked for Alberta (NatureServe 2008). Alkaline wing-nerved moss is a priority 1 species under goal 1 of the B.C. Conservation Framework (see <<http://www.env.gov.bc.ca/conservationframework/>> for details).

Until 2007, the majority of Canadian populations of alkaline wing-nerved moss had been found in B.C. (Figure 3), with only one population reported from Saskatchewan. However, a recent survey for this species in southern Saskatchewan and Alberta has shown that it is widespread and fairly common in the southern portions of these provinces (McIntosh 2007). This recovery strategy does not cover the occurrences in these provinces.

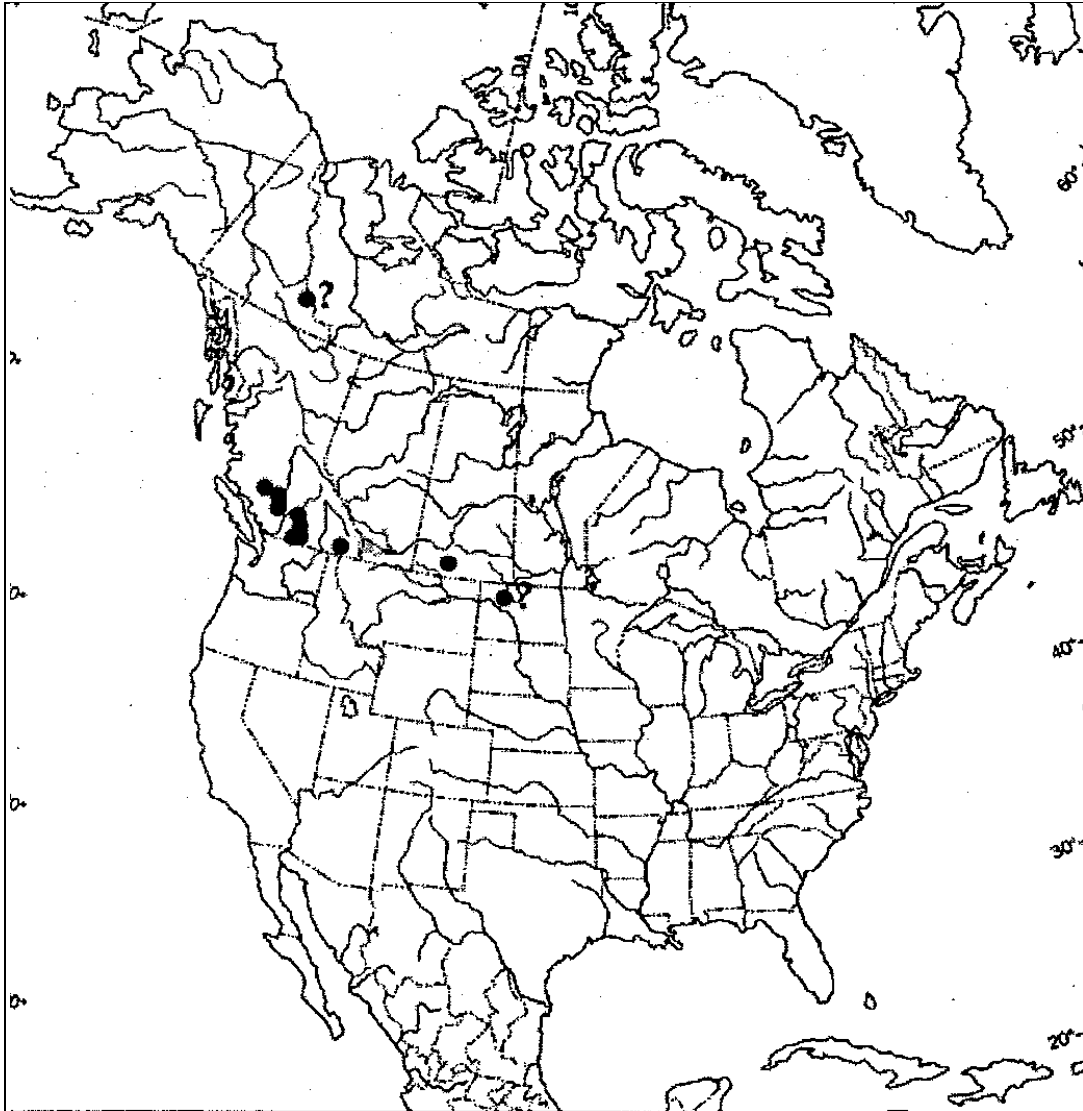


Figure 3. Distribution of alkaline wing-nerved moss in North America (from COSEWIC 2004). Note, new populations located in Alberta and Saskatchewan by McIntosh (2007) surveys were not included on this map.

