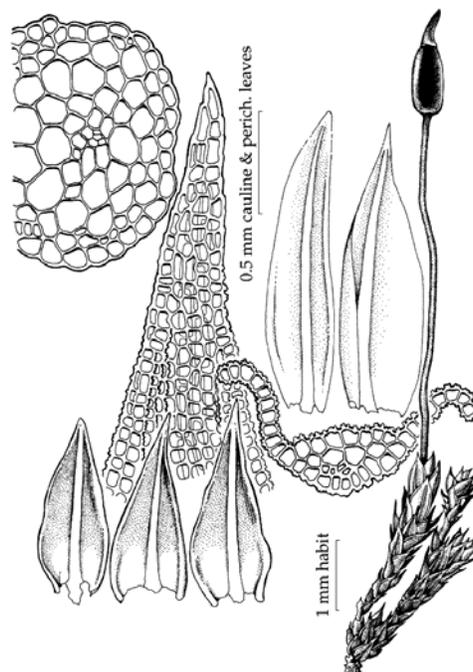


COSEWIC
Assessment and Status Report

on the

Columbian Carpet Moss
Bryoerythrophyllum columbianum

in Canada



SPECIAL CONCERN
2004

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA



COSEPAC
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DES ESPÈCES EN PÉRIL
AU CANADA

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur l'érythrophyllé du Columbia (*Bryoerythrophyllum columbianum*) au Canada.

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COSEWIC Assessment Summary

Assessment Summary – May 2004

Common name

Columbian carpet moss

Scientific name

Bryoerythrophyllum columbianum

Status

Special Concern

Reason for designation

This is a western North American endemic species. It is a small perennial species and in Canada has a restricted distribution in the shrub-steppe in semi-arid regions of British Columbia where recent surveys have confirmed its presence from 11 sites. The species is never abundant in sites where it is found and extensive surveys have provided few new locations. At least one population is believed to have been lost to cultivation (vineyard) or to stochastic events. Threats include agriculture (especially vineyards), impact by grazing animals, urban development, road improvements, and human recreational impacts. Based on known occurrences, the species appears to have a very restricted distribution. However, the species is patchily distributed at low densities in large habitats not all of which have been censused..

Occurrence

British Columbia

Status history

Designated Special Concern in May 2004. Assessment based on a new status report.



COSEWIC
Executive Summary

Columbian Carpet Moss
Bryoerythrophyllum columbianum

Species information

Bryoerythrophyllum columbianum, the Columbian carpet moss, is one of four species of *Bryoerythrophyllum* in North America. It is a small, often red-brown moss that grows in small clumps or compact turfs either as pure colonies or intermixed with other mosses and lichens. Its most distinctive features are the ovate-lanceolate leaves, sharp-pointed leaf tips, and the broad, somewhat ornamented leaf mid-ribs. It is dioicous, with male and female organs on separate stems.

Distribution

This species is a western North American endemic, and, in Canada, it appears to be restricted to British Columbia. It has a rather confined distribution in the province, found at 11 confirmed locations. It has been found in the south Okanagan Valley, near Kamloops, near Spence's Bridge, and at one site along the Fraser River in the Cariboo Region. Elsewhere it is known from Washington, Oregon and California.

Habitat

This species is restricted to soils in semi-arid steppe and grassland habitats of British Columbia. The habitats of two of the known sites for Columbian carpet moss are heavily disturbed, four are moderately disturbed, and five are relatively undisturbed.

Biology

Columbian carpet moss is a perennial that grows over soil in semi-arid shrub-steppe and grassland environments. Sporophytes have been reported only once in Canadian populations and spores are probably of limited importance in the dispersal of this species. It may disperse and colonize open soils by fragmentation of fragile leaf tips

Population sizes and trends

This species is uncommon or rare in seven of its known locations, and widespread but uncommon in four sites. Populations appear stable in nine sites, and two may be declining, but trends are largely unknown.

Limiting factors and threats

The most important threats are agricultural practices, including grazing and development of vineyards. However, urban development, road building, hiking, and general erosion also appear to be limiting factors and threats to Columbian carpet moss.

Special significance of the species

This species is a western North American endemic. The British Columbia populations may represent the northern extension of its range in North America. It is probably a contributing element in a healthy biological soil crust community characteristic of shrub-steppe habitats.

Existing protection and other status designations

Most of the extant populations of this species are found on public-owned lands, either municipal or provincial, in particular crown lands. No legislation, regulations, customs, or conditions currently protect this species. Columbian carpet moss is listed as critically imperiled at the provincial level and it is Red-listed. Globally, it is ranked vulnerable.



COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species and include the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal organizations (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership, chaired by the Canadian Museum of Nature), three nonjurisdictional members and the co-chairs of the species specialist and the Aboriginal Traditional Knowledge subcommittees. The committee meets to consider status reports on candidate species.

