Species at Risk Act
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Adopted under Section 44 of SARA

Recovery Strategy for the Rusty Cord-moss (*Entosthodon rubiginosus*) in Canada

Rusty Cord-moss

2012

Canada

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For copies of the recovery strategy, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk (SAR) Public Registry (www.sararegistry.gc.ca).

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RECOVERY STRATEGY FOR THE RUSTY CORD-MOSS (*Entosthodon rubiginosus*) IN CANADA

2012

Under the Accord for the Protection of Species at Risk (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada.

In the spirit of cooperation of the Accord, the Government of British Columbia has given permission to the Government of Canada to adopt the "Recovery strategy for the Rusty Cord-moss (*Entosthodon rubiginosus*) in British Columbia" under Section 44 of the *Species at Risk Act*. Environment Canada has included an addition which completes the SARA requirements for this recovery strategy, and excludes the section on Socio-Economic Considerations. Socio-economic factors are not part of the consideration process for federal recovery strategies developed under SARA. These factors are kept isolated from this strategic phase of recovery planning.

2012

The federal Recovery Strategy for the Rusty Cord-moss in Canada consists of:

PART 1: Federal Addition to the "Recovery strategy for the Rusty Cord-moss (*Entosthodon rubiginosus*) in British Columbia", prepared by Environment Canada.

PART 2: "Recovery strategy for the Rusty Cord-moss (*Entosthodon rubiginosus*) in British Columbia", prepared by the British Columbia Bryophyte Recovery Team for the British Columbia Ministry of Environment.

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PART 1: Federal Addition to the “Recovery strategy for the Rusty Cord-moss (*Entosthodon rubiginosus*) in British Columbia”, prepared by Environment Canada

PREFACE

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress within five years.

SARA section 37 requires the competent Minister, which is the federal Minister of the Environment in this case, to prepare a recovery strategy for all listed extirpated, endangered or threatened species. SARA section 44 allows the Minister to adopt all or part of an existing plan for the species if it meets the requirements under SARA for content (sub-sections 41(1) or (2)).

The attached provincial recovery strategy (Part 2 of this document) was provided as science advice to the jurisdictions responsible for managing the species in British Columbia. Environment Canada has prepared this federal addition to meet the requirements of SARA.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Environment Canada, or any other jurisdiction, alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Rusty Cord-moss and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by Environment Canada and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

SPECIES STATUS INFORMATION

Legal Designation: SARA Schedule 1 (Endangered) (2006)

Table 1. Conservation Status of Rusty Cord-moss (from NatureServe 2011 and B.C. Conservation Framework 2011).

Global (G) Rank	National (N) Rank	Sub-national (S) Rank	COSEWIC Status	B.C. List	B.C. Conservation Framework
G1G3*; Rounded Global Status G2-imperiled	Canada (N1) United States (NNR)	Canada: British Columbia (S1); United States: Arizona (SNR), Montana (SH), New Mexico (SNR)	Endangered (2004)	Red	Highest priority: 1, under Goal 1**

* Rank 1– critically imperiled; 2– imperiled; 3- vulnerable to extirpation or extinction; 4- apparently secure; 5– secure; H– possibly extirpated; SNR – status not ranked
** The three goals of the B.C. Conservation Framework are: 1. Contribute to global efforts for species and ecosystem conservation; 2. Prevent species and ecosystems from becoming at risk; 3. Maintain the diversity of native species and ecosystems

It is estimated that the percent of the global range of this species in Canada is greater than 95%.

SPECIES AT RISK ACT REQUIREMENTS

The following sections address specific requirements of SARA that are either not addressed, or which need more detailed comment, in the "Recovery strategy for the Rusty Cord-moss (*Entosthodon rubiginosus*) in British Columbia" (Part 2 of this document, and referred to henceforth as "the provincial recovery strategy").

1. Socio-economic Considerations

The "Recovery strategy for the Rusty Cord-moss (*Entosthodon rubiginosus*) in British Columbia" contains a short statement on socio-economic considerations. As socio-economic factors are not a consideration in any aspect of the preparation of SARA recovery strategies, (see Section 41(1) of SARA), the Socio-economic Considerations section of the "Recovery strategy for the Rusty Cord-moss (*Entosthodon rubiginosus*) in British Columbia" is not considered part of the federal Minister of Environment's recovery strategy for this species. Furthermore, socio-economic factors were excluded from the preparation of all other sections of this federal addition, including Population and Distribution Objectives and Critical Habitat.

2. Recovery Feasibility

This section replaces the "Recovery Feasibility" section in the provincial recovery strategy.

Recovery of the Rusty Cord-moss (*Entosthodon rubiginosus*) is considered technically and biologically feasible based on the following four criteria (Government of Canada 2009):

1. Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future, to sustain the population or improve its abundance.

   Yes, there are at least four extant populations in Canada. Field data suggest that three of these populations are "apparently stable". Data for one population indicates a decreasing abundance trend.

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

   Yes, there is habitat to support the existing populations in British Columbia, and additional suitable habitat might also be made available through habitat management or restoration.

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

   Yes, the primary threat of habitat destruction by livestock can be avoided or mitigated through livestock control, in cooperation with land managers.

4. Recovery techniques exist to achieve the population and distribution objectives, or can be expected to be developed within a reasonable timeframe.

   Yes, the population and distribution objective can be achieved through ongoing threat mitigation techniques.

3. Population and Distribution

The table provided in this section replaces Table 1 in the "Populations and Distribution" section of the provincial recovery strategy, to incorporate the most recent data for the six known extant populations of Rusty Cord-moss in Canada.

Two of the four populations of Rusty Cord-moss occurring in the White Lake Basin near Penticton, B.C. (i.e., National Resource Council (NRC) Observatory Population, Grasslands PA Population) were not described in the provincial recovery strategy. These two populations were first observed by species specialist Terry McIntosh in 2011, and were unknown previously. Occurrence information for extant populations of Rusty Cord-moss is updated in a summary table (Table 2).

Table 2. Extant population sizes at Rusty Cord-moss sites in Canada. Refer to the provincial document for historical data and/or data for populations that are presumed extirpated.

Population[1]	Dates observed	Estimated number of patches/individuals and extent	Habitat characteristics
White Lake Basin – White Lake Population	1980, 1992, 2002–2007, 2011	>20 patches and some individual plants; occupied area est: > 500 m^2	Mainly on soil hummocks on gently sloping terrain and in portion of gully; > 99% of this population is inside fenced areas that prohibit livestock access; only a few individual plants were found in the grazed area
White Lake Basin – Park Rill Population	2006–2007, 2011	Hundreds of patches and many individual plants. The most extensive subpopulation is scattered in a 10-15 m wide by ~100 m long area	On soil alongside gullies or on hummocks in washed flats; the most extensive subpopulation is in the context of a shallow gully; there has been heavy livestock use at this site in previous years (but not in 2010-11)
White Lake Basin – NRC Observatory Population	2011	<10 plants; occupied area est.: 5 X 5 cm	Adjacent to a boulder, along the degraded stream near the Observatory gate; (protected from livestock) at the edge of a mostly dry watercourse; open landscape; livestock use common (hoof prints and manure)

[1] According to B.C. CDC standards, the White Lake Basin occurrences are considered separate populations as they are > 1 km apart and suitable habitat is lacking between the sites.

White Lake Basin – Grasslands PA Population	2011	>100 plants; occupied area est.: 5 X 5 m	On and adjacent to a wildlife trail in a low, moist area in open forest (Douglas-fir and ponderosa pine)
Princeton Population	1981–2002	2 patches (> 0.01 m^2) at the 1981 location and 1 patch at the 2002 location (> 0.01 m^2)	Very heavy livestock trampling present at the site
Riske Creek Population	2002	1 patch > 0.5 m^2	Moderate to low livestock trampling present across the site

4. Population and Distribution Objectives

This section replaces the "Recovery Goal" section in the provincial recovery strategy.

Environment Canada has determined the Population and Distribution Objective for Rusty Cord-moss to be:

To maintain the six known extant populations of this species at current locations in Canada. To maintain or improve current population sizes at these locations, as well as any other extant populations that may be identified.

Rationale:

Historical abundance and distribution information for this species show six[2] confirmed extant populations in British Columbia; four occur in the White Lake Basin (2006-2007, 2011 surveys), one is at Princeton (2002 survey), and one is at Riske Creek (2002 survey). The population at Princeton is described as "may be extirpated" in the provincial recovery strategy, however it was observed at the site in 2002, and suitable habitat may still be available. Therefore the Princeton population meets the criteria for inclusion as outlined in Appendix 1, in accordance with the purposes of SARA (i.e., precautionary approach, to ensure maintenance of all extant populations). Historical data also provide record of one possibly extirpated population near Kamloops, B.C. The Kamloops population was recorded in a 1980 survey of the site, and it was not relocated in any subsequent surveys (2002-2003, 2005). Habitat characteristics were not described for this population in the 1980 survey, and housing developments have spread into the area where it was observed. As there is no information to suggest that this population has persisted, recovery should focus on maintenance of the existing six populations. There is no information to indicate that the species was previously more widespread, therefore an objective to actively increase the number of populations, which may allow for downlisting of the species, is also not appropriate. However, if additional naturally occurring populations are discovered, they should also be maintained.

[2] Four extant populations are described in the provincial recovery strategy. May-June 2011 surveys re-confirmed the two populations previously known from the White Lake Basin, and also revealed two new populations within that area (observers Kella Sadler (Environment Canada), Terry McIntosh (Consultant), Greta Westby).

