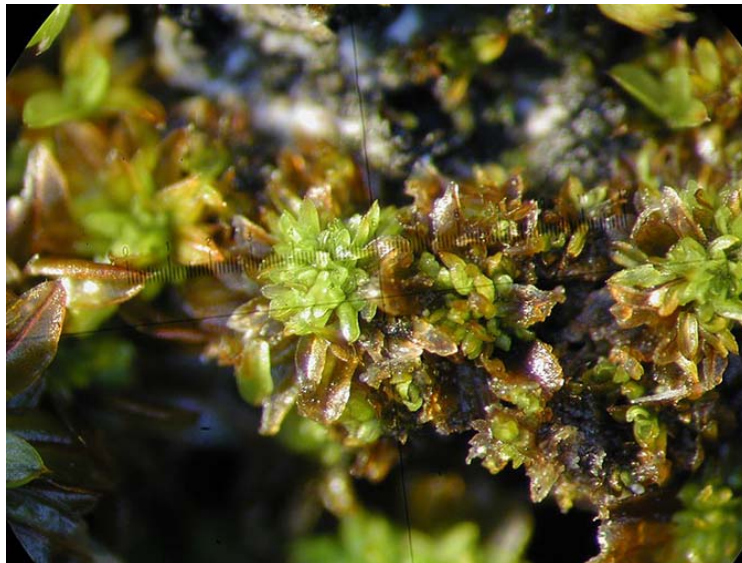


COSEWIC
Assessment and Status Report

on the

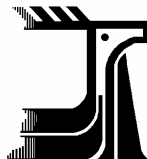
Twisted Oak Moss
Syntrichia laevipila

in Canada



SPECIAL CONCERN
2004

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA



COSEPAC
COMITÉ SUR LA SITUATION
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:

COSEWIC 2004. COSEWIC assessment and status report on the twisted oak moss *Syntrichia laevipila* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 21 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Production note: COSEWIC acknowledges Terry T. McIntosh for writing the status report on the twisted oak moss *Syntrichia laevipila* in Canada. The report was overseen and edited by René Belland, COSEWIC Co-chair (Mosses and Lichens) Plants and Lichens Species Specialist Subcommittee.

For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment Canada
Ottawa, ON
K1A 0H3

Tel.: (819) 997-4991 / (819) 953-3215
Fax: (819) 994-3684
E-mail: COSEWIC/COSEPAC@ec.gc.ca
<http://www.cosewic.gc.ca>

Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur le tortule à poils lisses (*Syntrichia laevipila*) au Canada.

Cover illustration:
Twisted oak moss — photo by W. Miles (2002).

©Her Majesty the Queen in Right of Canada 2004
Catalogue No. CW69-14/402-2004E-PDF
ISBN 0-662-37379-0
HTML: CW69-14/402-2004E-HTML
0-662-37380-4



Recycled paper



COSEWIC Assessment Summary

Assessment Summary – May 2004

Common name

Twisted oak moss

Scientific name

Syntrichia laevipila

Status

Special Concern

Reason for designation

This moss is a small species that occurs from British Columbia and Washington southward to California. The Canadian populations are at the northern limits of their range in western North America, and in Canada the species has a restricted distribution where it occurs in the area of south-eastern Vancouver Island and the Gulf Islands. The species is known from 25 sites where it is restricted to the bark of trees, in particular Garry oaks. This species is never dominant where it grows, nor is it frequent in large oak stands. Many of the known populations are in protected areas. The major threat to the species is the disappearance of mature Garry oaks, which would result in the extirpation of most populations of this species.

Occurrence

British Columbia

Status history

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



COSEWIC
Executive Summary

Twisted Oak Moss
Syntrichia laevipila

Species information

Syntrichia laevipila is a very small, acrocarpous moss that grows in clumps on exposed tree bark. It is a member of the genus *Syntrichia*, characterized by generally coarse plants, with, usually, entire and awned, ligulate to spatulate leaves. *Syntrichia laevipila* has two varieties: var. *laevipila* and var. *meridionalis*, separated by leaf characteristics and the presence of specialized reproductive structures. In British Columbia, *S. laevipila* var. *laevipila* can be confused with small plants of *S. princeps*.

Distribution

Twisted oak moss has a widespread but scattered global distribution: southern South America, Europe, Asia, North Africa, and western North America. In North America, it is found along the coast in British Columbia southwards and inland through Washington and Oregon and into California. It has a relatively narrow distribution in coastal British Columbia, restricted to Garry oak habitats from southern Vancouver Island northwards to the Nanaimo area on Vancouver Island.

Habitat

In British Columbia, this moss is restricted to the bark of trees, in particular Garry oak. Most populations of the twisted oak moss are found on exposed bark of trees in open habitats where the climate is characterized by hot to mild, dry summers and cool to cold wet winters. Most of the habitats in which this species was collected appear stable and undisturbed. There is concern for those populations within city limits or in areas where only older oaks are found, as there is little to no replacement of these older trees. Approximately one half of the populations are located in parks or Ecological Reserves and are protected from tree cutting or further development.

Biology

Twisted oak moss is an acrocarpous moss that grows as small clumps on tree bark, especially Garry oak. It is most readily distinguished by the habitat as well as its diminutive size. The *laevipila* variety of twisted oak moss produces sporophytes and spores relatively frequently in British Columbia.

Population sizes and trends

Most populations appear to be in good condition and appear stable. There is no specific information on the trends of these populations.

Limiting factors and threats

Limiting factors and threats include tree or branch harvesting, the potential of the death of older host oaks and low rate of recruitment, and, possibly, air pollution, and human disturbance.

Special significance of the species

The Canadian populations of twisted oak moss represent the northern limit of the distribution of this species in North America. It is a characteristic species of the Garry oak ecosystem, one of the most threatened of all native ecosystems in Canada.

Existing protection and other status designations

No legislation, regulations, customs, or conditions protect this species. Globally, both varieties of this species are tentatively considered vulnerable to, possibly, secure, and they are Red-listed in British Columbia.



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.