DEFINITIONS (AFTER MAY 2004)

| | |
|------------------------|--|
| Species | Any indigenous species, subspecies, variety, or geographically or genetically distinct population of wild fauna and flora. |
| Extinct (X) | A species that no longer exists. |
| Extirpated (XT) | A species no longer existing in the wild in Canada, but occurring elsewhere. |
| Endangered (E) | A species facing imminent extirpation or extinction. |
| Threatened (T) | A species likely to become endangered if limiting factors are not reversed. |
| Special Concern (SC)* | A species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats. |
| Not at Risk (NAR)** | A species that has been evaluated and found to be not at risk. |
| Data Deficient (DD)*** | A species for which there is insufficient scientific information to support status designation. |

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.

** Formerly described as “Not In Any Category”, or “No Designation Required.”

*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.



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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Columbian Carpet Moss

Bryoerythrophyllum columbianum

in Canada

2004

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SPECIES INFORMATION

Name and classification

Scientific Name: *Bryoerythrophyllum columbianum* (Herm. & Lawt.) Zand.
Pertinent Synonyms: *Didymodon columbianus* Herm. & Lawt.
Common Name: Columbian Carpet Moss
Family: Pottiaceae
Major Plant Group: Mosses (Musci)

The Pottiaceae is a large and diverse family of mosses with many of its species restricted to dry environments. It is a taxonomically difficult family and has been undergoing extensive review in recent times (Zander 1993). New genera have been created or the constraints of older genera have been changed to exclude some species and/or include others from different genera. One result is that a number of taxa formerly members of either *Barbula* or *Didymodon* have been placed into *Bryoerythrophyllum*, including *Bryoerythrophyllum columbianum* (Zander 1978), following its initial description as a species of *Didymodon* (Hermann & Lawton 1968). *Bryoerythrophyllum* consists of a group of species characterized by turf-forming to loosely caespitose plants, sometimes with red to reddish-brown colouration on older parts, crowded upper laminal papillae (wart-like bumps over the leaf surface) that often obscure the cells, and strongly differentiated basal leaf cells (Chen 1941, Zander 1993, 2002).

According to Zander (2000), there are three additional species of *Bryoerythrophyllum* in North America: *B. ferruginascens* (Stirt.) Giac., *B. inaequalifolium* (Tayl.) Zand., and *B. recurvirostrum* (Hedw.) Chen. Anderson *et al.* (1990) also reported *B. recurvum* (Griff.) Saito from North America, but this has been transferred to *Bellibarbula* as *B. recurva* (Griff.) Zand. (Zander 1993). Zander (2000) lists *B. columbianum* and *B. recurvirostrum* from Canada, and noted that *B. ferruginascens* has been reported from Newfoundland (R. Zander pers. comm. 2002). He suspects that *B. inaequalifolium* is present in Canada as well. Ireland *et al.* (1987) reported that *B. jamesonii* (Tayl.) Crum and, possibly, *B. alpigenum* (Vent.) Chen are also present in Canada, but Zander considers these species to be large forms of *B. recurvirostrum*.

Bryoerythrophyllum columbianum is distinguished from other species in the genus principally by leaf characteristics:

1. its leaves end in sharp mucros consisting of elongate cells,
2. rows of smooth cells are sometimes present along the distal leaf margins, and
3. the costa, or leaf mid-rib, of *B. columbianum* is much wider at midleaf, and its upper surface bulges as a unistratose pad of cells.

Description

The following description has been derived from Zander (1993, 2000), Lawton (1971), McIntosh & Paige (2001), and from examination of herbarium specimens. Figure 1 is a composite illustration from Zander (2000) and shows many of the features discussed below.

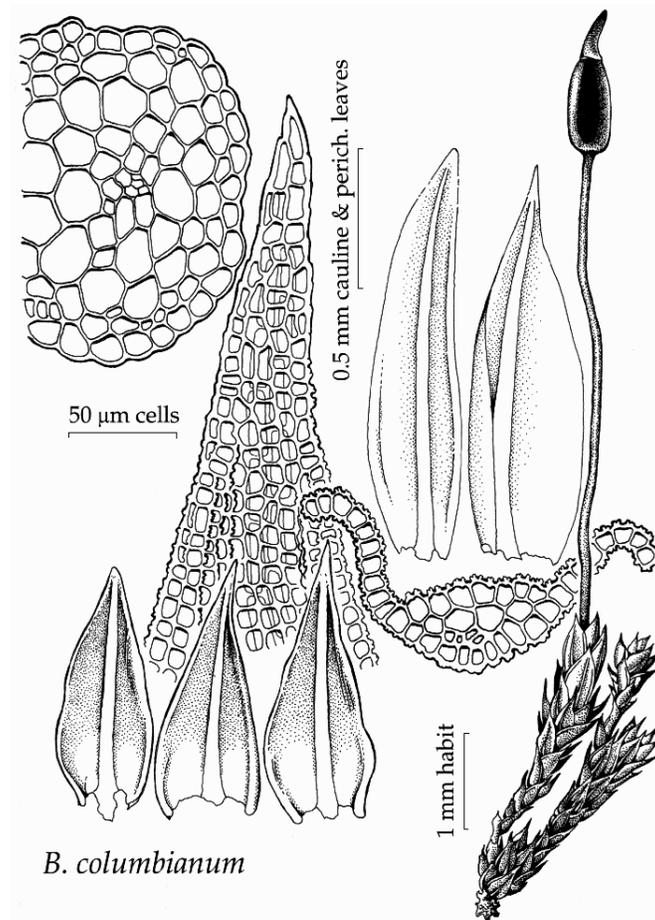


Figure 1. Illustration of plant, leaves, and cell details (upper left is stem cross-section, center is leaf tip and cross-section near middle of leaf) of *B. columbianum* from the Bryophyte Flora of North America project.