Twenty-eight populations have been reported for B.C. (Table 1). Of these, four have been reported since the COSEWIC (2004) status report. Based on the COSEWIC report, this species is restricted to south-central British Columbia: nine populations in the south Okanagan Valley¹, six in the North Thompson River Valley ranging from Kamloops to the Ashcroft/Cache Creek area, seven in the Cariboo Region west and south-west of Williams Lake, and two populations from the Rocky Mountain Trench further west. Of the four new populations, one is east of Cache Creek, a second is near Osoyoos, and two are near Kamloops. Six of the known populations may have been extirpated: three in the Osoyoos area; one west of Kamloops; one near Riske Creek; and one near Cranbrook leaving 22 extant populations in B.C. However, the current status of several of these populations is unknown as they have not been revisited in recent years (Table 1).

¹ These populations are concentrated around Osoyoos and Oliver. Because the original populations northwest of Osoyoos were not georeferenced, it is possible that some of these populations should be considered to be the same.

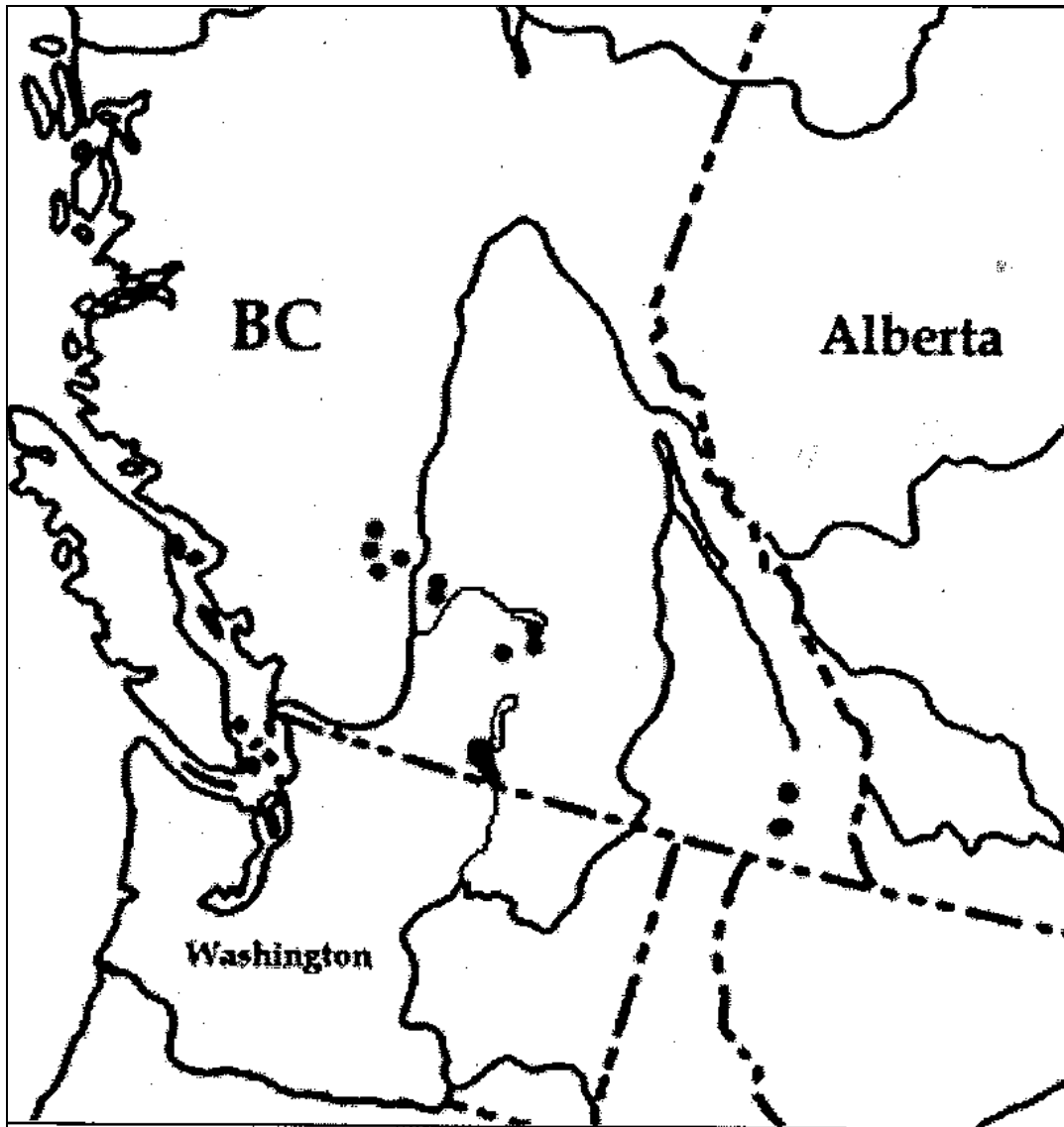


Figure 4. Distribution of alkaline wing-nerved moss in British Columbia (from COSEWIC 2004).

Detailed population data for alkaline wing-nerved moss in B.C. is limited. Although confirmations of the presence of some populations from McIntosh (1986) and discoveries of new populations have been made, no data are available that would provide an assessment of population trends in B.C. Approximately 75% of the accessible alkaline wetland sites in B.C. have been surveyed since 1980 for this species (T. McIntosh pers. Comm., 2009).

There are no reported estimations of global distribution and abundance for this moss. However, based on its widespread distribution as compared to other areas, the B.C. populations probably represent less than 5% of its global distribution.