Environment
Canada

Canadian Wildlife
Service

Environnement
Canada

Service canadien
de la faune

Canada

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

COSEWIC Status Report

on the

Twisted Oak Moss

Syntrichia laevipila

in Canada

2004

TABLE OF CONTENTS

SPECIES INFORMATION.....	3
Name and classification.....	3
Description.....	4
DISTRIBUTION.....	6
Global range.....	6
Canadian range.....	7
HABITAT.....	10
Habitat requirements.....	10
Trends.....	10
Protection/ownership.....	10
BIOLOGY.....	11
General.....	11
Reproduction and dispersal.....	11
POPULATION SIZES AND TRENDS.....	11
LIMITING FACTORS AND THREATS.....	11
SPECIAL SIGNIFICANCE OF THE SPECIES.....	13
EXISTING PROTECTION OR OTHER STATUS.....	13
SUMMARY OF STATUS REPORT.....	13
TECHNICAL SUMMARY.....	15
ACKNOWLEDGEMENTS.....	17
LITERATURE CITED.....	17
BIOGRAPHICAL SUMMARY OF THE REPORT WRITER.....	18
AUTHORITIES CONTACTED.....	18
COLLECTIONS EXAMINED.....	19
RECORD OF FIELD WORK.....	21

List of figures

Figure 1. A leaf of <i>Syntrichia laevipila</i> var. <i>laevipila</i> (W. Miles 2002).....	5
Figure 2. A grouping of plants of <i>Syntrichia laevipila</i> var. <i>meridionalis</i> showing gemmae and eroded leaves (W. Miles 2002).....	6
Figure 3. North American distribution of <i>Syntrichia laevipila</i>	7
Figure 4. Canadian distribution of <i>Syntrichia laevipila</i>	8

List of tables

Table 1. Population Information for <i>Syntrichia laevipila</i>	9
Table 2. Habitat and General Characteristics of Known Populations of <i>Syntrichia laevipila</i> in British Columbia.....	12

SPECIES INFORMATION

Name and classification

Scientific Name: *Syntrichia laevipila* Brid.
Pertinent Synonyms: *Tortula laevipila* (Brid.) Schwaegr.
Common Name: Twisted oak 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), including the placement of a number of species of *Tortula* into the genus *Syntrichia*. The genus *Syntrichia* is characterized by generally coarse plants, with, usually, entire, awned (with hair-tips) leaves that are ligulate to spatulate and twisted when dry. The sporophytes (spore-producing structures) of *Syntrichia* have long stems, long-cylindrical, often curved capsules (spore sacs), and well developed, tall peristomes (fringes of tooth-like appendages surrounding the mouth of the capsule), often with basal membranes (Zander 1993; this document provides the rationale for separating *Syntrichia* from the previously polyphyletic genus *Tortula*). Closely related species in this genus are often difficult to separate, due to inherent environmental variability and rather subtle morphological differences.

There are ten species of *Syntrichia* in Canada (Ireland *et al.* 1987; listed there as species of *Tortula*). Of these, eight are found in British Columbia, and only one, *S. princeps* (de Not.) Mitt., is commonly found in similar habitats as *S. laevipila*, although *S. ruralis* appears to be present occasionally (W. B. Schofield pers. comm., 2002).

Syntrichia laevipila has two varieties:

1. var. *laevipila*, distinguished by leaves with distinct awns and lacking gemmae (asexual reproductive structures), and
2. var. *meridionalis*, distinguished by many leaves lacking well developed awns and with copious gemmae in the upper stem axils; its leaves are often eroded and appear to be in poor condition as compared with leaves of var. *laevipila*.

According to Merrifield (2000), the two varieties often grow together in Oregon, although separate populations of each variety also appear to be common. In a few of the British Columbia populations, intermediate plants are present. It is T. McIntosh's opinion, based on the examination of numerous collections and supported with information from Merrifield (2000) that a varietal status for either form is unwarranted; *Syntrichia laevipila* var. *meridionalis* appears to be a form of *S. laevipila* characteristic of more stressful habitats, as indicated by the eroded leaves, and, sometimes, more

exposed microhabitat. During her extensive survey of *S. laevipila* on Garry oaks (*Quercus garryana* Dougl. ex Hook.) in Oregon, Merrifield (2000) noted that heavy grazing occurs on bryophytes in many localities, probably by insects and, possibly, slugs. She found that the occurrence of *S. laevipila* var. *meridionalis* often coincided with heavy grazing, although not always. W. Miles (pers. comm., 2000) found that an unidentified caterpillar chewed a number of stems in one of her collections of *S. princeps*.

In British Columbia, *Syntrichia laevipila* var. *laevipila* can be confused with small plants of *S. princeps* (larger plants, that is > 1cm, are readily identifiable as *S. princeps*). With care, the two species can be distinguished by the following characters:

1. Leaf size and shape; rarely does *S. princeps* have leaves as small as var. *laevipila*, and the leaves of var. *laevipila* are usually more constricted in mid-leaf,
2. Leaf margin characters; the leaves of *S. princeps* are more recurved towards the base,
3. Sexuality; *S. princeps* is often synoicous, with both male and female structures found in a single unit, whereas *S. laevipila* is autoicous, with male units appearing on minute branches along the upper stems below the female structures, and
4. Number of cell layers above the guide cells (large central cells) of the costa (mid-rib); *S. princeps* usually has two layers of cells, compared to *S. laevipila* which has one to, rarely, two layers (Lawton 1971, Kramer 1980).

Confusion with *Syntrichia ruralis* may also be a problem, but this species was not encountered in this study. The more squarrose (bent away from the stem) leaves of *S. ruralis*, when wet, as well as its generally more highly recurved leaf margins separate small specimens of this species from *S. laevipila*.

Worldwide, the taxonomy of this species is complex, especially with respect to the closely related species, *Syntrichia pagorum* Milde (Crum & Anderson 1981).

Description

The following description has been derived principally from Steere (1939) and Lawton (1971), and from personal observations.