5. Critical Habitat

5.1 Identification of the Species' Critical Habitat

This section replaces the "Critical Habitat" section in the provincial recovery strategy.

Section 41 (1)(c) of SARA requires that recovery strategies include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction. The 2008 provincial recovery strategy for this species noted that critical habitat could not be identified at that time (nor is it required in the provincial process), but that it might be identified in a subsequent federal strategy or addition. This federal document does identify critical habitat to the extent possible for this species. More precise boundaries may be mapped, and additional critical habitat may be added in the future if ongoing research (e.g. through work by the province, stewardship and recovery groups, university projects, or related federal Interdepartmental Recovery Fund projects) supports the inclusion of areas beyond those currently identified. A primary consideration in the identification of critical habitat is the amount, quality, and locations of habitat needed to achieve the population and distribution objectives.

Ecological attributes of Rusty Cord-moss habitat are outlined in the provincial recovery strategy:

1. It is found mainly in the Ponderosa Pine, Bunchgrass, and dry Interior Douglas-fir Biogeoclimatic Zones, in south-central portions of British Columbia;
2. Within these environments, Rusty Cord-moss is found in relatively low elevations, in sagebrush or grassland habitats;
3. Microhabitat properties include:
    a. Exposed areas,
    b. Along the edges of seasonally wet, alkaline areas where bare soil is available, such as late autumn and spring wet, alkaline ponds, lakes, and sloughs, and on seepage slopes or narrow gullies, or
    c. On flat to very gentle slopes within a low-growing vegetation zone above, but not in, a zone defined by a complete alkaline-deposit crust; the low-growing vegetation is often defined by the presence of two graminoid species: black-footed sedge and saltgrass as well as associated moss species.

Critical habitat for Rusty Cord-moss is fully identified for the six known extant populations, occurring within the White Lake Basin (four populations), near Princeton (one population) and near Riske Creek (one population), British Columbia.

Critical habitat is identified as the area occupied by individual plants or patches of plants, including the associated potential location error from GPS units, plus an additional 50 meters to encompass the immediately adjacent areas. Key ecological features that are integral to Rusty Cord-moss occurrence include local seepage slopes and drainage pathways; i.e., proximal hydrological processes in the immediately adjacent areas produce and maintain suitable microhabitat conditions for the species. Where a seepage slope or drainage pathway is apparent

as a distinct ecological feature[3] at the landscape scale, the entire portion of the seepage slope or drainage pathway associated with the plant or patch of plants is also identified as critical habitat. Connectivity is maintained between sub-populations[4] where they occur in close proximity, and where there is consistent intermediate habitat. The exact areas identified as critical habitat, and the methodology behind the identification, are described in Appendix 1.

5.2 Schedule of Studies to Identify Critical Habitat

This section replaces the "Recommended schedule of studies to identify critical habitat" section in the provincial document.

Critical habitat has been fully identified in this document; therefore no schedule of studies is required.

5.3 Examples of Activities Likely to Result in Destruction of Critical Habitat

Understanding what constitutes destruction of critical habitat is necessary for the protection and management of critical habitat. Destruction is determined on a case by case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time. Activities described in Table 3 include those likely to cause destruction of critical habitat for Rusty Cord-moss; destructive activities are not limited to those listed.

Table 3. Examples of activities likely to result in destruction of critical habitat for Rusty Cord-moss.

Activity	Description of how activity may result in destruction of critical habitat	Threat level
Intensive[5] livestock use	Results in trampling of habitat (i.e., alteration of local biophysical properties), including disturbance or compaction of soil by animal hooves. Effect may be immediate or long-term, and cumulative.	High
Deliberate introduction of alien invasive plants	Direct effect is a reduction of space and soil available for Rusty Cord-moss, and indirect effects, e.g., alteration of shade, water, and nutrients available to exclude niche range of Rusty Cord-moss.	Low / Unknown

[3] "Distinct" ecological, or landscape features are here referred to as those that are distinguishable at a landscape scale (through use of detailed ecosystem mapping or aerial photos), which, at that scale, appear as ecologically contiguous features with relatively distinct boundaries (e.g., cliffs, banks, or slopes, drainage basins, seepage plateaus, or distinct vegetation assemblages), and which comprise the context for a species occurrence.
[4] "Populations" are separated by >1 km; "sub-populations" represent records of individuals, or patches of individuals, that are within 1 km of each other.
[5] Additional research is required to determine what level of livestock use is considered destructive to Rusty Cord-moss, i.e., the level at which ecological attributes necessary for long-term persistence are destroyed.

Use of ATVs or other vehicles outside of existing trails	Results in disturbance of local biophysical conditions, including immediate or proximal substrate properties, to the extent that the habitat is no longer suitable for Rusty Cord-moss.	Low / Unknown
Deliberate modification of local hydrological processes	Results in change in drainage patterns and/or lake water level to the extent that habitat moisture regime is no longer suitable for Rusty Cord-moss.	Low / Unknown

Livestock, in particular cattle but occasionally horses, have been identified as the major threat likely to result in destruction of critical habitat for Rusty Cord-moss. Habitat may be destroyed by trampling, and compaction or disturbance of soil by animal hooves. Cattle are present in all of the areas where Rusty Cord-moss has been found, and heavy trampling is common in the habitats where most populations are found.

This species takes advantage of bare open soil, caused by small-scale erosion and disturbance (e.g., digging by Pocket Gophers, *Thomomys talpoides*). As a colonizer of open soil, is likely at a competitive disadvantage when growing among other mosses and vascular plants. Therefore, critical habitat may be destroyed by the deliberate introduction of invasive plants which would compete with Rusty Cord-moss.

6. Statement on Action Plans

One or more action plans will be posted on the Species at Risk Public Registry by 2017.

7. Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself.

Impacts to other species, natural communities, or ecological processes are not anticipated during the initial stages of the recovery process for Rusty Cord-moss. It is anticipated recovery actions, such as the recommended habitat protection, will indirectly benefit associated species at risk. For example, several other endangered plant species that are present at the White Lake site, including: SARA-listed Alkaline Wing-nerved Moss (*Pterygoneurum kozlovii*), and Showy Phlox (*Phlox speciosa* ssp. *occidentalis*), and provincially endangered mosses *Pterygoneurum lamellatum*, and *Pottia nevadensis*. In acknowledgement of the high potential for shared habitat among local species at risk, large-scale management actions should be planned and implemented carefully. All

on-site activities (surveys, research, and management) to aid recovery may pose a threat to co-occurring species (e.g., via trampling, increase or decrease in herbivory, or inadvertent dispersal of alien species), unless care is taken to avoid damage.

8. References

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Appendix 1. Critical habitat identification and location

1. Decision tree for critical habitat identification

In Canada, there are six confimed populations of Rusty Cord-moss. Four populations are in the White Lake Basin (White Lake, Park Rill, NRC-Observatory, and Grasslands PA populations - Figures A1- A4), and two are at Princeton and Riske Creek (Figure A5, and Figure A6). A decision tree was developed to identify critical habitat for these populations, based on available knowledge.

The first decision is regarding the quality of available information on all records[6] of this species in Canada, with the choice of accepting or rejecting any given record for consideration as critical habitat based on three criteria, i.e., time since most recent observation, location uncertainty, and observation of current habitat suitability.

The second decision is based on how readily the habitat is able to be defined. For all accepted records a minimum "critical function zone" distance[7] is imposed. If critical habitat is readily identifiable based on available ecological information (ecosystem and/or aerial photo mapping, as well as expert advice from individuals who have specialized knowledge of the species and its locations), boundaries are extended on that basis to include areas of importance; i.e., priority landscape features that are plainly critical to the occurrence. "Distinct" ecological, or landscape features are here referred to as those that are distinguishable at a landscape scale (through use of detailed ecosystem mapping or aerial photos), which, at that scale, appear as ecologically contiguous features with relatively distinct boundaries (e.g., cliffs, banks, or slopes, drainage basins, seepage plateaus, or distinct vegetation assemblages), and which comprise the context for a species occurrence.

If the information described above is not available, i.e., (a) absence of high-resolution mapping, (b) lack of detailed ecosystem information, or (c) lack of expert advice, and/or (d) absence of any apparent landscape features of critical importance which would direct identification, then a formula for minimum habitat size (defaulting to minimum "critical function zone" distance) is proposed.

This approach (1) allows for an emphasis on ecological attributes which are of actual importance to the species, (2) permits the opportunity to use all available types of knowledge and information on a priority basis (i.e., within the context of a logical sequence of implementation), and (3) provides a method to identify critical habitat when detailed and/or specialized knowledge is lacking.

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[6] "Records" are here referred to as the finest-scale of data available (i.e., point data representing individual plants, or polygons representing discrete patches of plants). The term "occurrence" is used synonymously in this text, to describe actual portions of a landscape that are occupied by individuals or patches of individuals, and which form the basis for critical habitat mapping.

[7] Minimum "critical function zone" distance is defined here as 50 m additional to the area of occupancy. Detailed rationale for use of this distance is included in section 2 of this Appendix.