Table 1. Population data for alkaline wing-nerved moss in British Columbia (numbers of patches are estimations only).

Locality²	Status report population number	Dates observed	Estimated number of patches/individuals and extent	Habitat characteristics	Land tenure
Osoyoos*	2	1981	unknown	edge of alkaline slough	unknown
NW of Osoyoos*	3	1980	unknown	edge of alkaline slough	unknown
NW of Osoyoos* (1.5 km NW)	4	1980	unknown	edge of alkaline slough	unknown
NW of Osoyoos (N of Spotted Lake)	5	1980, 2006	a few patches observed in 2006	under dense litter along edge of alkaline slough	?B.C. Crown land
NW of Osoyoos	9	1983	unknown	edge of alkaline slough	First Nations (recently purchased)
NNW of Oliver (behind Silica works and mine)	1	1980	unknown	edge of alkaline slough	unknown
Kaledon (S of Penticton)	7	1980	unknown	edge of alkaline slough	First Nations
Oliver (S of Okanagan Falls)	11	2002	>300 patches observed	under dense litter along edge of alkaline slough	Private
White Lake, S of Penticton	25	1998, 2005	1 - 5 patches observed	along edge of alkaline slough	Federal
W of Kamloops (near Coquihalla turnoff from Hwy. #1)	15	2002	~ 5 patches observed	under dense litter along edge of alkaline slough	?B.C. Crown land
W of Kamloops*	6	1980	unknown	edge of alkaline slough	City of Kamloops
S of Savona (W of Kamloops)	21	2002	~ 5 patches observed	edge of alkaline slough	?B.C. Crown land
S of Kamloops (near Nicola Lake)	12	1999	~ 10 patches observed	edge of alkaline slough	?B.C. Crown land
S of Kamloops (near Lac La Juene)	18	2002	~4 patches observed	edge of alkaline slough	?B.C. Crown land
S of Ashcroft (along Hat Creek Road)	22	2002	1 - 5 patches observed	edge of alkaline slough	?B.C. Crown land
NW of Clinton (Alberta Lake)	23	2002	2 patches observed	edge of alkaline slough	?B.C. Crown land
Near Riske Creek, W of Williams Lake*	8	1981	unknown	edge of alkaline slough	unknown
S of Riske Creek (road to Farwell Canyon)	13	2002	1 - 5 patches observed	on alkaline seepage flat	?B.C. Crown land