Syntrichia laevipila is an acrocarpous (producing female structures and sporophytes at the tips of the main stems) moss that grows as small clumps on exposed tree bark. It is most readily distinguished by the habitat as well as its diminutive size: it is one of the smallest species in the genus, with stems usually well under 0.5 cm tall. Its oblong to spatulate leaves are twisted when dry, and spreading and slightly

recurved when wet. Lawton (1971) notes that they range from 2-3.5 mm in length, but leaves from Canadian populations are rarely over 2 mm long. Leaf margins are often somewhat recurved in the middle of the leaf, but otherwise plane. The leaf mid-ribs are excurrent as smooth to toothed, hyaline awns in var. *laevipila* (Fig. 1). The awns are very short to absent in var. *meridionalis*, which is further characterized by the presence of small, generally 0.4 mm long, leaf-like and costate gemmae in the upper leaf axils (Fig. 2). The median and upper leaf cells of *S. laevipila* are isodiametric to short-rectangular, covered by small papillae (surficial bumps), and range in diameter from 10-16 μm . In some specimens from the United States, the leaves are distinctly bordered by a few rows of thick-walled cells (none of the collections examined for this report had this feature). The basal leaf cells are elongate, smooth, and clear.



Figure 1. A leaf of *Syntrichia laevipila* var. *laevipila* (W. Miles 2002).



Figure 2. A grouping of plants of *Syntrichia laevipila* var. *meridionalis* showing gemmae and eroded leaves (W. Miles 2002).

Syntrichia laevipila is autoicous where both male and female sex organs are found on the same plant. The perigonia, which contain antheridia or the male sex organs, are on short stems below the perichaetia, which contain the female sex organs, the archegonia. The perigonial bracts are small and ovate, with their tips usually bent away from the stem. The cylindrical capsules of *S. laevipila* are long-exserted, and straight to slightly curved. Its peristome is long and twisted with a distinct basal membrane. Its spores are papillose and range in size from 9-16 μm .

Taxonomic keys and additional illustrations are found in Steere (1939), Savicz-Ljubitzkaja & Smirnova (1970; in Russian, keys only as illustration appears to be of *S. pagorum*), Lawton (1971), and Smith (1989).

DISTRIBUTION

Global range

Syntrichia laevipila has a widespread but scattered global distribution: southern South America, Europe, Asia, North Africa, and western North America (Harpel 1997, Smith 1989; specimens from Australia and New Zealand identified as *S. laevipila* in the Herbarium at the University of British Columbia do not appear to be this species; further examination is required in order to confirm its presence in these areas). The global range of this taxon will probably change following a detailed taxonomic review of this species.

In North America, the distribution of *Syntrichia laevipila* basically follows the western distribution of the Garry oak ecosystem: it is found along the coast in British Columbia southwards and inland through Washington and Oregon and into California (Fig. 3). Harpel (1997) collected *Syntrichia laevipila* var. *laevipila* six times and *S. laevipila* var. *meridionalis* eight times from various locations on the western side of the San Juan Islands, less than 20km from known sites in British Columbia. It appears to be more common than previously thought In Oregon (Merrifield 2000).

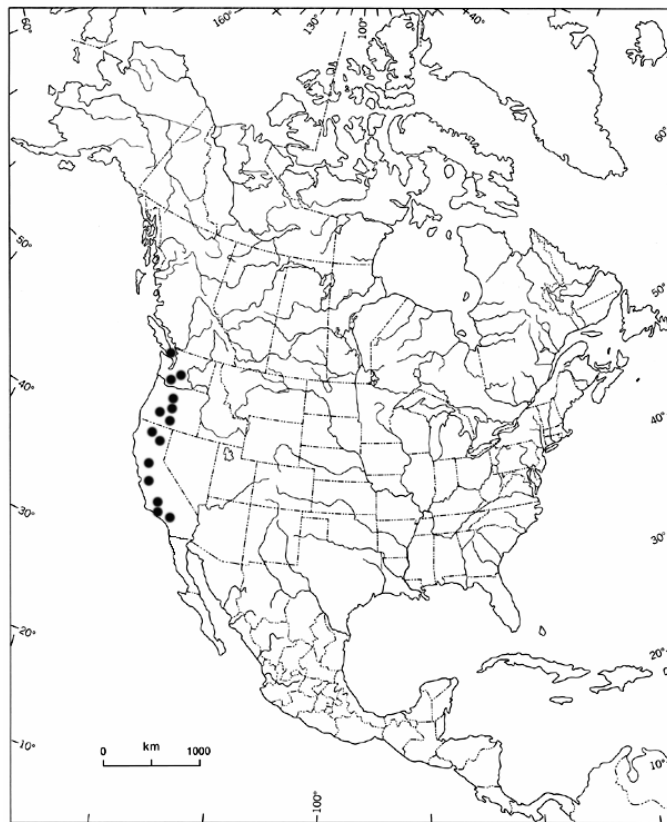


Figure 3. North American distribution of *Syntrichia laevipila*.

NatureServe Explorer 2002 lists the range of *Syntrichia laevipila* var. *laevipila* (under *Tortula laevipila*) as frequent through most of Britain and Ireland, but rare in North Scotland; it is also listed from continental Europe, West, Central and East Asia, Algeria, Morocco, the Canaries and Azores, North America, southern South America, and Australia.

Canadian range

Syntrichia laevipila has a relatively narrow distribution in coastal British Columbia, restricted to Garry oak habitats from southern Vancouver Island northwards to the Nanaimo area on Vancouver Island (Fig. 4). It is most common in the Victoria area, with multiple populations at a number of sites, including Oak Bay, Saanich and North Saanich, Beacon Hill, and Mount Tolmie (see Table 1 for a listing of known populations and sites). Outside of Victoria, it becomes uncommon, found in a few scattered sites from Pedder Bay, west of Victoria, and northwards to the Nanaimo area. It has also been reported from two of the Gulf Islands, Salt Spring Island and Galiano Island. However, the twisted oak moss, although widespread in the Victoria area, is never a dominant species on the bark of Garry oak, nor is it common in large stands of oaks. Ryan (1996) listed it as present in the Queen Charlotte Islands, but this population has since been shown to be a misidentification.