Decision Tree:

1a. Occurrences have not been revisited for >25 years, **and** use imprecise and/or inaccurate geographic referencing systems (location uncertainty distance is greater than 100 m), **or** the habitat no longer exists at that location to support the species (no critical habitat will be defined until more is known about the population and location)

1b. Occurrences have been relocated and revisited in the past 25 years, **or** habitat has been revisited in the past 5 years to confirm it has the potential to support an occurrence, **or** geographic reference is accurate and precise (location uncertainty distance is less than 100 m) (go to 2)

2. Minimum critical habitat identified for ALL occurrences will include (*a*) specified area of occupancy, (*b*) all of the habitat within the GPS error distance (m) of the specified area of occupancy, and (*c*) an added minimum critical function zone distance of 50 m to ensure the inclusion of all necessary habitat associated with the occurrence (refer to rationale section following the decision tree), i.e., in all cases:

- *Minimum critical habitat (distance to boundary) = occurrence area + b + c*

2a. Where the species is a generalist associated with widespread habitats, **or** a specialist that occupies dynamic disturbance regimes difficult to delineate as patches in space, **or** occupies habitat that is otherwise poorly defined, **or** the best available information does not support more detailed interpretation and determination of critical habitat at a landscape scale, the minimal critical function zone distance (as defined above) is maintained around all occurrence areas.

2b. Where the species occupies readily identifiable habitat patches, such that any or all of the following methods of determination are available, and applicable, and support more detailed interpretation and determination of critical habitat:

- use of detailed ecosystem mapping
- use of aerial photos for identification of critical landscape features, and opportunities for connectivity, particularly wherever habitat quality and characteristics are continuous between patches
- use of any existing studies that can provide more detailed insight into critical habitat location and connectivity between occurrences
- consideration of any special circumstances or threats

In this case, this additional set of information may be used to extend critical habitat identification beyond the minimal critical habitat distance described above, i.e.:

- *Critical habitat (distance to boundary) = occurrence area + b + c + d*

Where *d* = extent of additional critical habitat identified; i.e., landscape feature, connectivity corridor, adjustment for special circumstances. In order to ensure that the identification of critical habitat is biologically defensible, extended and/or irregular critical habitat boundaries should be developed with, agreed upon, and confirmed by, species experts and/or relevant recovery teams.

2. Rationale for decision tree hierarchy

To identify habitat critical for the survival or recovery of a plant, it is necessary to consider factors that contribute to sustained reproductive success and colonization (i.e., dispersal of propagules, successful germination, and natural population fluctuation), as well as primary resources required for growth (i.e., space, water, sunlight, nutrients).

Population dynamics for plants in early successional environments may show greater fluctuation, both spatially and temporally, as compared to plants that comprise later-successional environments. This can be attributed to contrasting life history strategies typical of colonizing, versus competitive, and/or slow-growing species. Colonizing species can occupy patches opportunistically and perpetually within early-successional habitats (Hanski 1982), and are dependent on (a) local ecosystem dynamics, to perpetuate the creation of suitable habitat patches, and (b) connectivity between patches, for successful dispersal and colonization. Patch dynamics may be important within the context of later-successional environments as well, e.g. some species may persist as "satellite" species in old growth forest, colonizing new forest gaps. Plants with a more competitive live history approach (typically perennial, slower-growing) will have occurrences that are more spatially and temporally consistent, and which may therefore exhibit a more directly observable link between "threshold" breeches in required microhabitat properties, and population decline.

In most cases a detailed understanding of population dynamics will not be available for individual plant species at risk. The task, therefore, is to identify the properties that we know are of critical importance to its success, built on a prioritized model of (1) identifying basic biological requirements, (2) understanding ecological dynamics that relate to the context of the occurrence, (3) promoting connectivity between occurrences to foster reproductive success, and (4) accounting for special circumstances and threats.

The first priority in critical habitat identification should be to identify the primary resources required for the species growth. Each plant species has a different range of biological requirements, however. Where species occur, niche requirements have been met; therefore it follows that identifying an occurrence will involve identifying the unique combination of microhabitat properties at that site. It is understood that activities in areas proximal to an occurrence will affect local microhabitat properties. The distance at which proximal effects will impact rare plant occurrences may vary, depending on circumstance. Since it is unlikely that all factors contributing to local microhabitat can be identified, it is reasonable to include as critical habitat a minimum distance to ensure the maintenance of required microhabitat properties, wherever specialized information is lacking.

Existing research has identified bryophytes (mosses and liverworts) and lichens as uniquely sensitive indicators of microhabitat change. Lacking roots, bryophytes take up the majority of water and nutrients through atmospheric inputs, and as well as passively from the substrata on which they grow (Schofield 1985). As such, this group of plants has been used in monitoring a range of environmental effects, including acid raid, air pollution, and identifying threshold habitat fragment size for maintaining constituent microhabitat properties (light, moisture, humidity).

Studies that have used bryophytes or lichens to identify edge effect thresholds in mixed forest and coniferous forests (Esseen & Renhorn 1998, Baldwin & Bradfield 2005) have identified effects up to a distance of 45-50 m into remnant habitat fragments. Similarly, a study on microenvironmental gradients at habitat edges, i.e., light, temperature, litter moisture, vapor pressure deficit, humidity (Matlack 1993), and a study of edge effects as evidenced by changes in plant community structure and composition (Fraver 1994), each showed that effects could be detected to 50 m into habitat fragments. Forman and Alexander (1998) and Forman et al. (2003) found that most roadside edge effects on plants resulting from construction and repeated traffic have their greatest impact within the first 30 to 50 m. These data provide a logical basis for suggesting a minimum critical function zone distance of 50 m to ensure microhabitat properties for rare plant species occurrences are incorporated in the identification of critical habitat.

Once a critical function zone distance has been determined (minimum = 50 m), and where additional information exists, these boundaries may be built on or extended to account for factors identified previously (context, connectivity, special circumstances and threats). Ecosystem features that are discrete, identifiable, and which are logically associated with an occurrence should be included in the identification of critical habitat. That is, critical habitat should be identified such that relevant ecosystem dynamics (i.e., that directly contribute to spatial, and temporal perpetuation of the species) are included, wherever they can be determined, using the best available knowledge. Where habitat is consistent between existing occurrences, connectivity should be maintained. Finally, special circumstances should also be considered which may support a critical function zone distance that is greater than the standard minimum (50 m), e.g., proximity to dominant invasive alien species and/or roadside planting that would rapidly reduce or alter existing habitat (Jordan et al. 2008, Van Riper and Larson 2009), or proximity to heavy roadside or industrial emissions that would result in increased deposition of deleterious chemicals and alteration of existing habitat. Some species may be particularly sensitive to atmospheric deposition, which is detectable in plants and soils up to 1 to 2 km away from the source (Meshalkina et al. 1996, Hao et al. 2006, Kochy and Wilson 2001). In some cases, and based on supporting evidence, site- and species-specific factors could logically modify the placement or distance of critical habitat boundaries, based on the area required to maintain necessary resources for plant survival.

Anthropogenic features including roads and well-established trails are not identified as critical habitat, even when they occur within the minimum critical function zone distance. It is not clear at this time whether or to what extent these features provide an essential ecological function (i.e., how they influence resources such as light, heat, moisture, nutrients, etc.) to support Rusty Cord-moss populations.

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4. Maps of critical habitat for Rusty Cord-moss in Canada