² N= north; S= south; W= west

Recovery Strategy for Alkaline Wing-nerved Moss June 2009

SW of Williams Lake (Alberta Lake)	24	1997	unknown	edge of alkaline slough	?B.C. Crown land
SW of Williams Lake (Poison Lake)	14	2002	>200 patches observed	edge of alkaline slough	?B.C. Crown land
W of Williams Lake	19	2002	a few patches observed	edge of alkaline slough	?B.C. Crown land
Churn Creek Protected Area, SW of Williams Lake	20	2001	unknown	edge of alkaline slough	B.C. Protected Area
NE of Cranbrook*	16	2002	single patch observed	on small protected piece of soil along heavily degraded (ATVs and motorbikes) edge of alkaline slough	unknown
W of Canal Flats	17	2002	>300 patches observed	under litter along edge of alkaline slough	?B.C. Crown land
E of Cache Creek S of Oliver	N/A	2005	unknown	unknown	unknown
	N/A	2006	~20 patches observed	on soil in alkaline flat along lake	First Nations
S side of Kamloops	N/A	2007	>100 patches observed	edge of alkaline slough	?B.C. Crown land or City of Kamloops
NW side of Kamloops	N/A	2008	>200 patches observed	edge of alkaline slough	City of Kamloops

* Localities are probably extirpated.

Needs of the alkaline wing-nerved moss

Habitat and biological needs

Alkaline wing-nerved moss is restricted to open, late autumn to spring wet, alkaline edges of ponds, lakes, and sloughs across its range in Canada. It also rarely occurs on seepage slopes in B.C. The topography in these habitats is flat to very slightly sloping and bare soil is available through time. It usually grows on fine mineral soils often under overhanging litter (fine litter is sometimes closely associated with the moss at its growing point over the soil).

In B.C., alkaline wing-nerved moss grows on open or lightly litter-covered soil amongst a relatively short vascular plant layer, comprised mainly of graminoids, in particular salt grass (*Distichlis stricta*), sedges (most commonly *Carex praegracilis*; black-footed sedge), and less often, foxtail barley grass (*Hordeum jubatum*).

Alkaline habitats that can potentially support this species are relatively common in semi-arid, low elevation, open areas in the south-central portions of B.C., as well as in the Rocky Mountain Trench. Alkaline wetlands where this moss has been found in B.C. are in sagebrush- or grassland-dominated habitats in the Bunchgrass, Ponderosa Pine, or Interior Douglas-fir Biogeoclimatic Zones.

Published information about the general biology and reproductive capabilities of this species is lacking, although field observations on microhabitat and spore production are available. As with most moss species, the primary means of dispersal and reproduction is probably by spores, although it appears that this species also reproduces vegetatively through underground expansion, possibly via buds along thickened rhizoids. Alkaline wing-nerved moss has male and female structures on the same plant, and this helps to ensure successful fertilization and consequent production of sporangia and spores. This species produces spores regularly across its range in Canada, as mature sporophytes have been observed at almost every known location each time that they were observed in the field. There are no data on spore dispersal distances, viability, or germination success for this species, although moss spores in this type of habitat are most frequently water or insect-dispersed. Because of the open terrain that characterizes this species' habitat, it is possible that spores may also be wind-dispersed.

Ecological role

Because this species is a colonizer of open soils and sometimes forms small turfs, it may have a role in soil stability. No other ecological role is known.

Limiting factors

A possible limiting factor for alkaline wing-nerved moss is its small size. This may be a competitive disadvantage when growing amongst other mosses and vascular plants, and may readily be covered by litter. In addition, this species tends to be naturally rare (i.e. populations appear to consist of a small number of patches) so recovery potential may also be limited by an increased vulnerability to stochastic events.

Threats

Threat classification

Table 2. Threat classification table for alkaline wing-nerved moss.