Bryoerythrophyllum columbianum is a perennial, acrocarpous (producing female structures and sporophytes at the tips of the main stems) moss species that grows in small clumps or compact turfs either as pure colonies or intermixed with other mosses and lichens. Stems branch at the base, and range from 2-6 mm in height, although smaller plants are common in provincial collections (1-3 mm stems are common in British Columbian collections). The leaves of *B. columbianum* are ovate-lanceolate to, less commonly, ovate, and usually sharply acute. They are stiffly erect to, rarely,

twisted in some larger plants, imbricate (overlapping), and usually dark red-brown when dry, and erect-spreading, and sometimes green, when wet. Leaves range from 0.8-1.2 mm in length, although Zander (2000) notes that they can be somewhat longer. Leaf margins are entire and narrowly recurved from near the base almost to the apex.

The leaf midrib is up to 8 cells wide at midleaf, and the upper surface bulges forming a distinctive pad. The midrib is excurrent, forming a sharp mucro comprised of elongate cells, at least on the younger leaves. In older and eroded leaves, this apical cell is difficult to see or is absent, making species confirmation difficult in some specimens. The median and upper leaf cells of *Bryoerythrophyllum columbianum* are isodiametric to irregular-short-rectangular, are covered by small papillae, and range in size from 8-15 µm in diameter. The basal cells are smooth, thin-walled, and quadrate to short-rectangular.

Bryoerythrophyllum columbianum is dioicous, with male and female organs on separate stems. Leaves around the female sex organs are larger and more concave than the stem leaves, ranging from 1.6-1.8 mm in length, and often have plane margins. Sporophytes, which produce spores, mature in early spring, but are rarely found across its North American range. Its capsules (spore producing sacs) are long-exserted above the leaves on a dark seta (stem), and are cylindrical to ovate-cylindrical. They have conic-rostrate opercula (lids) and their peristomes, fringes of tooth-like appendages surrounding the mouth of the capsule, are rudimentary or absent. Its nearly smooth spores range in size from 8-13 µm.

In British Columbia, *Bryoerythrophyllum columbianum* can be confused with *Didymodon vinealis* (Brid.) Zand., a more common moss of similar habitats which also grows as red-brown patches over soil. This species can be distinguished from *B. columbianum* by its less recurved and, usually, more twisted upper leaves, at least when dry, its much narrower leaf mid-ribs, and the absence of a multi-cellular and sharply pointed leaf apex, although it does have a smaller and blunter conical cell at the leaf apex. *Tortula atrovirens* (Sm.) Lindb., formerly *Desmatodon convolutus* (Brid.) Grout, another red-brown and small taxon that is relatively common in silt-rich sites in the province, can also be confused with *B. columbianum*. It is distinguished from *B. columbianum* by its blunt leaf apices and generally tightly twisted habit when dry.

Taxonomic keys and additional illustrations are found in Lawton (1971, as *Didymodon columbianus*) and Zander (1978, 2000).

DISTRIBUTION

Global range

Bryoerythrophyllum columbianum is endemic to western North America (Fig. 2), and has been found in British Columbia, Washington, Oregon, and California (Lawton 1971, McIntosh 1986, 1997, Zander 2000). It has also been reported from the

Northwest Territories (Steere & Scotter 1978) and Bolivia (Lewis 1981). The Bolivian collection has been re-identified as *B. fuscinerium* (Mitt.) Zand. (Zander, pers. comm. 2002), but no further information has been found on the collection from Northwest Territories; it was not listed by Zander (2000) but is listed by NatureServe Explorer (2003).