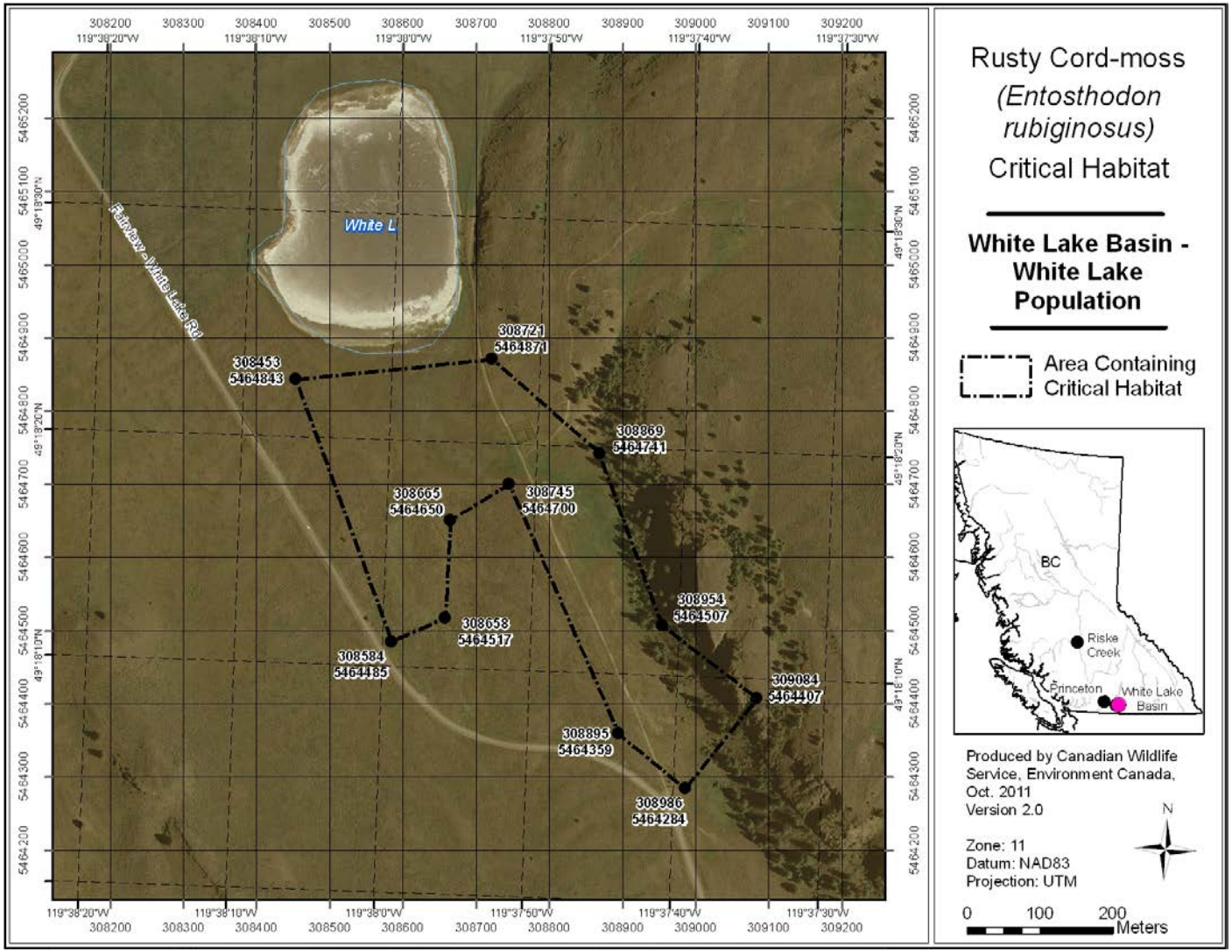

Figure A1. Critical Habitat for Rusty Cord-moss at White Lake (White Lake Basin), South Okanagan, British Columbia; the White Lake Population corresponds with the “White Lake Basin 1” population in the provincial recovery strategy. Anthropogenic features within the indicated polygon, including roads and well-established trails, are not identified as critical habitat.

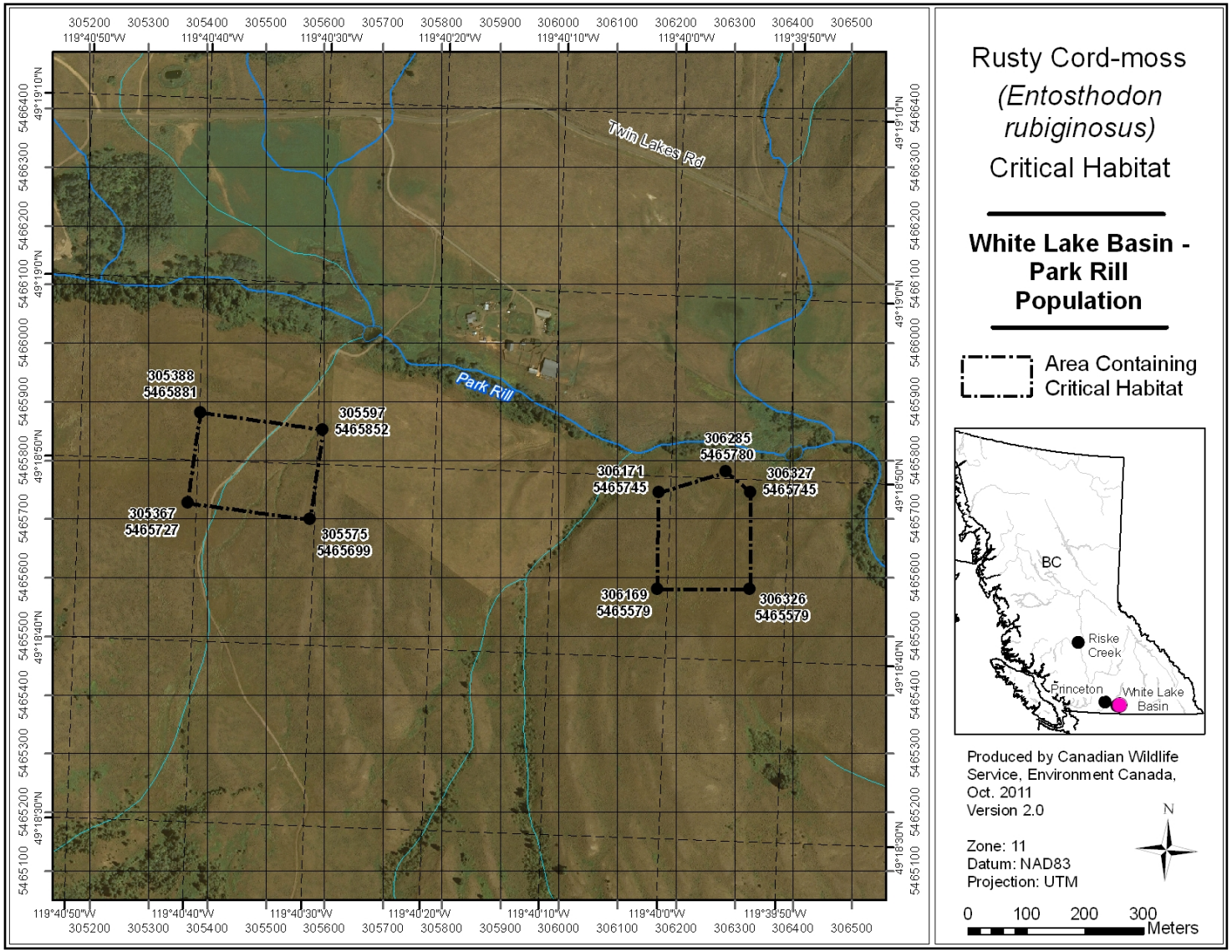

Figure A2. Critical Habitat for Rusty Cord-moss at Park Rill (White Lake Basin), South Okanagan, British Columbia; the Park Rill Population corresponds with the “White Lake Basin 2” population in the provincial recovery strategy.

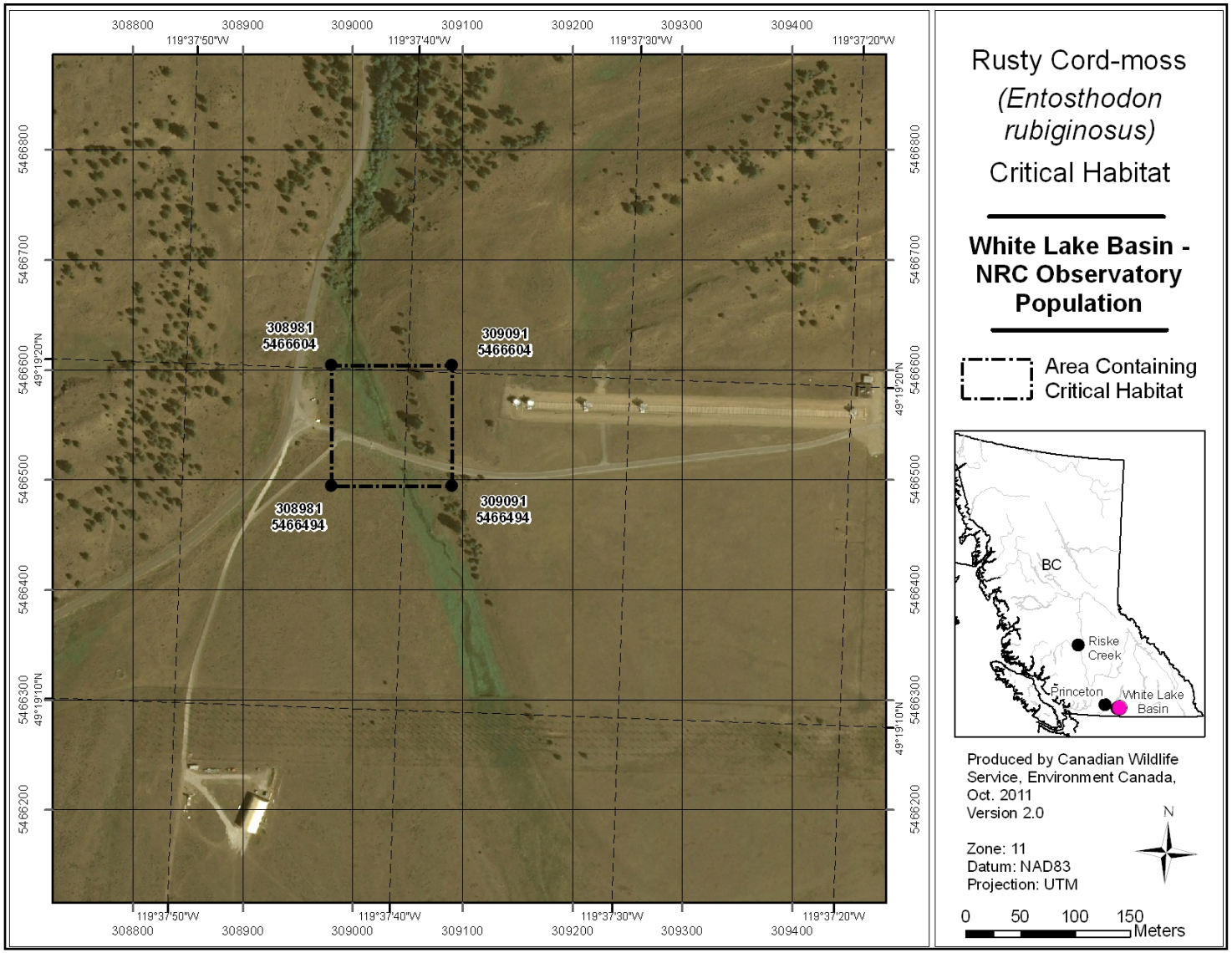

Figure A3. Critical Habitat for Rusty Cord-moss at the NRC Observatory (White Lake Basin), South Okanagan, British Columbia; this population is not described in the provincial recovery strategy.