In 2001, a study on the distribution and status of *Syntrichia laevipila* var. *meridionalis* was initiated in Victoria by W. Miles (sponsored by the BC Conservation Data Center; Miles 2001). Her study was thorough, yet focused only on the one variety of this species. She did not look for or collect *S. laevipila* var. *laevipila*, except unintentionally a few times. She showed that this variety is relatively widespread within the Garry oak ecosystem of coastal British Columbia (fieldwork for this Status Report has revealed that *Syntrichia laevipila* var. *meridionalis* appears to be the more common of the two varieties in Canada).

Miles surveyed about 1200 Garry oak trees across its range on Vancouver Island and on the Gulf Islands. She found the twisted oak moss on 66 oak trees, therefore on about 5 percent of the trees that were examined. She also examined about 20 trees of other species, mostly big-leaf maple (*Acer macrophyllum*), but only found it once (on maple; Population 39). In addition to examination of known populations in the Victoria area, T. McIntosh examined about 400 oaks in addition to those examined by Miles; these trees are mainly near Duncan, Nanaimo, and on Salt Spring Island at the apparent periphery of this moss' range. It was found on three of these oak trees. Other tree species in open sites, especially big-leaf maple, were also surveyed, but not with the intensity of Garry oaks, and *Syntrichia laevipila* was not found.

During fieldwork, the presence of *Syntrichia laevipila* was confirmed at 25 sites, many of which, as noted earlier, are clustered in the Victoria area. Garry oak habitats north of Victoria were also searched, but it was confirmed only from Salt Spring Island.

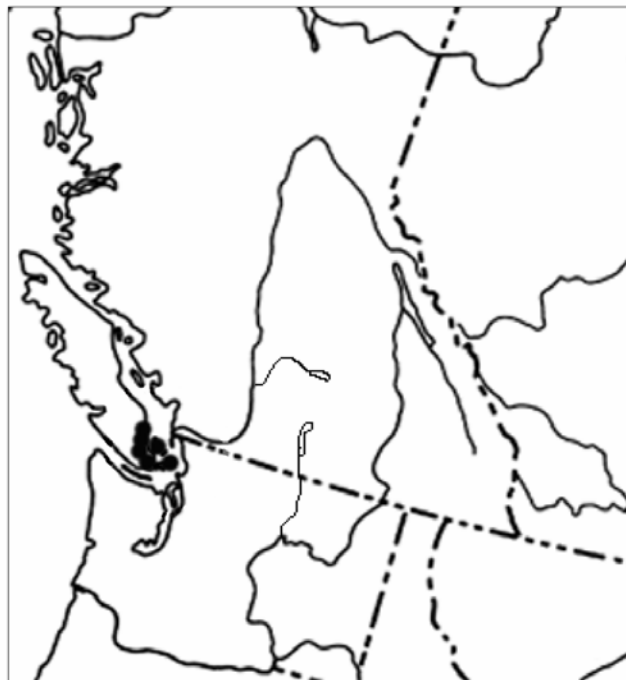


Figure 4. Canadian distribution of *Syntrichia laevipila*.

Table 1. Population Information for *Syntrichia laevipila* (numbers in brackets following population number refer to the collections that were examined for this report, and are either listed in Collections Examined section or as VC numbers which are housed in the Royal British Columbia Museum, Victoria; * refers to field description only and no collection was made due to paucity of material).

Population #	Location	Dates visited	Confirmed in 2002
1 (1, VC011968)	Oak Bay, Victoria	2001/2002	yes
2 (VC011967)	Oak Bay, Victoria	2001/2002	yes
3 (VC011966)	Oak Bay, Victoria	2002/2003	yes
4 (VC011965)	Saanich	2001/2002	yes
5 (VC011964)	Oak Bay, Victoria	2001/2002	yes
6 (VC011963)	Oak Bay, Victoria	2001/2002/2003	yes
7 (2, 3)	Victoria	2001/2002	yes
8 (VC011962)	Saanich	2001	not visited
9 (VC011961)	Victoria	2001/2002	yes
10 (VC011960)	Saanich	2001	yes
11 (VC011959)	Saanich	2002	yes
12 (VC011958)	Saanich	2002	yes
13 (VC011957)	Saanich	2002/2003	yes
14 (VC011956)	Saanich	2002	yes
15 (VC011955)	Langford	2002	yes
16 (VC011954)	Colwood	2002	yes
17 (VC011953)	Victoria	2002	yes
18 (VC011952)	Esquimalt	2002	yes
19 (VC011951)	Victoria	2002/2003	yes
20 (VC011950)	Saanich	2002	yes
21 (VC011948)	North Saanich	2002	yes
22*	Galiano Island	2002	no
23 (VC011949)	Saltspring Island	2002	yes
24*	Saanich	2002	yes
25*	Saanich	2002/2003	yes
26 (8)	Duncan	2001	no
27 (4)	Duncan		no
28 (5)	Pedder Bay	2001	not visited
29 (6)	Nanose Hill	2001	no
30 (7)	Salt Spring Island	2001/2002	yes
31 (9,10)	Victoria	2003	yes

HABITAT

Habitat requirements

In British Columbia, *Syntrichia laevipila* is restricted to the bark of trees, in particular Garry oak. It appears most common on tree boles, but is also found on tree bases and on upper branches. Recent investigations have revealed that it is also on big-leaf maple in the Victoria area, although this may be an unusual habitat for this species in Canada. Also, big-leaf maple is characteristic of more mesic habitats and is not common in the open habitats characterized by Garry oak. Most populations of the twisted oak moss are found on exposed bark of trees in open habitats where the climate is characterized by hot to mild, dry summers and cool to cold wet winters. In the United States, it is also found on Garry oak as well as, occasionally, on other tree species, in particular big-leaf maple (Harpel 1997). Merrifield (2000) provides detailed habitat information for this species in Oregon, noting that it is common only on drier aspects of Garry oaks, and that *S. laevipila* var. *meridionalis* was found at lower elevations than *S. laevipila* var. *laevipila* (under 100m vs. up to ~200m).

Syntrichia laevipila rarely is found growing admixed with other mosses or lichens, which may indicate that it may not compete well with other epiphytic taxa.