1 Livestock		Threat attributes		
Threat category	Habitat loss or degradation, accidental mortality	Extent		
			Local	Range-wide in B.C.
General threat	Livestock presence	Occurrence	Anticipated at most locations	Unknown
Specific threat	Trampling and soil compaction; livestock feces	Frequency	Recurrent	Unknown
		Causal certainty	High	Unknown
		Severity	High	Unknown
Stress	Reduced population size and viability; increased mortality; decreased recruitment	Level of concern	High	
2 Urban and/or highway development		Threat attributes		

Threat category	Habitat loss or degradation, accidental mortality	Extent		
General threat	Urban and/or highway development		Local	Range-wide in B.C.
		Occurrence	Anticipated	Unknown
Specific threat	Destruction of species and habitat	Frequency	Unknown	Unknown
		Causal certainty	Unknown	Unknown
		Severity	Unknown	Unknown
Stress	Reduced population size and viability; extirpation; decreased recruitment	Level of concern	Medium	
3 ATV and other vehicle use		Threat attributes		
Threat category	Habitat loss or degradation, accidental mortality	Extent		
General threat	ATV and other vehicle use		Local	Range-wide in B.C.
		Occurrence	Anticipated at least one location	Unknown
Specific threat	Habitat compaction by tires and killing of species	Frequency	Unknown/Recurrent	Unknown
		Causal certainty	Low	Unknown
Stress	Reduced population size and viability; extirpation; decreased recruitment	Severity	High	Unknown
		Level of concern	Low	
4 Invasive alien plants		Threat attributes		
Threat category	Invasive species	Extent		
General threat	Invasive vascular plants		Local	Range-wide in B.C.
		Occurrence	Anticipated at a few locations	Unknown
Specific threat	Burial of species and alteration of habitat	Frequency	Unknown	Recurrent
		Causal certainty	Unknown	Low
Stress	Reduced population size and viability; decreased recruitment	Severity	Unknown	Low
		Level of concern	Unknown	
5 Climate change		Threat attributes		
Threat category	Drought	Extent		
General threat	Prolonged lack of water		Local	Range-wide in B.C.
		Occurrence	Anticipated at a few locations	Unknown
Specific threat	Loss of suitable habitat	Frequency	Unknown	Recurrent
		Causal certainty	Unknown	Low
Stress	Loss of suitable habitat	Severity	Unknown	Low
		Level of concern	Unknown	

Stress	Reduced population size and viability; decreased recruitment	Level of concern	Low
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Description of the threats

Livestock

A major threat to alkaline wing-nerved moss in B.C. is the trampling of suitable habitat by livestock, usually cattle, but also horses at a few populations. Most alkaline areas where this species grows are not protected and are used by cattle for drinking water and for grazing, and heavy disturbance in these areas is common. Damage caused by livestock can be direct destruction by trampling, or indirect by loss of habitat. The loss of habitat is mostly through compaction and alteration of the soil surface. One population near Riske Creek may have been lost because of extensive trampling by cattle. At least one portion of the population at White Lake was destroyed by livestock trampling in 2005, since that time a fence has been reinstalled, and if it remains intact, the threat of further trampling species will be negligible. However, at two of the three populations where this species is most common and sometimes forms extensive turfs (near Canal Flats and near Oliver), there is usage by livestock, but apparently not enough to alter the populations significantly. The population west of Williams Lake, where the species is also relatively common, is protected by a fence. An additional threat from livestock is animal feces which have the potential to bury and kill the moss as well as alter its habitat, possibly through chemical changes. Not only can habitats be strongly modified by the hooves of livestock, there is sometimes an increase of invasive alien plants following habitat disturbance (T. McIntosh pers. comm. 2009).

The threat by livestock is anticipated as we do not know if it is occurring currently, and probably would be seasonal, as livestock would alter the habitat by trampling and killing plants. The causal certainty is high. This threat will probably decrease population sizes and numbers over the long term.