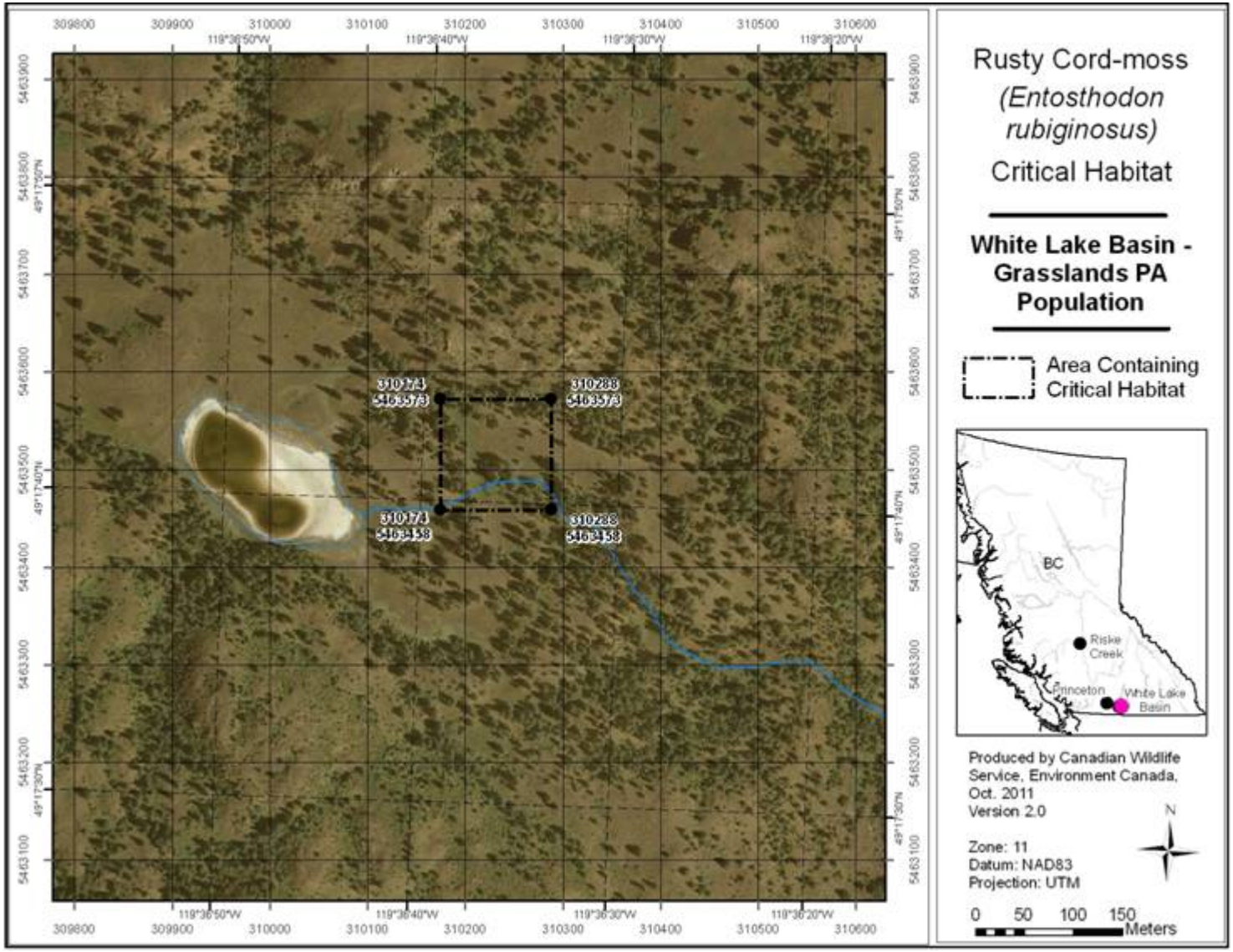

Figure A4. Critical Habitat for Rusty Cord-moss occurring in the provincial White Lake Grasslands Protected Area (White Lake Basin), South Okanagan, British Columbia; this population is not described in the provincial recovery strategy.

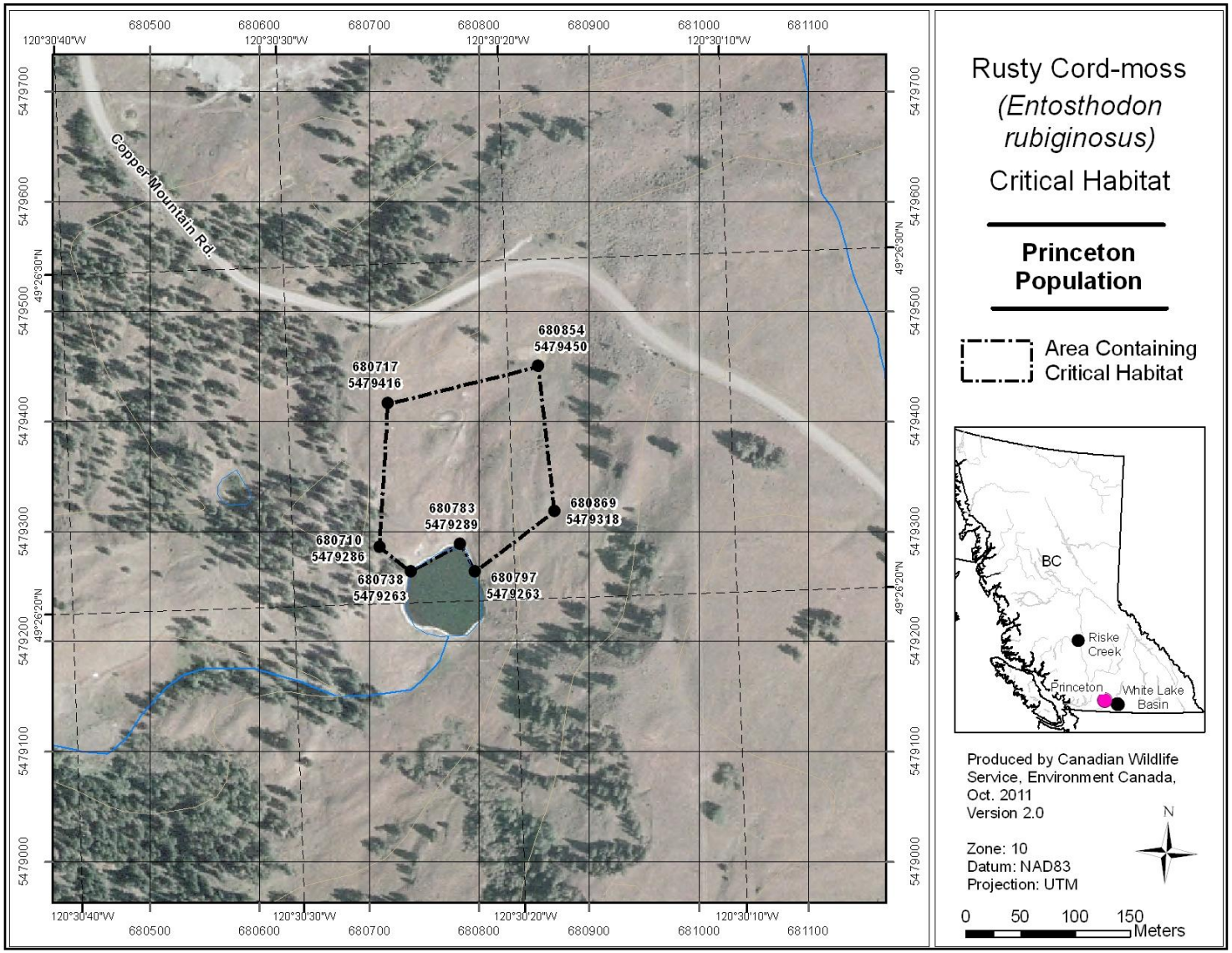

Figure A5. Critical Habitat for Rusty Cord-moss near Princeton, British Columbia; this population corresponds with the “Princeton” population in the provincial recovery strategy.