Trends

Most of the habitats in which this species was collected appear stable (Table 2, Column C) and, with respect to the trees on which they grow, undisturbed (however, the associated habitats of these trees are often heavily disturbed as the trees are on lawns or near roads). There is some concern for those populations within city limits or in areas where only older oaks are found. There is little to no replacement of these older trees and, at some point, these trees will die, probably eliminating these populations of *Syntrichia laevipila*. Widespread loss of elms (*Ulmus* spp.) through disease in the Netherlands has greatly reduced the number of populations of *Syntrichia laevipila* there (van Zanten 1992). This type of destruction of Garry oaks is possible in British Columbia considering that sudden oak death (SOD) has been responsible for wide scale destruction of oaks in California and southern Oregon, although *Quercus garryana* there is not affected by this disease to date.

Protection/ownership

Approximately one half of the sites are in parks or Ecological Reserves and protected from tree cutting or further development. The other sites are street trees or are located on private lots. Legislation in six municipalities prevents or restricts the cutting of Garry oaks.

BIOLOGY

General

Syntrichia laevipila is an acrocarpous moss that grows as small clumps on tree bark, especially Garry oak. It is most readily distinguished by the habitat as well as its diminutive size.

Reproduction and dispersal

Syntrichia laevipila var. *laevipila* produces sporophytes and spores relatively frequently in British Columbia. Spores are wind-dispersed or water-dispersed along bark surfaces, but there is no information on spore dispersal distances, viability, or germination success for this species. Asexual reproduction by gemmae is probably an important method of dispersal, at least over short distances, and in stressed environments (Merrifield 2000, Studlar et al. 1984). Miles (pers. comm., 2002) grew gemmae of *S. laevipila* on agar and transplanted the young plants onto oak bark at her residence in Victoria. Some of these transplants have survived for 2 years.

POPULATION SIZES AND TRENDS

Table 2 (Column D) provides general information about population sizes and trends of the Canadian populations of *Syntrichia laevipila*. Most populations appear to be in good condition and appear stable. There is no specific information on the trends of these populations. There is no detailed population information available about the adjacent American populations in the United States.

LIMITING FACTORS AND THREATS

Table 2 (Column B) lists the limiting factors and threats for each known population of the twisted oak moss. Tree harvesting or branch cutting may be a threat to the populations of *Syntrichia laevipila* that are on private property. However, with an increase in awareness of the ecological importance of Garry oaks, supported by legislation in some municipalities, removal of Garry oaks has become highly restricted. Also, many of the known sites for this moss are within protected areas that do not allow for the removal of Garry oaks. A more serious threat is the general lack of regeneration of Garry oaks across their range, even within some protected areas. Although mature oaks are common in Victoria at present, there appears to be little evidence that this population will be maintained over the long term, as young oaks are often removed, at least on many private properties. In other areas, such as in the Mt. Maxwell Ecological Reserve on Salt Spring Island, there are abundant older oaks, but regeneration of oaks there is minimal, mostly due to grazing by feral sheep and goats, and deer, although the situation there is improving following efforts to remove sheep and goats. Since *S. laevipila* is only found on older oaks, lack of oak regeneration is a major concern.

Table 2. Habitat and General Characteristics of Known Populations of *Syntrichia laevipila* in British Columbia (see Table 1 for additional population information).

A Population	B Limiting Factors and Threats	C Habitat Condition and Trend	D Population Size and Trend	E Protection and Ownership
1	B, C, D, E	A, B	A (1.0), B	street; municipal
2	C, D, E	A, B	A (1.0), B	library; municipal
3	B, C, D	A, B	C (<0.01), B	private lot
4	D	A, B	B (0.03), B	municipal park
5	B, C, D, E	A, B	A (0.5), B	street; municipal
6	C, D, E	A, B	B (0.2), B	municipal park
7	C, D, E	A, B	A (0.3), B	municipal park
8	C, D, E	A, B	A (0.1), B	municipal park
9	C, D, E	A, B	B (0.2), B	municipal park
10	C, D, E	A, B	B (0.06), B	municipal park
11	C, D, E	A, B	B (0.3), B	?municipal
12	C, D, E	A, B	A (2.6), B	street; municipal
13	C, D, E	A, B	B (0.8), B	University of Victoria
14	C, D, E	A, B	A (0.6), B	municipal park
15	C, D, E	A, B	A (1.8), B	street; municipal
16	C, D, E	A, B	A (0.1), B	recreation center; municipal
17	C, D, E	A, B	A (0.6), B	municipal park
18	C, D, E	A, B	A (0.7), B	school; municipal
19	C, D, E	A, B	A (1.8), B	private lot
20	C, D, E	A, B	B (0.4), B	street; municipal
21	C, D, E	A, B	C (< 0.01), B	street; municipal
22	A	A, B	C (0.06), B	regional park
23	C, D, E	A, B	B (<0.02), B	Ecological Reserve
24	C, D, E	A, B	B (0.05), B	municipal park
25	C, D, E	A, B	B (0.03), B	municipal park
26	C	A, B	?	Preserve
27	A	A, B	?	Ecological Reserve
28	?	?	?	?
29	?	?	?	?
30	C	A, A	C(<0.02), A	regional park
31	C, D, E	A, B	A (1.8), B	municipal park

Notes (in all cases, '?' refers to 'unknown' or 'uncertain'):

1. With respect to **Column B**: A refers to no noticeable limiting factors or threats, B refers to tree or branch harvesting, C refers to lack of oak regeneration, D refers to potential air pollution, including by automobiles, E refers to human-related disturbances, including dogs.
2. With respect to **Column C**: *Habitat Condition* ('Habitat' here refers only to the bark of the tree): A refers to no noticeable disturbance, 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 more than twenty clumps, 'B' means five to twenty clumps, and 'C' means fewer than five scattered clumps. The number in parentheses is the approximate span of the population in m²; this usually includes other bryophytes and exposed bark.; *Population Trend*: A refers to possibly improving, B refers to apparently stable, C refers to possibly degrading.

Air pollution may also be a threat to *Syntrichia laevipila* populations within or nearby urban centers, although this is unlikely, as these areas receive sea breezes which keep the air fresh. However, Adams and Preston (1992) note that *S. laevipila* appears to be one of the most sensitive and adversely affected moss species by air pollution in the United Kingdom. It has been shown to be sensitive to air pollution in other parts of Europe as well (e.g., Sim-Sim et al. 2000). Many of the known sites for the twisted oak moss are near roadways, and automobile exhaust pollution may affect some populations although this is unknown.