Urban and/or highway development

Urban and/or highway development has probably eliminated some alkaline ponds and their associated populations of alkaline wing-nerved moss (e.g. the population northwest of Osoyoos and at one population west of Kamloops). For example, highway expansion has eliminated one population west of Osoyoos. The threat by urban and/or highway development is anticipated as it is unknown whether any sites are currently earmarked for development. In all cases the populations and habitat is completely lost. The causal certainty is unknown. This threat would decrease population sizes and numbers over the long term.

ATV and other vehicle use

The alkaline winged-nerve moss population near Cranbrook is threatened by heavy recreational use of this site by vehicles, especially ATVs. Much of this area is denuded of vegetation, and only small patches of potential habitat for this species remains. The threat of vehicle use is anticipated on at least one site. Vehicle use would alter the habitat and kill plants. This is a presumed threat, thus the causal certainty is low. However, this threat may decrease the population size over the long term.

Invasive alien plants

Invasive alien vascular plants pose a potential threat to this species through competition for habitat and increased litter buildup although this has not been determined in B.C. The threat of invasive alien plant species is unknown, although probably seasonal. Plants would disturb the habitat as they grow and the litter they produce may cover the moss during the growing period. The causal certainty is unknown. However, this threat may decrease the population size over the long term.

Climate change

Prolonged drought is a potential threat which may cause decline of the population due to loss of habitat (COSEWIC 2004). The attributes of this threat are poorly understood.

Actions Already Completed or Underway

No species specific actions are currently underway to protect this species in B.C. However, additional surveys since the 2004 COSEWIC status report were undertaken in 2007. Cattle exclusion fencing has been erected around one population to the west of Williams Lake. This was to protect livestock from poisoning and was not installed specifically for alkaline-wing nerved moss. As well, fencing was also re-installed at the White Lake population.

Knowledge Gaps

- Tenure of the population locations is unknown and needs to be clarified.
- Distribution of the species needs to be clarified (e.g. surveys at known and potential habitat locations).
- Assessment of the threats to the species is required to determine if invasive alien plants are a potential or real threat to the species.
- Determination of threshold levels for the species with respect to land management practices (e.g., livestock trampling levels, buffer distances, water removal), is required to inform development of best management practices for range use.
- Detailed habitat requirements, biological attributes and other ecological factors are not known for this species.

RECOVERY

Recovery Feasibility

Overall, recovery is considered to be biologically and technically feasible for alkaline wing-nerved moss. An assessment of the criteria for technical and biological feasibility for recovery of alkaline wing-nerved moss is found in Table 3.

Although the biology and ecology of alkaline wing-nerved moss are not completely understood, field observations suggest that regular recruitment is occurring in some populations.

Successful recovery will depend on a combination of scientific investigations, habitat protection, and possibly, management activities (e.g., operational contractors are being aware of locations of the alkaline wing-nerved moss), and long-term population monitoring. The level of effort required for recovery is expected to be low. In most cases, further studies and trials will be needed to determine whether there are insurmountable barriers to the recovery of existing populations.

Table 3. Technical and biological feasibility for recovery of alkaline wing-nerved moss; criteria from Environment Canada *et al.* (2005).

Feasibility criteria	
1. Are individuals capable of reproduction currently available to improve the population growth rate or population abundance?	YES – there are extant populations in Canada.
2. Is sufficient suitable habitat available to support the species or could it be made available through habitat management or restoration?	YES – the habitat at the currently occupied locations is suitable, and additional suitable habitat may also be available.
3. Can significant threats to the species or its habitat be avoided or mitigated through recovery actions?	YES – recovery actions in cooperation with land managers can prevent major threats.
4. Do the necessary recovery techniques exist and are they demonstrated to be effective?	YES – general restoration methods/techniques are being developed

Recovery Goal

To maintain all known populations of alkaline wing-nerved moss in British Columbia.

Rationale for the Recovery Goal

As with many other rare plant species, we lack adequate information about the historical distribution of alkaline wing-nerved moss. Although there is no direct evidence that this species was previously more abundant or widespread in the arid central interior of B.C., substantial disturbance has occurred to the alkaline habitats where it lives since the mid 1800's. Therefore, it was likely more widespread and had larger populations in the past. Recovery with respect to this species should focus on improving the probability that it will persist in the wild. As such, this could include restoring the species at extirpated sites if deemed necessary once distribution and population trends are determined. However, until the knowledge gaps for this species have been addressed, recovery will focus on the known populations in B.C.