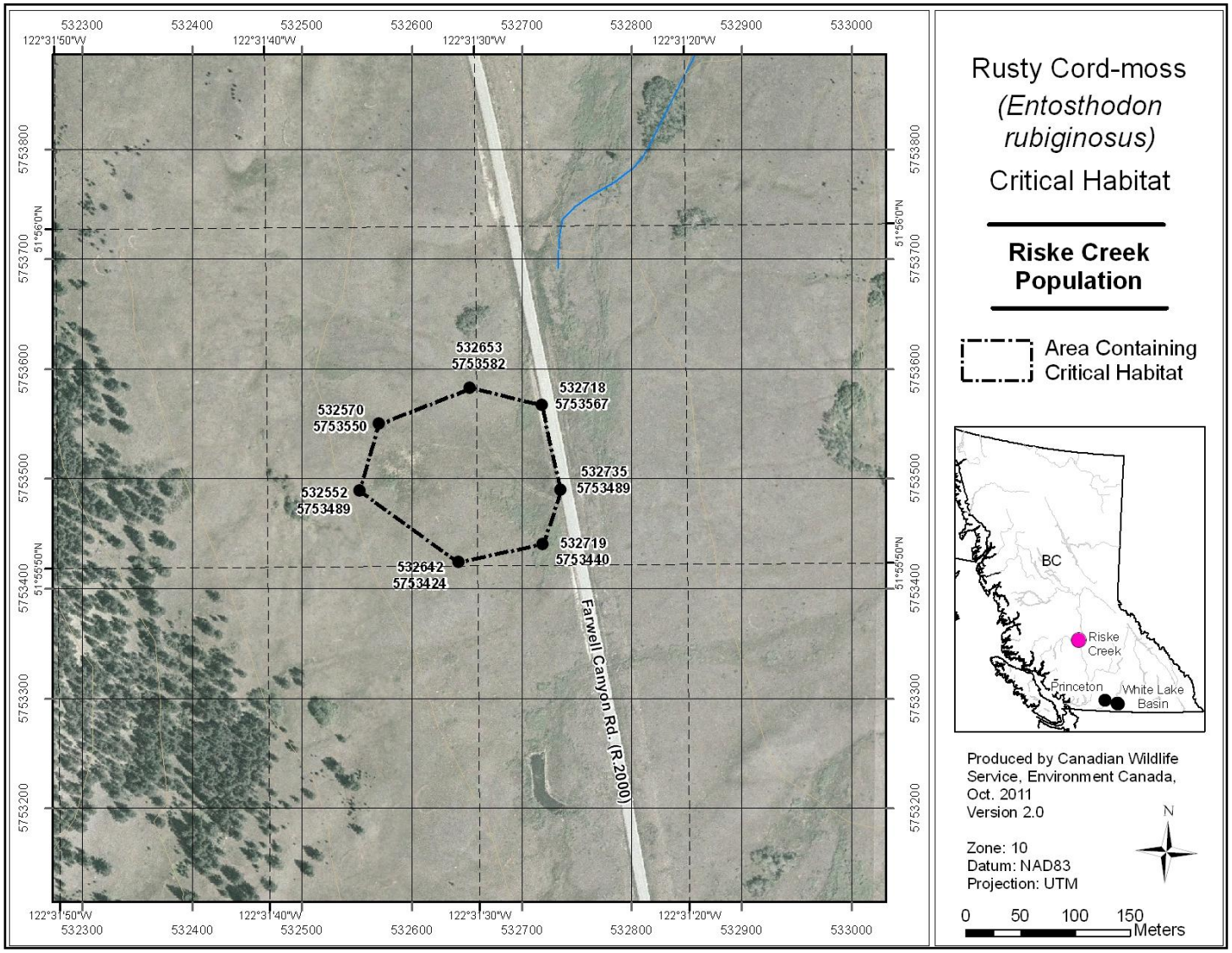

Figure A6. Critical Habitat for Rusty Cord-moss near Riske Creek, British Columbia; this population corresponds with the “Riske Creek” population in the provincial recovery strategy. Anthropogenic features within the indicated polygon, including roads and well-established trails, are not identified as critical habitat.

PART 2: Recovery Strategy for the Rusty Cord-moss (*Entosthodon rubiginosus*) in British Columbia, prepared by the British Columbia Bryophyte Recovery Team for the B.C. Ministry of Environment

Recovery Strategy for the Rusty Cord-moss (*Entosthodon rubiginosus*) in British Columbia

Prepared by the British Columbia Bryophyte Recovery Team

BRITISH COLUMBIA
The Best Place on Earth
Ministry of Environment

November 2008

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' 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>

Recovery Strategy for the Rusty Cord-moss (*Entosthodon rubiginosus*) in British Columbia

Prepared by the British Columbia Bryophyte Recovery Team

November 2008

Recommended citation

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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 the rusty cord-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 the rusty cord-moss.

RECOVERY TEAM MEMBERS

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RESPONSIBLE JURISDICTIONS

The British Columbia Ministry of Environment is responsible for producing a recovery strategy for the rusty cord-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.

ACKNOWLEDGEMENTS

The B.C. Ministry of Environment funded this recovery strategy.

EXECUTIVE SUMMARY

The rusty cord-moss (*Entosthodon rubiginosus)* was designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered in November 2004, and listed on the federal *Species at Risk Act* (SARA) Schedule 1 in November 2006. Its current known Canadian range consists of 5 scattered populations in south-central British Columbia. The rusty cord-moss is a tiny plant that grows as individuals or in small patches in semi-arid regions of the province. It is restricted to open mineral soil alongside seasonally wet, alkaline ponds, lakes, and sloughs, and on seepage slopes or narrow gullies.

Potential threats to the survival of the population include the degradation or destruction of the habitat through livestock damage, invasive alien plants, and ATV use.

Recovery Goal

The goal of the rusty cord-moss recovery strategy is to protect and maintain known populations in Canada.

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 the rusty cord-moss;
II. To determine the level of real and potential threats to this species and its habitat and to mitigate their effects;
III. To determine the precise habitat requirements of the populations of the rusty cord-moss; and
IV. To determine sizes and population trends of the known populations.

No critical habitat can be identified for rusty cord-moss in Canada at this time, but it may be identified at a later date in a federal addendum by Environment Canada, or in a future action plan. 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 the populations to determine population trends. Consultation with affected landowners and organizations will also be necessary.

An action plan will be completed by 2012.

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BACKGROUND

Species Assessment Information from COSEWIC

Date of assessment: November 2004
Common name (population): Rusty Cord-moss
Scientific name: *Entosthodon rubiginosus*
COSEWIC status: Endangered
Reason for designation: This species is endemic to western North America where it occurs in southern British Columbia, and has been reported from Montana, Arizona, and New Mexico. This moss has a highly restricted distribution in south-central British Columbia where only four populations have been found. Of these, three populations are extant, and one was not relocated; the species is not abundant at any known site. The species' habitat is a narrow band of shoreline dominated by grasses and other mosses in seasonally wet, alkaline habitats. Two populations have been affected by horses or cattle, and all sites examined have been impacted to varying degrees by domestic animals. At least a portion of one population has been lost as result of trampling by domestic animals.
Canadian occurrence: British Columbia
COSEWIC status history: Designated Endangered in November 2004. Assessment based on a new status report.

Description of the Species[1]

The rusty cord-moss grows as inconspicuous, 2–3 mm tall plants, either as individuals or in small patches. Mature plants have their leaves crowded at the summit of an erect stem. The leaf mid-rib in the upper leaves often extends from the leaf tip, forming a short point. It has male and female structures on the same plant, helping to ensure annual production of sporophytes (comprised of a stalk and a spore-bearing capsule). The sporophytes of the rusty cord-moss grow from the tops of the leafy stems. They mature in the late winter and into the spring, range in height from 4 to 7 mm, and usually remain obvious into the summer (Figure 1), even though the leaves wither. This species has relatively large and distinct calyptrae (hoods) that protect the developing sporophyte by nearly completely covering the maturing capsules (Figure 2). Mature capsules are erect; red- to yellow-brown' and, when dry, usually contracted below the mouth and wrinkled at the base. The walls of the capsule are comprised of distinctive elongate and thick-walled cells. Although considered an annual species, the rusty cord-moss may be a perennial or a short-lived perennial (COSEWIC 2004). Persistent, small buds are present on some of its underground stems and they may act as a means of vegetative reproduction.

Because of its tiny size, the rusty cord-moss is usually difficult to observe in the field. Also, it might be confused with another small species, *Pterygoneurum ovatum* (common wing-nerved moss), which also has erect, reddish-brown capsules. However, this species has capsules that are usually wrinkled to near the top, and has leaves with long hair-points and flaps along the mid-rib of the leaves. Also, it is only occasionally found near the alkaline habitats where the rusty cord-moss grows.

[1] This description is based on COSEWIC (2004), Lawton (1971), and Miller and Miller (2007).

Figure 1. Patch of the rusty cord-moss showing dried capsules (photograph by Ole Westby).

Figure 2. Plants and young sporophytes of the rusty cord-moss (photograph by Ole Westby).

Populations and Distribution

The rusty cord-moss is endemic to western North America where it has a widely scattered distribution. It has been reported from southern B.C., Montana (this population is probably extirpated; NatureServe Explorer 2008), Texas, and New Mexico (Miller and Miller 2007; Figure 3). Five populations of the rusty cord-moss have been reported for Canada, all from south-central B.C. Two populations are in the White Lake basin in the southern Okanagan Valley, with single populations reported from southeast of Princeton, northwest Kamloops, and just south of Riske Creek west of Williams Lake (Figure 4). Table 1 lists observation dates for all occurrences. Over the past three decades, Terry McIntosh (pers. comm., 2008) has investigated hundreds of alkaline wetlands and seepage slopes that have potential habitat for this species in B.C. (McIntosh 1986; COSEWIC 2004), and he confirmed the presence of this species at only the five sites. However, the edges of many of these ponds and the potential habitat for this species are extensive, covering hectares at some sites; this species could have been overlooked at some of the sample sites.

Globally, this species is listed as G1G3 (critically imperiled to vulnerable to extirpation or extinction) by NatureServe Explorer (2008) and it is Red-listed (S1; critically imperiled) by the B.C. Conservation Data Centre (B.C. Conservation Data Centre 2008). The Montana Natural Heritage Program (2008) ranks it SH for the state (H = Historical, known only from records over 50 year ago). It is not listed for New Mexico (Natural Heritage New Mexico 2008). NatureServe does not list this species as being in Texas (NatureServe Explorer 2008), and the Texas Natural Heritage Program has been discontinued.