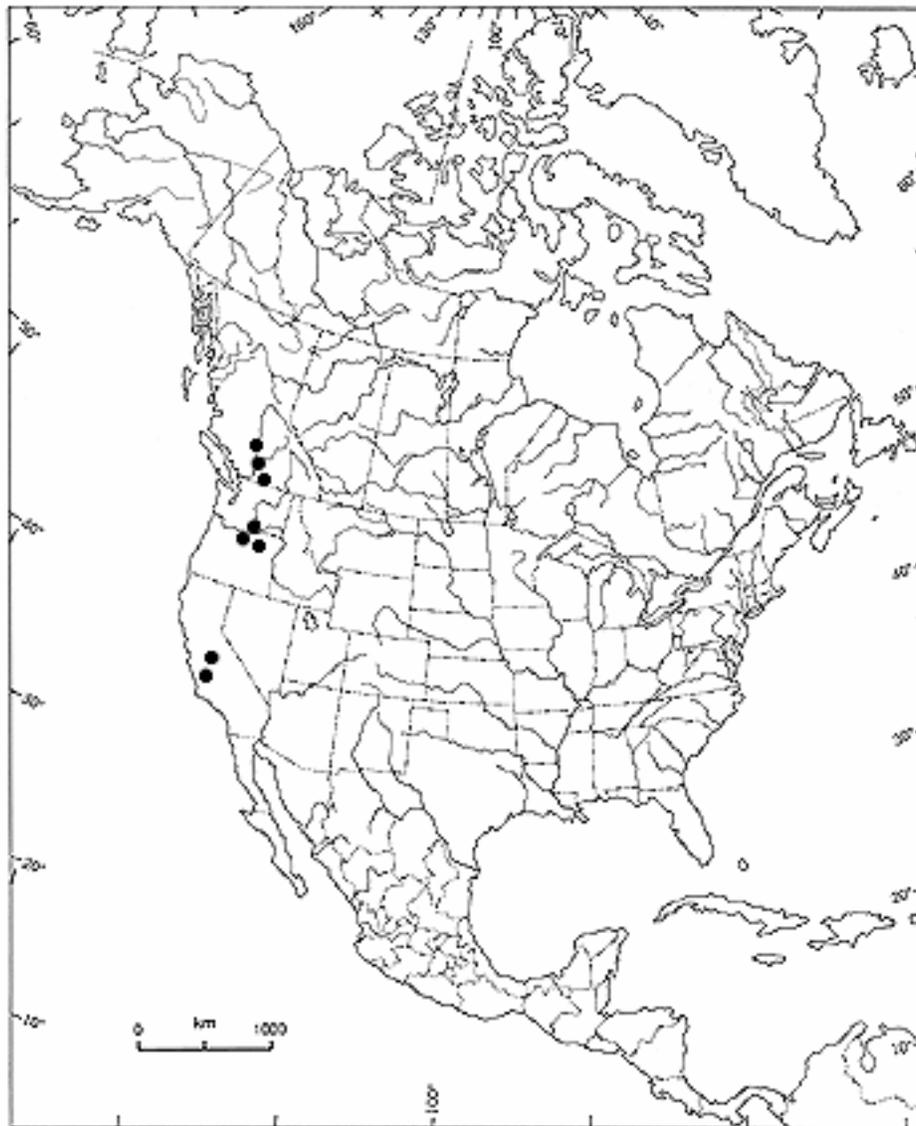


Figure 2. North American distribution of *Bryoerythrophyllum columbianum*.

Canadian range

In Canada, *Bryoerythrophyllum columbianum* has been reported with certainty only from British Columbia, though it may possibly also exist in the Northwest Territories. Table 1 lists all of the locations, or populations, where this species has been collected, to date, in British Columbia (collections 8 and 10 are part of the same population). Of the eighteen known locations of this species in the province, 11 have been confirmed for the purpose of this report (Fig. 3, with some dots on the map representing more than one population; McIntosh 1986, McIntosh and Paige 2001). Populations are concentrated within a narrow geographic area: principally in the south Okanagan Valley and near Kamloops, although it also has been found near Spences Bridge, and at one site along the Fraser River in the Cariboo area.

Table 1. Collection Locations (Populations) and Observational Information for *Bryoerythrophyllum columbianum* in British Columbia (collection numbers correspond to the collections listed in Collections Examined section).

| COLLECTION # | LOCATION/POPULATION | DATES VISITED | CONFIRMED |
|--------------|---------------------|----------------|-------------------------|
| 1 | Oliver 1 | 1980/2002 | no |
| 2 | Spence's Bridge | 1980/2002 | no |
| 3 | Osoyoos 1 | 1981/2000/2002 | no |
| 4 | Kamloops 1 | 1983/2002 | no |
| 5 | Oliver 2 | 1986/2002 | no |
| 6 | Naramata | 2001/2002 | yes |
| 7 | McGhee Flats | 2001 | no; not visited in 2002 |
| 8 and 10 | Kamloops 2 | 2002 | yes |
| 9 | Kamloops 3 | 2002 | yes |
| 11 | Kamloops 4 | 2002 | yes |
| 12 | Kamloops 5 | 2002 | yes |
| 13 | Kamloops 6 | 2002 | yes |
| 14 | Keremeos | 2003 | yes |
| 15 | Keremeos 2 | 2003 | yes |
| 16 | Osoyoos 2 | 2002 | yes |
| 17 | Osoyoos 3 | 2003 | yes |
| 18 | Penticton | 2003 | yes |
| 19 | Osoyoos 4 | 1981 | no |



Figure 3. Canadian distribution of *Bryoerythrophyllum columbianum* (dots may represent more than one population).