Some landowners remove mosses and lichens from oaks on their property, and this is probably of minor concern. Damage can occur to the bases of oaks in parks during routine grass or weed maintenance.

SPECIAL SIGNIFICANCE OF THE SPECIES

The Canadian populations of *Syntrichia laevipila* represent the northern limit of the distribution of this species in North America. Also, it is a characteristic species of the Garry oak ecosystem, one of the most threatened of all native ecosystems in Canada. The Garry Oak Ecosystems Recovery Team (GOERT) has been put in place to address the loss of Garry oak habitats in British Columbia. A great deal of research is presently underway to assist in the understanding and potential recovery of many of the rare species and oak habitats along the coast (Fuchs 2001). Although this moss appears more common than previously reported, its range is still, nevertheless, highly restricted in Canada.

EXISTING PROTECTION OR OTHER STATUS

No legislation, regulations, customs, or conditions protect this species. Globally, both varieties of this species are tentatively considered vulnerable to possibly secure (G3G5T?), and they are Red-listed (S1) in British Columbia (BC Conservation Data Center 2001, Ryan 1996). In Norway it is Red-listed and considered vulnerable by Timmermann (2001). J. Christy (pers. comm., 2002) notes that *Syntrichia laevipila* is not currently listed for Oregon, but found only two records and suggests a G4S1 ranking (apparently globally secure and critically imperiled sub-nationally). The work of Merrifield (2000), however, shows that *S. laevipila* may be fairly common there. NatureServe Explorer (2002) ranks this species as G3G5 globally.

SUMMARY OF STATUS REPORT

The twisted oak moss is a small species with a restricted distribution in Canada, where it occurs in coastal British Columbia, from south-eastern Vancouver Island and the Gulf Islands. The species is confirmed from 25 sites. The Canadian populations are at the northern limits of their range in western North America, where *Syntrichia laevipila*

occurs from British Columbia and Washington southward to California. The species is restricted to the bark of trees, in particular Garry oaks, but is never dominant where it grows, nor is it common in large oak stands. Many of the known populations are protected. The major threat to the species is the aging population of Garry oaks combined with little or no recruitment. Disappearance of Garry oaks will result in the extirpation of most populations of the twisted oak moss.

TECHNICAL SUMMARY

Syntrichia laevipila

Twisted oak moss

tortule à poils lisses

Range of Occurrence in Canada: BC

Extent and Area Information	
• <i>Extent of occurrence (EO)(km²)</i>	~ 1890km ²
• <i>Specify trend in EO</i>	stable
• <i>Are there extreme fluctuations in EO?</i>	no
• <i>Area of occupancy (AO) (km²)</i>	? < 20km ²
• <i>Specify trend in AO</i>	stable
• <i>Are there extreme fluctuations in AO?</i>	no
• <i>Number of known or inferred current locations</i>	31 25 confirmed in recent surveys, 4 not found, 2 sites not visited
• <i>Specify trend in #</i>	unknown
• <i>Are there extreme fluctuations in number of locations?</i>	no
• <i>Specify trend in area, extent or quality of habitat</i>	stable – many Garry oak sites are in protected areas and cutting prohibited in 6 municipalities
Population Information	
• <i>Generation time (average age of parents in the population)</i>	perennial
• <i>Number of mature individuals</i>	minimum # is 305 individuals (clumps)
• <i>Total population trend:</i>	unknown, but may decline sharply in future as older trees die; seedling establishment replacing aging population appears very low
• <i>% decline over the last/next 10 years or 3 generations.</i>	unknown
• <i>Are there extreme fluctuations in number of mature individuals?</i>	no
• <i>Is the total population severely fragmented?</i>	yes
• <i>Specify trend in number of populations</i>	unknown, but individual populations appear healthy
• <i>Are there extreme fluctuations in number of populations?</i>	no
<i>List populations with number of mature individuals in each:</i>	see Table 1
Threats (actual or imminent threats to populations or habitats)	
tree harvesting, the potential of the death of older host oaks and low rate of seedling establishment	
Rescue Effect (immigration from an outside source)	
• <i>Status of outside population(s)?</i> USA: occurs in Washington, Oregon, California	
• <i>Is immigration known or possible?</i>	no
• <i>Would immigrants be adapted to survive in Canada?</i>	yes
• <i>Is there sufficient habitat for immigrants in Canada?</i>	yes
• <i>Is rescue from outside populations likely?</i>	Not known
Quantitative Analysis	
Not applicable	
Other Status: globally secure; possibly rare in Oregon	

Additional Sources of Information: Total Garry oak population in SW B.C. is estimated at >100,000 stems of all ages. Given that the species is known from 69 trees, and assuming 1 stem/tree, then given that the species was found on 4.3% of the trees examined (about 1600, page 4), a crude population estimate of the number of trees hosting the species could be 4300. However, since the species does not grow on young trees (included in the 100,000 estimate) and appears to have specific requirements with respect to shade (T. McIntosh pers comm., Feb 2004), then this number is certainly an overestimate.

The Garry Oak Ecosystems Recovery Team has looked at recruitment, and despite the loss of much Garry oak habitat on southern Vancouver Island and the Gulf Islands, has determined that there are probably as many or more Garry oaks on southern Vancouver Island as there were historically due to extensive recruitment due to lack of fires, but most of these are not mature trees.

According to Ted Lea and Marilyn Fuchs (BC Environment, pers. comm., to McIntosh Feb 2004), urban oaks are declining. They will do so more in the future because of homeowner concerns regarding branches and trees falling on structures or people. Lea says that 99% of all deep soil oaks (high potential for twisted oak moss presence) have been lost in Victoria and Cowichan areas (T. Lea, pers. comm., 2004), and in most city sites outside of protected parks (where most of the trees are open or growing on rock outcrops and, therefore, less likely to have the moss on them), there is little to no opportunity for regeneration in many sites (seedlings are mowed or removed by hand). Since most twisted oak moss sites are in the Victoria area (and where about 1/3 to date of the trees where it has been collected are not protected), then there is a real threat.