The original White Lake population has been observed seven times since its discovery in 1980 (McIntosh 1986, 1989). The second White Lake population was discovered about 2 km west of the original site in 2006. A few plants of the rusty cord-moss were observed in a small, seasonally wet depression southeast of Princeton in 2002 (COSEWIC 2004), but not at its original 1981 location (about 100 m from the 2002 observation), which had been heavily trampled by livestock. Subsequent examination of the Princeton site in 2004 and 2006 showed that livestock trampling across the area where this species was observed appeared to have increased, and no plants were found at either location. This population of the rusty cord-moss may be extirpated. The Riske Creek population has not been revisited since 2002. The population of the rusty cord-moss near Kamloops was not relocated during 2002 surveys (COSEWIC 2004).

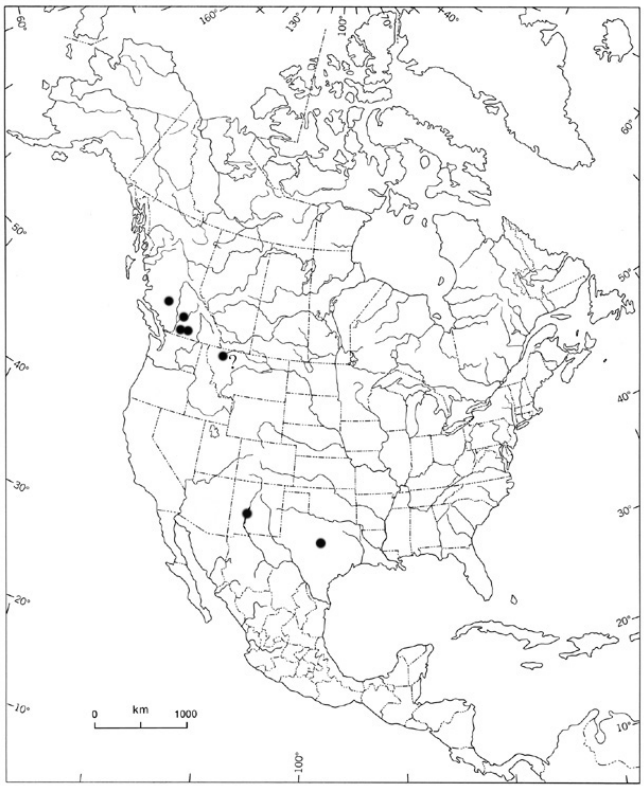

Figure 3. North American distribution of the rusty cord-moss.

Figure 4. Canadian distribution (B.C.) of the rusty cord-moss (White Lake populations are represented by one dot only).

Table 1 lists population data for the known occurrences of this species in B.C. Three of the occurrences of the rusty cord-moss (Kamloops, Princeton, and Riske Creek) are represented by a few small (< 1 cm) patches or as scattered individual plants and are apparently restricted to relatively small areas at each site. The two larger populations in the White Lake basin represent, to date, the largest known global concentrations for this species. In 2006, a detailed survey for this species was completed at White Lake (by T. McIntosh and J. Cameron) and numerous patches were observed at the original site and marked for follow-up observations.

The Canadian populations of the rusty cord-moss probably represent over 95% of its global distribution and abundance. Because populations were not estimated through time, the population trends of the rusty cord-moss cannot be assessed. However, the following is currently known about some populations: one population (Princeton) is probably extirpated because of livestock trampling, and a second (Kamloops) may also be extirpated as housing developments have spread into the area. The White Lake basin populations appear relatively stable, and the Riske Creek population, although not revisited, is also probably stable as the site appears not to have changed significantly since 2002 (F. Knezevich, pers. comm., 2007).

Table 1. Population data for the rusty cord-moss in Canada.

Population number and locality	Dates observed	Estimated number of patches/individuals and extent	Habitat characteristics	Population trend	Land tenure
1. Kamloops	1980	At least 10 individuals (counted in the herbarium collection)	Extent and habitat not described in 1980 (unknown)	Unknown (possibly extirpated)	Crown land
2. White Lake Basin 1[a]	1980, 1992, 2002–2007	~20 patches and some individual plants > 500 m^2	Mainly on soil hummocks on gently sloping terrain; > 99% of this population is inside fenced areas that prohibit livestock access; only a few individual plants were found in the grazed area	Apparently stable	Federal (leased to The Nature Trust of British Columbia)
3. White Lake Basin 2	2006–2007	~30 patches and many individual plants > 400 m^2 area; the most extensive subpopulation is found as a series of ~20 patches in a ~2 × 3 m area	On soil alongside gullies or on hummocks in washed flats; there is occasional trampling and some horse dung covering some patches of the most extensive subpopulation in a shallow gulley; heavy livestock trampling is	Apparently stable	Federal

			present at two of the other microsites (the patches here are smaller than average)		
4. Princeton	1981–2002	2 patches (> 0.01 m^2) at the 1981 location and 1 patch at the 2002 location (> 0.01 m^2)	Very heavy livestock trampling present at the site	May be extirpated	Crown land
5. Riske Creek	2002	1 patch > 0.5 m^2	Moderate to low livestock trampling present across the site	Probably stable	Crown land

[a] According to B.C. Conservation Data Centre (CDC) standards, the White Lake basin occurrences are considered separate populations as they are > 1 km apart and suitable habitat is lacking between the sites.

Needs of the Rusty Cord-moss

Habitat and biological needs

In B.C., the rusty cord-moss grows on naturally exposed mineral soil alongside late autumn and spring wet, alkaline ponds, lakes, and sloughs; and on seepage slopes or narrow gullies in the hottest portions of the dry interior. Frequent associated plants include saltgrass (*Distichlis stricta*) and field sedge (*Carex praegracilis*), as well as several mosses: *Pterygoneurum ovatum*, *Pterygoneurum lamellatum*, *Bryum* spp., *Tortula acaulon*, and *Drepanocladus* sp. (the latter moss taxa have no common names). The general topography at most sites is flat to very slightly sloping. In these habitats, bare soil is available through small-scale erosion, mainly caused by runoff following rains or snowmelt, or through the digging of pocket gophers (*Thomomys talpoides*) that produce mounds of open soil. The rusty cord-moss appears to take advantage of the open soil on these mounds, avoiding litter buildup and competition from vascular plants. On seepage slopes and gullies, bare soil is produced through small-scale erosion and not by pocket gophers (T. McIntosh, pers. comm., 2008).

Alkaline habitats where this species can potentially occur are relatively common in low elevation, open areas in the south-central portions of the province, as well as in the Rocky Mountain Trench. Alkaline wetlands where this moss has been found occur in grassland habitats mainly in the Ponderosa Pine but also in the Bunchgrass and dry Interior Douglas-fir biogeoclimatic ecological zones (M. Ryan., pers. comm., 2008).

There is little published information about the general biology and reproductive capacity of the rusty cord-moss. However, some field observations on microhabitat and spore production are available (T. McIntosh, pers. comm., 2008). The primary means of dispersal and reproduction of most mosses in this type of habitat is by spores, and the rusty cord-moss appears to produce spores regularly. There are no data on spore dispersal distances, viability, or germination success for this species, although moss spores in this type of habitat are likely dispersed by water or wind, as well as possibly by insects. Also, this species appears to reproduce asexually via buds along underground stems.

Ecological role

Because this species is a colonizer of open soils, it may have a role in soil stability, although this would be minor due to the size of this species and its limited distribution. No other ecological role is known.

Limiting factors

The rusty cord-moss's small size may be a competitive disadvantage when growing among other mosses and vascular plants. Also, it may easily be buried by vascular plant litter. Habitat specificity, such as soil type and moisture, may also be a limiting factor. Long periods of drought may also be a limiting factor for this species, however, it is unknown whether drought has caused a population decline (COSEWIC 2004).

Threats

Threat classification

Table 2. Threat classification table for rusty cord-moss.

1	**Livestock**		**Threat attributes**	
Threat category	Habitat loss or degradation, accidental mortality		**Extent**	
			Local	**Range-wide**
General threat	Loss of habitat and populations	**Occurrence**	Anticipated at four populations	Unknown
		Frequency	Recurrent	Unknown
Specific threat	Destruction, removal, or burial of species and alteration of habitat through trampling of plants and habitat, and soil compaction	**Causal certainty**	High	Unknown
		Severity	High	Unknown
Stress	Fragmentation or destruction of habitat; increased mortality, reduced population size, or local extirpation.	**Level of concern**	High	
2	**Invasive alien vascular plants**		**Threat attributes**	
Threat category	Habitat loss or degradation		**Extent**	
			Local	**Range-wide**
General threat	Loss of habitat and populations	**Occurrence**	Potentially at two sites	Unknown
		Frequency	Recurrent	Unknown
Specific threat	Burial of species and alteration of habitat	**Causal certainty**	Low	Unknown
		Severity	Low	Unknown
Stress	Fragmentation or destruction of habitat;	**Level of concern**	Low	

	increased mortality, reduced population size, or local extirpation			
3	**ATV or other vehicle use**		**Threat attributes**	
Threat category	Habitat loss or degradation, accidental mortality		**Extent**	
			Local	**Range-wide**
General threat	Traversing through habitat near plants in known habitats	**Occurrence**	Potentially at least at one site	Unknown
		Frequency	Unknown/recurrent	Unknown
Specific threat	Habitat compaction by tires and killing of species	**Causal certainty**	Low	Unknown
		Severity	Low	Unknown
Stress	Destruction of habitat; increased mortality, reduced population size, or local extirpation	**Level of concern**	Low	

Description of threats

Livestock

Livestock, in particular cattle but occasionally horses, are the major threat to both the survival and recovery of the rusty cord-moss and its habitat. In most cases, this threat is from the trampling and compaction of the soil on which this species grows. There is a reduction of available habitat, for example, animal hooves destroy soil mounds produced by pocket gophers. Direct mortality through trampling is also a threat. Cattle are present in all of the areas where the rusty cord-moss has been found and heavy trampling disturbance is common in the habitats where most populations are found. The Princeton population may have been lost because of extensive trampling by cattle. In the White Lake basin, the highest density of patches and most vigorous populations of the rusty cord-moss are found in sites where livestock trampling is either prevented through fencing or reduced because part of the population is in a gulley that cattle avoid (T. McIntosh, pers. comm., 2008). In contrast, potential habitats (habitat that is potentially suitable for the species, but which is currently unoccupied) in the White Lake basin that have been heavily grazed and trampled either lack this species or contain only a few small patches. Horse feces have covered a few patches of the rusty cord-moss in the White Lake basin. Feces have the potential to bury and kill the moss as well as alter its habitat, possibly through chemical changes.