McIntosh (1986) found *Bryoerythrophyllum columbianum* at 11 sites during his PhD research. Collections were made from four of these sites (Collections 1 – 4 in Table 1) and accessioned into the UBC herbarium (individual plants or tiny clumps of *B. columbianum* were seen in general collections from the other seven sites, but they were not accessioned into the herbarium). For the purposes of this report, searches were made at all 11 sites reported by McIntosh (1986). Since precise location information for the original populations is lacking, all sites had to be extensively re-examined. In 2002, *B. columbianum* was not found at collection sites 1 – 4. Site 1 has probably been converted into a vineyard. Site 2 has had considerable erosion near the waterfalls where the original collection was made and the population may have been lost. The populations at sites 3 and 4 were not re-located, even though environmental conditions probably have not changed since the time of their first collections. As for the remaining seven sites listed in McIntosh (1986), *B. columbianum* was found again in the Valleyview area (Collections 8, 9 and 10), east of Kamloops adjacent to the cement plant (Collections 12 and 13), and found in two locations south-east of Keremeos (Collections 14 and 15). It was not found south-west of Vernon or at two reported sites

west of Skaha Lake in the South Okanagan. Two additional collections, Collection 5 near Oliver and Collection 19 near Osoyoos, were made by other researchers and, although their locations were visited, *Bryoerythrophyllum columbianum* was not found. Much of the location information on these earlier herbarium collection packets is not very specific and, since these locations have abundant potential habitat, the exact location of individual populations may have been missed.

In 1997, Terry McIntosh initiated a survey of provincial arid-land areas in order to complement his doctoral work (McIntosh 1986) in preparation for a research paper describing and providing keys for the bryophytes of these regions. From 1997 to 2003, including sites visited for this report, some 300 sites of suitable habitat for *Bryoerythrophyllum columbianum* in the semi-arid portions of the province were surveyed and collections made and examined for the presence of this species (this survey was focused in the Okanagan Valley and around Kamloops, but also included other dryland areas in the Cariboo, near Grand Forks, and in the Rocky Mountain Trench). Also, some 500 collections from provincial arid-land areas made by T. McIntosh during his PhD fieldwork but not included as sites in his dissertation were examined for the presence of *B. columbianum* and other rare dryland species. As a result of these surveys and examinations, *B. columbianum* was found five more times (Collections 6, 7, 11, 16, and 17; the McGhee Flat site, Collection 7, was not confirmed for this report).

HABITAT

Habitat requirements

Bryoerythrophyllum columbianum is restricted to soils in semi-arid shrub-steppe and grassland environments, characterized by dry, hot summers and cool to cold, moderately wet winters. Across its North American range, it has been found growing on soil over acid rock, on sandy soil, in grassland steppe, or on ledges and bluffs near rivers (Zander 2000).

In British Columbia, this species is found in the Bunchgrass Biogeoclimatic Zone, which is restricted to a number of narrow valleys in the south-central part of the province. Common plants in this zone are bluebunch wheatgrass (*Agropyron spicatum*), needlegrass (*Stipa comata*), big sage (*Artemisia tridentata*), and antelope brush (*Purshia tridentata*, in the southern portions of the Okanagan Valley). Within the Bunchgrass Zone, it has been found on a variety of soil types, including compact silts, silt-loams, and sandy loams, where it appears to be a minor component of some biological soil crusts, important contributors to the health of arid land ecosystems (Belnap *et al.* 2001, Evans and Johansen 1999). Common crust associates include lichens, *Cladonia cariosa*, *Acarospora schleicheri*, and *Psora* spp., and mosses, in particular *Tortula atrovirens*, *Didymodon vinealis*, *Syntrichia ruralis*, *Pseudocrossidium obtusulum*, and *Ceratodon purpureus*. It also has been found on thin soil over an outcrop face (Collection 5), growing with a species of *Grimmia*, although this is an unusual habitat for this species.

Trends

Table 2 (Column C) lists habitat trends and conditions for each of the 11 known populations, along with conditions for some of the reported but unconfirmed locations of *Bryoerythrophyllum columbianum* in British Columbia. Two of the known locations are heavily disturbed, four are moderately disturbed, and five are relatively undisturbed. Most sites appear to be relatively stable, but site monitoring is necessary in order to confirm this.

| A Collection Site (* = confirmed population) | B Limiting Factors and Threats | C Habitat Condition and Trend | D Population Size and Trend | E Protection and Ownership |
|---|--|---|---------------------------------------|--------------------------------------|
| 1 | B (C) | B – C, B | ? | ? |
| 2 | ?A (E) F | A – B, B | ? | Gmp |
| 3 | ? | ? | ? | ? |
| 4 | ? | ? | ? | ? |
| 5 | ? | ? | ? | ? |
| 6* | D E | A – B, B | B, B | Gm? |
| 7 | A | B, A - B | ? | Gp |
| 8 and 10* | ?D E | A, B | A, B | Gm |
| 9* | ?D E | A, B | B, B | Gm |
| 11* | C E F | B, B | A, C | Gp |
| 12* | A F | B, B | B, B | Gp |
| 13* | E | A – B, A | B, B (?A) | P |
| 14* | A | B – C, B | A, B | Gp |
| 15* | A (F) | B – C, B | B, B | Gp |
| 16* | D E | C, B | C, C | Gp? |
| 17* | E F | C, ?A | A, B (?A) | Gm |
| 18* | E F | A – B, B | C, B | Gm |
| 19 | ? | ? | ? | ? |

Notes (in all cases, '?' refers to 'unknown' or 'uncertain', and a letter in brackets refers to 'minor importance'):

1. With respect to **Column B**: A refers to grazing impacts, B refers to vineyard, C refers to urban development, D refers to road building, E refers to human impacts such as hiking, and F refers to general erosion.
2. With respect to **Column C**: *Habitat Condition*: A refers to relatively undisturbed, B refers to moderately disturbed, C refers to heavily disturbed; *Habitat Trend*: A refers to improving, B refers to stable, C refers to degrading.
3. With respect to **Column D**: *Population Size*: 'A' means widespread in area surveyed, 'B' means uncommon across site, and 'C' rare across site; *Population Trend*: A refers to improving, B refers to stable, C refers to declining.
4. With respect to **Column E**: P refers to private ownership and G refers to government ownership, either municipal (m) or provincial (p, usually crown land).