Status and Reasons for Designation

Status: Special Concern	Alpha-numeric code: Met criteria for Threatened, D2, but designated as Special Concern because of the high potential numbers of Garry Oak host.
Reasons for Designation: This moss is a small species that occurs from British Columbia and Washington southward to California. The Canadian populations are at the northern limits of their range in western North America, and in Canada the species has a restricted distribution where it occurs in the area of south-eastern Vancouver Island and the Gulf Islands. The species is known from 25 sites where it is restricted to the bark of trees, in particular Garry oaks. This species is never dominant where it grows, nor is it frequent in large oak stands. Many of the known populations are in protected areas. The major threat to the species is the disappearance of mature Garry oaks, which would result in the extirpation of most populations of this species.	
Applicability of Criteria	
Criterion A (Declining Total Population): does not meet thresholds for decline (no decline is documented)	
Criterion B (Small Distribution, and Decline or Fluctuation): does not meet thresholds for small population (too many known sites), or decline or fluctuation	
Criterion C (Small Total Population Size and Decline): would meet criteria for Endangered, 2a(i), based on inferred future decline due to lack of regeneration of Garry oak in parts of its range; however, there is no evidence for future decline of Garry oak.	
Criterion D (Very Small Population or Restricted Distribution): meets criteria for Threatened, D2	
Criterion E (Quantitative Analysis): not applicable.	

ACKNOWLEDGEMENTS

Wynne Miles provided considerable assistance throughout the project, with fieldwork, preparation of specimens, illustrative materials, and in report editing. W.B. Schofield provided helpful comments.

Funding for the preparation of this status report was provided by the Canadian Wildlife Service, Environment Canada.

LITERATURE CITED

- Adams, K.J. and C.D. Preston. 1992. Evidence for the effects of atmospheric pollution on bryophytes from national and local recording. In: Biological recording of changes in British wildlife, Harding, P.T. (ed.), ITE Symposium 26.
- BC Species and Ecosystem Explorer. 2003. Victoria, British Columbia, Canada. Available at: <http://srmapps.gov.bc.ca/apps/eswp/> (accessed 2003).
- Crum, H.A. & L.E. Anderson. 1981. Mosses of Eastern North America. Columbia University Press, New York. 2 Vols.
- Fuchs, Marilyn A. 2001. Towards a Recovery Strategy for Garry Oak and Associated Ecosystems in Canada: Ecological Assessment and Literature Review. Technical Report GBEI/EC-00-030. Environment Canada, Canadian Wildlife Service, Pacific and Yukon Region.
- Harpel, J.A.S. 1997. The phytogeography and ecology of the mosses within the San Juan Islands, Washington State. PhD Dissertation. University of British Columbia, Vancouver, B.C.
- Ireland, R.R., G.R. Brassard, W.B. Schofield, & D.H. Vitt. 1987. Checklist of mosses of Canada II. *Lindbergia* 13: 1-62.
- Kramer, W. 1980. *Tortula* Hedw. Sect. *Rurales* De Not. (Pottiaceae, Musci) in der östlichen Holarktis. Bryophyt. Biblioth. 21. J. Cramer, Vaduz.
- Lawton, E. 1971. Moss Flora of the Pacific Northwest. The Hattori Botanical Laboratory, Nichinan, Japan.
- Merrifield, K. 2000. Bryophytes on isolated *Quercus garryana* trunks in urban and agricultural settings in the Willamette Valley, Oregon. *The Bryologist* 103(4): 720-724.
- Miles, Wynne. 2001. Untitled and unpublished report for the Conservation Data Center of British Columbia.
- NatureServe Explorer: An Online Encyclopedia of Life. 2002. Version 1.6. Arlington, Virginia, U.S.A. Available at: <http://www.natureserve.org/explorer/> (accessed 2002).
- Ryan, M.W. 1996. Bryophytes of British Columbia: rare species and priorities for inventory. Res. Br., B.C. Min. For., and Wildl. Br., B.C. Ministry of Environment, Lands, and Parks. Victoria, B.C., Work. Pap. 12. 100 pp.
- Savicz-Ljubitzkaja L.I. & Z.N. Smirnova. 1970. The Handbook of the Mosses of the U.S.S.R.: The Mosses Acrocarpous. Academy of Science, Leningrad.

- Sim-Sim, M., P. Carvahlo, & C. Sergio. 2000. Cryptogamic epiphytes as indicators of air quality around an industrial complex in the Tagus Valley, Portugal. Factor analysis and environmental variables. *Cryptogamie, Bryol.* 21 (2): 153-170.
- Smith, A.J.E. 1989. *The Moss Flora of Britain and Ireland* (2nd ed.). Cambridge Univ. Press, London.
- Steere, W.C. 1939. In A.J. Grout (Ed.): *Moss Flora of North America, North of Mexico*. Vol. I, pp. 239-240. Newfane, Vermont.
- Studlar, S.M., J.D. Caponetti, & A.J. Sharp. 1984. Morphology of the urban moss, *Tortula pagorum* in sterile culture. *J. Hatt. Bot.* 56: 351-368.
- Timmermann, V. 2001. Red list of threatened mosses in Norway. The bryophyte herbarium: The Natural History Museums and Botanical Garden, University of Oslo. http://www.toyen.uio.no/botanisk/mose/red_alfa.htm
- Van Zanten, B.O. 1992. Distribution of some vulnerable epiphytic bryophytes in the north of the province of Groningen, The Netherlands. *Bio. Cons.* 59: 205-209.
- Zander, R.H. 1993. *Genera of the Pottiaceae: Mosses of Harsh Environments*. Bulletin of the Buffalo Society of Natural Sciences, Vol. 32, Buffalo.

BIOGRAPHICAL SUMMARY OF THE REPORT WRITER

Dr. Terry McIntosh completed his PhD in 1986 following a study of dry grassland and 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 four COSEWIC Status Reports on mosses.