Invasive alien vascular plants

Invasive alien vascular plants may threaten this species. A few species, in particular a sow-thistle (*Sonchus* spp.), are common across some of the flats where the rusty cord-moss is found, especially in the protected area in the White Lake basin. Although not confirmed, increased litter buildup from these species may cover the moss or prevent its colonization. Also, invasive species may compete for habitat by growing on the bare soil that is required by the rusty cord-moss. No threats of this type have been observed from native plants. As well, not only can habitats be strongly modified by the hooves of

livestock, alien plants sometimes increase following habitat disturbance (T. McIntosh, pers. comm., 2008).

ATV or other vehicle use
At the White Lake site, ATV use may also be a threat. In 2006, an ATV twice crossed near populations of this species in the fenced, protected area. ATVs have the potential to either alter the habitat by compacting or otherwise disturbing the soil or they can destroy portions of the populations of the rusty cord-moss.

Actions Already Completed or Underway

1. T. McIntosh assisted by J. Cameron (supported by the Environment Canada's Canadian Wildlife Service) initiated a monitoring survey for the rusty cord-moss at White Lake in 2006.

2. Recommendations for fencing and protection in the White Lake basin have been proposed to the Nature Trust of British Columbia, which leases the land from the federal government. Most of one population of the rusty cord-moss in the White Lake basin is protected within a cattle exclosure.

Knowledge Gaps

1. Physical habitat requirements of the rusty cord-moss (e.g., soil moisture, chemistry, and texture; site characteristics including relation to seasonal moisture regimes).

2. Potential role of pocket gophers in the life cycle and survival of this moss species.

3. Degree of threat of invasive alien vascular plant species.

4. Population distribution and occurrence and population sizes and trends.

RECOVERY

Recovery Feasibility

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

Table 3. Technical and biological feasibility for recovery of the rusty cord-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
2.	Is sufficient suitable habitat available to support the species or could it be made available through habitat management or restoration?	Yes
3.	Can significant threats to the species or its habitat be avoided or mitigated through recovery actions?	Yes
4.	Do the necessary recovery techniques exist and are they demonstrated to be effective?	Yes

Recovery Goal

To protect and maintain the known populations of the rusty cord-moss in Canada.

Rationale for Recovery Goal

As with many other rare plant species, we lack adequate information about the historical distribution of the rusty cord-moss. There is no evidence to indicate that this species was previously more abundant or widespread in the arid central interior of British Columbia, therefore, recovery with respect to this species should focus on improving its probability of persistence in the wild. Although the biology and ecology of the rusty cord-moss are not completely understood, field observations suggest that regular recruitment is occurring at some sites. Successful recovery, however, will depend on a combination of scientific investigation, habitat protection and management activities and long-term population monitoring.

Recovery Objectives

The objectives for the next five years are:

I. To secure long-term protection for the known populations and habitats of the rusty cord-moss.
II. To determine the level of real and potential threats to this species and its habitat and to mitigate their effects.
III. To determine the precise habitat requirements of the populations of the rusty cord-moss.
IV. To determine sizes and population trends of the known populations.

Approaches Recommended to Meet Recovery Objectives

Table 4. Recovery planning table for rusty cord-moss.

Priority	Obj. No.	Broad approach/ strategy	Threat addressed	Specific steps	Outcomes or deliverables
High	I	Habitat protection	All threats	• Investigate and document protection in place, if any • Establish appropriate protection mechanisms (e.g., stewardship agreements) depending on land tenure • Communicate with property owners about the presence of the species and the importance of protecting habitat	• Securement and protection of populations and habitats • Increased awareness and assistance by the public in the protection and recovery of this species.
High	II	Site management	All threats	• Research and document threats to habitat at each of the known sites • Determine negative effects of threats and manage for mitigation	• Stewardship plans or covenants • Reduced threats
High	IV	Population monitoring	All threats	• Develop and implement standardized protocols for monitoring population and habitat trends • Report monitoring results and assess trends in populations, area of occupancy and habitat condition every 5 years • Document population sizes and trends	• Standardized monitoring protocol • Periodic assessment of recovery progress for better improved management • Data on population sizes, reproduction status, and health, and determination of population trends
Medium	III	Research: ecology and habitat requirements of the populations	All threats	• Design and prioritize a research program • Analyze habitat requirements • Investigate the importance of pocket gophers in the distribution of this species • Analyze dispersal and colonization strategies of this moss	• Precise information on habitat requirements • Ecological information relevant to management is determined
Medium	I	Inventory		• Inventory for new subpopulations at known sites	• Additional known sites to protect and monitor

Performance Measures

I. Population monitoring indicates that the numbers of plants at active sites are stable or increasing by 2012 (Objectives I and IV).
II. Effects of the two main threats to the populations have been investigated and reduced through mitigative actions at all known sites by 2012 (Objective II).
III. Priority scientific studies have been completed by 2012 (Objective III).

Critical Habitat

No critical habitat can be identified for rusty cord-moss in Canada at this time, but it may be identified at a later date in a federal addition by Environment Canada, or in a future action plan. 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 the populations to determine population trends. Consultation with affected landowners and organizations will also be necessary.

The known ecological attributes of rusty cord-moss habitat include:

1. Along the edges of seasonally wet, alkaline areas where bare soil is available, such as late autumn and spring wet, alkaline ponds, lakes, and sloughs, and on seepage slopes or narrow gullies;
2. On flat to very gentle slopes within a low-growing vegetation zone above, but not in, a zone defined by a complete alkaline-deposit crust; the low-growing vegetation is often defined by the presence of two graminoid species: black-footed sedge and saltgrass as well as associated moss species; and
3. In exposed areas at relatively low elevations in sagebrush or grassland habitats.

Recommended schedule of studies to identify critical habitat

Table 5. Timeline for completion of studies to identify critical habitat for the rusty cord-moss.

Description of study	Outcome/rationale	Completion date
Inventory for undocumented patches of this moss at the known localities	Confirm current area of occupancy of known localities	2011
Identify biotic and abiotic habitat attributes (including microhabitats) of known populations	Qualitate habitat variables	2011
Using established survey and mapping techniques, delineate the boundaries of all occupied habitats	Delineate habitat	2011

Existing and Recommended Approaches to Habitat Protection

Most of one population of the rusty cord-moss in the White Lake basin is protected within a cattle exclosure, although a few patches have been found outside the exclosure. Historically, in the White Lake basin, cattle and horses used the area around the lake. However, in 2000, The Nature Trust of British Columbia signed a 99-year lease to establish a study area on federal lands at White Lake in accordance with its 2000 Biodiversity Ranch Management Plan. As part of this plan, many areas, including some patches of the rusty cord-moss, have been permanently excluded from grazing and other potential large-scale disturbances through the construction and maintenance of a fence. The habitat in fenced areas is expected to improve or at least be protected from degradation, although data are lacking on how changes will affect the population of this species.

Recommended approaches to protection of the rusty cord-moss include stewardship on private land, and incorporation of management for this species in Range Stewardship Plans.

Effects on Other Species

Impacts to other species or ecological processes are not anticipated during the initial stages of the recovery process for the rusty cord-moss. It is anticipated that some actions regarding the recovery of the rusty cord-moss, such as the maintenance and the establishment of protected sites, may benefit other species, and this will be assessed as work is undertaken. The alkaline wing-nerved moss *(Pterygoneurum kozlovii*) (Endangered on Schedule 1 of SARA) is present at the White Lake site, as are two CDC Red-listed mosses: *Pterygoneurum lamellatum* and *Pottia nevadensis*. In both cases, the White Lake site is one of two known locations for these species in B.C. A SARA-listed (Endangered) vascular plant showy phlox (*Phlox speciosa* ssp. *occidentalis*) grows near one of the White Lake populations of the rusty cord-moss.

Socioeconomic Considerations

The socioeconomic impact is considered low at some sites for the rusty cord-moss, as fencing may be required to protect this species from livestock damage. Benefits include protecting other species at risk present at the White Lake site, including two other Red-listed mosses (see above).

Recommended Approach for Recovery Implementation

This recovery strategy should be considered for integration within other conservation efforts, such as the South Okanagan–Similkameen Conservation Program.

Statement on Action Plans

An action plan for rusty cord-moss will be completed by December 31, 2012.

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