Protection/ownership

Most of our extant populations of *Bryoerythrophyllum columbianum* are found on public-owned lands, either municipal or provincial, in particular crown lands. At

Collection Site 1, it may be present in an ecological research area that is found along Inkaneep Road north of Osoyoos, but was not seen there during the survey. At Collection Site 2 near Spences Bridge, there is a sign near the site that restricts entry to the waterfalls area at the municipal site, but *B. columbianum*, if it is still present here, is probably more common in the shrub-steppe nearby where access is allowed. Some protection appears available at Collection Site 7 (Churn Creek Provincial Park in the Cariboo) and at Collection Sites 8, 9, and 10 (apparently this part of the Valleyview area in Kamloops is a municipal recreational park, and dogs are regularly walked at this location).

BIOLOGY

General

Bryoerythrophyllum columbianum is a perennial, acrocarpous moss species that grows over soil in semi-arid shrub-steppe and grassland environments.

Reproduction and dispersal

Sporophytes have been reported only once in Canadian populations (Collection 5). This possibly reflects the fact that male and female reproductive units are on separate plants, which appears to restrict sporophyte production in many moss species. This may be of increased importance in arid land habitats where the dry environment may restrict gamete and sporophyte production. Therefore, spores are probably of limited importance in the dispersal of this species, at least in Canada. It may disperse and colonize open soils by fragmentation of its fragile leaf tips as reported by Zander (2000).

POPULATION SIZES AND TRENDS

Table 2 (Column D) lists sizes and trends for each confirmed population. *Bryoerythrophyllum columbianum* is uncommon or rare in seven sites, and relatively widespread but uncommon in four sites. Populations appear stable in nine sites, and two may be declining, but trends are unknown. Site monitoring is necessary in order to confirm population trends.

There is no detailed population information available about adjacent American populations in Washington, although it is a common component of some biological crusts in the central shrub-steppe regions of south-central Washington State (McIntosh 2003).

LIMITING FACTORS AND THREATS

Table 2 (Column B) lists limiting factors and threats for each site. Agricultural practices, including the elimination of wide areas of shrub-steppe to plant vineyards, and the disturbance by domesticated animals appear to be the most serious factors

impacting populations of *Bryoerythrophyllum columbianum*. Other factors, including urban development, road building activities, hiking, and general (natural) erosion, are probably of less significance. Detailed studies are necessary to confirm the degree of threat of any of the above factors.

Vineyards completely eliminate all of the native vegetation when constructed. They are especially common in the south Okanagan valley, one of the centers of distribution in Canada for this moss species. Large areas of the shrub-steppe ecosystem have been lost over the past few decades, and will continue to be lost as more vineyards are developed. Site 1 has probably been lost due to this activity.

The impact from domesticated animals, in particular cattle, is common in arid land areas. Trampling of grazing herds reduces the cover of biological crusts in rangelands with the result, in some areas, of a near complete elimination of viable microbiotic ground cover. Populations of *Bryoerythrophyllum columbianum* will also be affected. Three of the confirmed populations are probably affected by trampling of cattle. However, these impacts do not completely eliminate the native crusts and they can readily recover once grazing is reduced or eliminated.

Urban development may impact populations. Collection Site 11 may have had its population size reduced by the expansion of a property. Road building and expansion, and erosion that may coincide following these activities may be impacting four populations. Other human impacts, in particular hiking, appear to have impacted, although slightly, eight populations. General (natural) erosion related to steep slopes is a concern at five sites, and may be responsible for the loss of the population at Collection Site 2.

SPECIAL SIGNIFICANCE OF THE SPECIES

Bryoerythrophyllum columbianum is a western North American endemic that is relatively common in portions of south-central Washington State but is rare in southern British Columbia. The British Columbia populations possibly represent the northern extension of its range in North America, depending on the taxonomic status of the collection from the Northwest Territories.

This species may be of some ecological importance. When present as a component of biological soil crusts, *Bryoerythrophyllum columbianum* is probably a contributing element in a healthy shrub-steppe community (Belnap *et al.* 2001). These crusts are comprised of a complex of lichens, bryophytes (mainly mosses), fungi, vascular plant roots, and cyanobacteria. Crusts have a number of ecological functions in a healthy shrub-steppe community, including reducing soil erosion and increasing available nutrients. In British Columbia, like many areas elsewhere, these crusts are heavily impacted by trampling of grazing animals, in particular cattle. Recovery of these crusts follows reduction in trampling pressure, either through alteration of grazing patterns, or through elimination of grazing altogether.

Further, it is a characteristic species in the endangered *Purshia tridentata* ecosystem in the south Okanagan Valley.