Recovery Objectives

The recovery strategy has the following objectives for the next five years:

- I. To secure long-term protection for the known populations and habitats of alkaline wing-nerved moss;
- II. To determine the levels of real and potential threats to this species and its habitat and to mitigate their effects;
- III. To address knowledge gaps (e.g. habitat requirements; biological attributes; and ecological factors) for this species.
- IV. To confirm the distribution of the alkaline wing-nerved moss (including new locations), and reliably determine population trends.

Approaches Recommended to Meet Recovery Objectives

Table 4 outlines the broad approaches to meet recovery objectives.

Recovery planning table

Table 4. Recovery planning table for alkaline wing-nerved moss.

Priority	Obj. No.	Broad approach / strategy	Threat or concern addressed	Recommended approaches to meet recovery objectives	Outcomes or deliverables
High	I, II	Public outreach – stewardship with land owners and land managers	Habitat loss or degradation: mortality due to livestock and urban/highway development	<ul style="list-style-type: none"> • Encourage landowners and land managers to steward and manage lands for the persistence of the species • Educate landowners and land managers on the location of species on their lands • Develop and implement best management practices for mitigating threats 	<ul style="list-style-type: none"> • Populations maintained • Reduced mortality • Increased awareness and assistance by the landowners and land managers in the protection and recovery of this species.
High	I, II	Habitat management	Habitat loss or degradation: mortality due to livestock presence; urban/highway development; ATV/vehicle use and invasive alien species	<ul style="list-style-type: none"> • Develop best management practices for mitigating threats • Control livestock access, and ATV and vehicle use near populations • Survey for invasive plants and control if necessary 	<ul style="list-style-type: none"> • Populations maintained • Reduced mortality • Potential recruitment or expansion of populations
High	I	Habitat protection	All	<ul style="list-style-type: none"> • Determine land tenure • Establish appropriate protection mechanisms (e.g., stewardship agreements) depending on type of ownership 	<ul style="list-style-type: none"> • Securement and protection of populations and habitats
High	II, III	Scientific research: investigation of	Threats - Invasive alien plants;	<ul style="list-style-type: none"> • Research specific habitat requirements and other ecological factors 	<ul style="list-style-type: none"> • Precise information on habitat requirements to manage the life history

		habitat requirements	knowledge gaps (threat assessment)	<ul style="list-style-type: none"> • Assess the threats to the species and determine if invasive alien plants are a potential or real threat 	stages to ensure recovery
Medium	II, IV	Inventory and population and threat monitoring	All	<ul style="list-style-type: none"> • Monitor extant sites and survey potentially suitable sites in B.C. • Design a monitoring program to determine population trends • Monitor populations to assess the effects of threats 	<ul style="list-style-type: none"> • Data on population sizes, reproduction status, determination of population trends • Determine whether new locations for the species exist • Assess status of populations and effectiveness of recovery actions • Determine impacts of threats to the species

Performance Measures

- I. Population monitoring indicates known sites are still extant and population data has been gathered to help determine long term trends by 2013 (Objectives I and IV).
- II. A minimum of 60% of the suitable habitat has been surveyed for this species and documented by 2013 (Objective IV).
- III. Effects of the four main threats to the populations have been investigated and reduced through mitigative actions at all known sites by 2013 (Objective II).
- IV. Priority scientific studies to determine the habitat requirements have been completed by 2013 (Objective III).

Critical Habitat

No critical habitat as defined under the federal *Species at Risk Act* is proposed for identification at this time. It is expected that critical habitat will be proposed following the completion of outstanding work required to quantify specific habitat and area requirements for the species, further research on the biology of the species, and monitoring of populations to determine population trends. Consultation with affected land managers will also be necessary.

The schedule of studies included in the section below outlines the additional research and analysis required to address the biological and technical limitations that prevent identification of critical habitat.