AUTHORITIES CONTACTED

John A. Christy:

Wetland Ecologist, Oregon Natural Heritage Program
Herbarium Research Associate, Oregon State University

W. B. Schofield:

Professor Emeritus, Botany Department
University of British Columbia, Vancouver

James R. Shevock:

Associate Regional Director, Resources, Partnerships and Science
National Park Service, Pacific West
1111 Jackson St., Suite 700, Oakland, CA 94607-4807

COLLECTIONS EXAMINED

Collections examined 1 - 6 are housed in the Herbarium at the University of British Columbia in Vancouver. Collections 7 - 10 will be deposited there at a later date. A large number of collections of *Syntrichia laevipila* var. *meridionalis* by Miles (2001) in the Herbarium at the Royal British Columbia Museum in Victoria were also confirmed by T. McIntosh. For sake of brevity, these are not listed here, although detailed information from these collections is presented in Table 1.

1.

Tortula laevipila (Brid.) Schwaegr. var. *meridionalis* (Schimp.) Wijk & Margad.
Accession number: B177600
Location: Vancouver Island: Oak Bay, Victoria
Habitat: Urban, by road. On branches of *Quercus garryana*
Collector: Wynne Miles
Collection number: 37
Collection date: 11 January 2001
Determination by: W. B. Schofield
Confirmation: T.T. McIntosh 2002
Notes: a second collection from this site is housed at the Royal British Columbia Museum; # VC011968; this specimen was also examined)

2.

Tortula laevipila (Brid.) Shwaegr. var. *meridionalis* (Schimp.) Wijk & Marg.
Accession number: B151607
Locality: Vancouver Island: Beacon Hill Park, Victoria.
Habitat: On bark of Oaks.
Collector: J. W. Bailey?
Collection number: s.n.
Collection date: 14 September 1930
Determination by: J. A. Harpel (25 June 1996)
Confirmation: T.T. McIntosh 2002
Notes: (originally determined by W. B. Schofield as *T. laevipila*)

3.

Tortula laevipila (Brid.) Shwaegr. var. *meridionalis* (Schimp.) Wijk & Marg.
Accession number: B159098
Locality: Vancouver Island: Victoria, Beacon Hill Park, North section of park
Habitat: On Garry oak, base of trunk, east exposure. Partially shaded.
Elevation: ca. 20m
Collector: N. Djan-Chékar & C. Norris.
Collection number: 2070
Collection date: 10 May 1996
Determination by: N. Djan-Chékar, November 1996
Confirmation: T.T. McIntosh 2002
Notes: cfr. some plants with leaf-like gemmae, autoicous.

4.

Tortula laevipila (Brid.) Schwaegr.
 Accession number: B986
 Location: Berg Tzuchalem s Duncan. Insel Vancouver.
 Habitat: Epiphytisch an Baumrinde von *Quercus garryana* in
 Sonnlagen.
 Collector: A. V. Hübschmann
 Collection number: s.n.
 Collection date: October, 1978
 Determination by: O. Lee 1979
 Confirmation: T.T. McIntosh 2002
 Notes: -

5.

Tortula ? laevipila (Brid.) Shwaegr.
 Accession number: B151606
 Locality: Vancouver Island: Pedder Bay.
 Habitat: Trunk of *Quercus garryana*.
 Collector: W. B. Schofield with J. H. Lyford.
 Collection number: 59567
 Collection date: 7 March 1976
 Determination by: W. B. Schofield
 Confirmation: T.T. McIntosh 2002
 Notes: C.fr.

6.

Tortula laevipila var. *laevipila ?*
 Accession number: B10528
 Location: Nanoose Hill, Nanoose Bay, Vancouver Island.
 Habitat: On *Quercus garryana* trunk
 Collector: W. B. Schofield
 Collection number: 74818
 Collection date: 3 May 1980
 Determination by: W. B. Schofield
 Confirmation: T.T. McIntosh 2002
 Notes: -

7.

Tortula laevipila (Brid.) Shwaegr.
 Accession number:
 Locality: Salt Spring Island, British Columbia
 Habitat: On bark of large Garry oak
 Collector: T.T. McIntosh
 Collection number: 8057
 Collection date: June 7, 2002
 Determination by: T.T. McIntosh 2002

8.

Tortula laevipila (Brid.) Shwaegr
 Accession number:
 Locality: Cowichan Garry Oak Preserve, Duncan, British Columbia
 Habitat: On bark of large Garry oak in open field
 Collector: W. Miles
 Collection number: Miles 26
 Collection date: Nov. 16, 2001
 Determination by: T.T. McIntosh 2002

9.

Tortula laevipila (Brid.) Shwaegr. var. *meridionalis* (Schimp.) Wijk & Marg.
 Accession number:
 Locality: Topaz Park, Victoria, British Columbia
 Habitat: Abundant in rain tracks on bark of large Garry oak
 Collector: W. Miles
 Collection number: WM 030057
 Collection date: Nov. 30, 2003
 Determination by: W. Miles 2003
 Confirmation by: T.T. McIntosh 2003

10.

Tortula laevipila (Brid.) Shwaegr. var. *meridionalis* (Schimp.) Wijk & Marg.
 Accession number:
 Locality: Topaz Park, Victoria, British Columbia
 Habitat: In rain tracks on bark of large big-leaf maple (*Acer grandiflorum*)
 Collector: W. Miles
 Collection number: WM 030058(b)
 Collection date: Nov. 30, 2003
 Determination by: W. Miles 2003
 Confirmation by: T.T. McIntosh 2003

RECORD OF FIELD WORK

Together, W. Miles and T. McIntosh visited many of her collection sites (Miles 2001, on October 1, and 2, and on December 12, 2002). Miles investigated additional sites on October 14, and 26 and on December 3, 2002. Field work was also undertaken by T. McIntosh on Salt Spring Island (May 3 - 4, June 6 - 8, and October 13, 2002), in the Duncan area in June, 2002, and in the disjunct Garry oak stand at Yale a number of times in 2000 and 2001 (once with W. B. Schofield), before this report was initiated. Searches for this moss are ongoing. Since *Syntrichia laevipila* was previously thought to be restricted to Garry oak in Canada, associated tree species were only occasionally inspected for the presence of this moss.