EXISTING PROTECTION OR OTHER STATUS

No legislation, regulations, customs, or conditions protect this species. For British Columbia, Ryan (1996) ranked *Bryoerythrophyllum columbianum* as critically imperiled at the provincial level (S1), whereas the BC Species and Ecosystem Explorer (2003) and NatureServe Explorer (2003) rank it as imperiled (S2). It is Red-listed in the province. Globally, BC Species and Ecosystem Explorer and NatureServe Explorer rank it as imperiled or secure (G2G4). J. Christy (pers. comm. 2002) notes six records in Oregon and ranks it vulnerable globally and imperiled in that state (G3S2), and suggests that it is S2 in Washington State, although it is common in the shrub-steppe in south-central Washington (rankings are being restructured for Washington State at this time). NatureServe Explorer also ranks it as S2 for Oregon.

J. Shevock (pers. comm. 2002) states that it is known from two occurrences in California, Lake and Colusa Counties, but a ranking was not provided. It is not listed as rare by Shevock (2001) for California.

SUMMARY OF STATUS REPORT

The Columbian carpet moss is a small perennial species with a restricted distribution in the shrub-steppe in semi-arid regions of Canada. The species typically grows on soil and is a rare component of the biological crust community in these areas. It is never abundant in sites where it is found. In Canada, recent surveys have confirmed the presence of *Bryoerythrophyllum columbianum* from 11 sites in British Columbia. Thus, the British Columbian populations may be the northernmost locations for this species in Canada. Although the species was not relocated at all of the previous sites where it had been found, extensive surveys have provided few new locations. At least two populations are believed to have been lost to cultivation (vineyard) or to stochastic events. Threats include agriculture (especially vineyards), impact by grazing animals, urban development, road improvements, and human recreational impacts.

TECHNICAL SUMMARY

Bryoerythrophyllum columbianum

Columbian carpet moss

Range of Occurrence in Canada: BC

Érythrophylle du Columbia

| Extent and Area Information | |
|--|--|
| • <i>Extent of occurrence (EO)(km²)</i> | > 20,000 km ² |
| • <i>Specify trend in EO</i> | stable to declining |
| • <i>Are there extreme fluctuations in EO?</i> | no |
| • <i>Area of occupancy (AO) (km²)</i> | > 20 km ² , based on area of Bunchgrass and <i>Purshia</i> communities in which species was found. |
| • <i>Specify trend in AO</i> | unknown |
| • <i>Are there extreme fluctuations in AO?</i> | no |
| • <i>Number of known or inferred current locations</i> | 11 recently confirmed of 18 known/reported |
| • <i>Specify trend in #</i> | 1 possibly lost |
| • <i>Are there extreme fluctuations in number of locations?</i> | no |
| • <i>Specify trend in area, extent or quality of habitat</i> | stable to declining depending on habitat type (e.g., <i>Purshia</i> ecosystem is declining) (refer to Table 1) |
| Population Information | |
| • <i>Generation time (average age of parents in the population)</i> | perennial, likely several years |
| • <i>Number of mature individuals</i> | unknown |
| • <i>Total population trend:</i> | ?declining – possible loss of 1 population |
| • <i>% decline over the last/next 10 years or 3 generations.</i> | |
| • <i>Are there extreme fluctuations in number of mature individuals?</i> | unknown |
| • <i>Is the total population severely fragmented?</i> | yes |
| • <i>Specify trend in number of populations</i> | ?declining, based on loss of 1 population |
| • <i>Are there extreme fluctuations in number of populations?</i> | no |
| • <i>List populations with number of mature individuals in each:</i> | unknown # of mature individuals (refer to Table 1) |

| | |
|---|--|
| Threats (actual or imminent threats to populations or habitats) | |
| grazing impacts, vineyard and urban development, road construction, human impacts such as hiking, camping, and general erosion (refer to Table 1) | |
| Rescue Effect (immigration from an outside source) | |
| <ul style="list-style-type: none"> • <i>Status of outside population(s)?</i> USA: especially common in south-central Washington | |
| <ul style="list-style-type: none"> • <i>Is immigration known or possible?</i> | not likely. Spores seldom produced in this species |
| <ul style="list-style-type: none"> • <i>Would immigrants be adapted to survive in Canada?</i> | yes |
| <ul style="list-style-type: none"> • <i>Is there sufficient habitat for immigrants in Canada?</i> | yes |
| <ul style="list-style-type: none"> • <i>Is rescue from outside populations likely?</i> | no |
| Quantitative Analysis | not applicable |
| Other Status NatureServe: imperiled to secure (G2G4) | |