Recommended schedule of studies to identify critical habitat

The following studies will allow for the identification of critical habitat for known populations:

1. Identify habitat attributes required for persistence, including microhabitats, at known sites (e.g. soil structure, texture, and chemical composition; wetland hydrology; water chemistry; light and moisture requirements) by 2012.
2. Using established survey and mapping techniques, delineate the boundaries of all

occupied habitat by 2013.

3. Identify, map and describe all suitable habitat that is currently occupied by the alkaline wing-nerved moss by 2013.
4. Conduct inventories in potential habitat locations to locate previously unknown populations of alkaline wing-nerved moss by 2013.

Existing and Recommended Approaches to Habitat Protection

Three populations of alkaline wing-nerved moss, two west of Williams Lake and one south of Penticton at White Lake, are protected within permanent cattle enclosures. Historically, at White Lake, cattle and horses utilized the area. However, in 2000, The Nature Trust of British Columbia signed a 99 year lease in order to establish a study area in accordance with their 2000 Biodiversity Ranch Management Plan. As part of this plan, the lake and the surrounding vegetation, including two locations for alkaline wing-nerved moss, have been permanently excluded from grazing and other potential large-scale disturbances through the construction and maintenance of a fence. It is expected that the habitat in fenced areas will improve or, at least, be protected from degradation, although data are lacking on how changes will affect the population of this species. Improvement of range management for cattle and livestock to remove animals from sensitive areas such as water troughs, salt licks and potentially small exclusion fences at other locations where cattle graze are recommended.

Recommended approaches to protection of alkaline wing-nerved moss include stewardship with land owners and land managers. In the case of Churn Creek, this is a protected area under the B.C. *Park Act*, ATV's and motorcycles are prohibited. In addition, there is no driving allowed on the grasslands, and to control invasives, any horse feed must be pelleted or purchased from the ranch within the protected area.

Effects on Other Species

Impacts to other species or ecological processes are not anticipated during the initial stages of the recovery process. It is anticipated that some actions regarding the recovery of alkaline wing-nerved moss such as the maintenance and the establishment of protected areas may benefit other species, and this will be assessed as work is undertaken. At least one known COSEWIC-listed moss species, rusty cord-moss (*Entosthodon rubiginosus*), is present at the White Lake site, as are two CDC-listed moss species, Lamella pterygoneurum moss (*Pterygoneurum lamellatum*) (found at only three other locations in British Columbia) and Nevada pottia moss (*Pottia nevadensis*) (found at only two other locations in Canada). Interior alkaline vernal habitats, similar to where alkaline wing-nerved moss exists, are well known for the diversity of rare vascular plants that they support. The presence of rare vascular plants at known sites for the alkaline wing-nerved moss needs to be confirmed.

Socioeconomic Considerations

The socio-economic impact is considered low at most sites for alkaline wing-nerved moss, but is unknown until land ownership is assessed at others. Impacts of threats can likely be mitigated by

conscientious management practices rather than exerting a significant socio-economic impact. The ranching sector and municipalities could be most affected during the recovery process.

Recommended Approach for Recovery Implementation

There are a number of opportunities available to implement this recovery strategy. The South Okanagan Similkameen Conservation Program (SOSCP) and the East Kootenay Conservation Program (EKCP) should be contacted and be made aware of this species and its potential habitat. Integrating the protection of the alkaline wing-nerved moss within their conservation efforts would be beneficial to this species' recovery.

The Interior Grasslands Recovery Implementation Group (RIG) under the Ministry of Environment has been formed to provide administrative, policy/technical support and advice to the ecosystem-based SAR recovery action planning and implementation process throughout grasslands in the Southern Interior. This groups' intention is to work towards building a broad level of awareness and understanding about species at risk and land use pressures leading to fragmentation and development of grasslands and species at risk habitat. A draft action plan is an ecosystem-based, landscape-level plan which addresses the most significant threats to B.C.'s interior grassland ecosystems and species and identifies priority recovery actions for implementation (2009-2013). Alkaline wing-nerved moss is one of the species occurring in the regions covered by this action plan.

Statement on Action Plans

One or more action plans for the alkaline wing-nerved moss will be completed by 2013.

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