Status and Reasons for Designation

| | |
|--|--|
| Status: Special Concern | Alpha-numeric code: Not applicable |
| <p>Reasons for Designation:</p> <p>This is a western North American endemic species. It is a small perennial species and in Canada has a restricted distribution in the shrub-steppe in semi-arid regions of British Columbia where recent surveys have confirmed its presence from 11 sites. The species is never abundant in sites where it is found and extensive surveys have provided few new locations. At least one population is believed to have been lost to cultivation (vineyard) or to stochastic events. Threats include agriculture (especially vineyards), impact by grazing animals, urban development, road improvements, and human recreational impacts. Based on known occurrences, the species appears to have a very restricted distribution. However the species is patchily distributed at low densities in large habitats not all of which have been censused.</p> | |
| Applicability of Criteria | |
| <p>Criterion A (Declining Total Population): does not meet thresholds for decline</p> <p>Criterion B (Small Distribution, and Decline or Fluctuation): Does not meet any criterion for 'a' (known from 11 sites) or 'c' (no fluctuation)</p> <p>Criterion C (Small Total Population Size and Decline): no data – number of mature individuals not known.</p> <p>Criterion D (Very Small Population or Restricted Distribution): Does not meet criterion: Number of sites > 5 (11 confirmed), and area of occupancy likely > 20 km².</p> <p>Criterion E (Quantitative Analysis): not applicable.</p> | |

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W. B. Schofield and Wynne Miles made helpful comments on the manuscript. Richard Zander provided useful taxonomic and geographical information. Fred Knezevich provided field assistance.

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BIOGRAPHICAL SUMMARY OF THE REPORT WRITER

Dr. Terry McIntosh completed his Ph.D. in 1985 following a study of dry grassland and shrub-steppe bryophytes in the interior portions of British Columbia. Since then, he has been active collecting bryophytes from many parts of the province and in dryland areas of adjacent Washington State. He has been a primary identifier of bryophyte collections from various government and private surveys in the province. He has recently completed sixteen rare species accounts on bryophytes for the Wildlife Branch of the Province of British Columbia and two COSEWIC Status Reports on mosses.

AUTHORITIES CONTACTED

The following authorities were consulted during the preparation of this report:

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University of British Columbia, Vancouver

James R. Shevock

Associate Regional Director, Resources, Partnerships and Science
National Park Service, Pacific West
Oakland, California, USA

COLLECTIONS EXAMINED

Collections were examined from the herbaria at the University of British Columbia (UBC) and the University of Victoria (UVIC). A number of collections will be deposited at UBC, and are indicated with an asterisk.

| | Accession number | Collector(s) | Collector number | Collection date | Herbarium |
|----|------------------|---|-------------------|-----------------|-----------|
| 1 | B89011 | T. T. McIntosh with A. Kruckeberg and T. Lester | 4222 | Jun. 8, 1980 | UBC |
| 2 | B109390 | T. T. McIntosh with A. Kruckeberg | 5069A | Aug. 4, 1980 | UBC |
| 3 | B89012 | T.T. McIntosh | 6937 | Jun. 22, 1981 | UBC |
| 4 | B109553 | T. T. McIntosh, with J. Spence and T. Goward | 7555 | Apr. 28, 1983 | UBC |
| 5 | B98120 | W. B. Schofield. | 84855 | May 5, 1986 | UBC |
| 6 | - | T. T. McIntosh and K. Paige | 8075 | Jun. 3, 2001 | UBC* |
| 7 | - | T. T. McIntosh and F. Knezevich | 8040A | Aug. 3, 2001 | UBC* |
| 8 | - | T. T. McIntosh | 8018 | Dec. 23, 2002 | UBC* |
| 9 | - | T. T. McIntosh | 8020 | Dec. 23, 2002 | UBC* |
| 10 | - | T. T. McIntosh | 8021 | Dec. 23, 2002 | UBC* |
| 11 | - | T. T. McIntosh | 8029 | Dec. 23, 2002 | UBC* |
| 12 | - | T. T. McIntosh | 8031 | Dec. 23, 2002 | UBC* |
| 13 | - | T. T. McIntosh | 8034 | Dec. 23, 2003 | UBC* |
| 14 | - | T. T. McIntosh | 8061 | Jan. 21, 2003 | UBC* |
| 15 | - | T. T. McIntosh | 8062 | Jan. 21, 2003 | UBC* |
| 16 | - | T. T. McIntosh | 8056 | Jul. 11, 2002 | UBC* |
| 17 | - | T. T. McIntosh | 8067 | Jan. 21, 2003 | UBC* |
| 18 | - | T. T. McIntosh and F. Knezevich | 8072K | Jan. 21, 2003 | UBC* |
| 19 | None | A. Nicholson, E. Hamilton, and T. T. McIntosh | 81-255 (BCMof) | May 25, 1981 | UVIC |

Record of Field Work

Field work directly related to this Report was completed in 2002, on the following dates and at the locations noted in brackets (sometimes field searches for *Bryoerythrophyllum columbianum* were made in addition to other work at these sites): May 15 – 18 (south Okanagan Valley), June 14 (Cranbrook area, eastern BC), July 11-12 (Osoyoos area), July 29 – 31 (Okanagan area), August 6 – 8 (Spences Bridge area), October 18 – 20 (Kamloops area), and December 22 – 24 (south Okanagan area). One to 4 hours was spent searching at each site, depending on the size of the site. Field work was undertaken on one additional day, January 21, 2003, in order to confirm earlier sight-only locations in the south Okanagan area, and to confirm some collections that were lost in 2001 following a survey for CDC red-listed moss species with K. Paige of the BC Ministry of Forests (these had been stored in damp condition and mosses were destroyed by fungi).