

## Recovery Strategy for the Rigid Apple Moss (*Bartramia stricta* Bridel) in British Columbia



Prepared by the British Columbia Bryophyte Recovery Team and  
the Garry Oak Ecosystems Recovery Team



Ministry of  
Environment

June 2007

## **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 our 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>

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## Disclaimer

This recovery strategy has been prepared by the British Columbia Bryophyte Recovery Team and the Garry Oak Ecosystem 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 rigid apple 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 rigid apple moss.

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## **RESPONSIBLE JURISDICTIONS**

The British Columbia Ministry of Environment is responsible for producing a recovery strategy for rigid apple moss under the *Accord for the Protection of Species at Risk in Canada*. Parks Canada Agency and Environment Canada, Canadian Wildlife Service participated in the development of this recovery strategy.

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## EXECUTIVE SUMMARY

The rigid apple moss is a small, brownish-green moss that grows in small tufts or patches. It has been found in North America, Europe, Asia, Africa, and Australia. It is rare in North America, reported from California, New Mexico, Texas, and British Columbia.

In British Columbia, it has been found on Nanoose Hill near Nanaimo, on Lasqueti Island, and on two sites southwest of Victoria. It may have been extirpated at one site near Pedder Bay (Victoria). Population data are presented from the Nanoose Hill and Mary Hill sites, but are not available for the Pedder Bay or the Lasqueti Island sites.

The Canadian populations probably represent under 0.01% of its global distribution and abundance. Little is known about the biological attributes that may influence the recovery of the rigid apple moss. It produces spores frequently and can reproduce by vegetative fragmentation. It is a temperate moss species requiring warm, summer dry sites, but there is little detailed information about the habitat needs for this species across its global range. Various microhabitats for this species include vertical rock faces, humus, fine litter, rock at the base of outcrops, and crevices and small ledges.

Threats include loss or degradation of its habitat, as large areas of Garry oak habitat have been lost or been degraded over the past many years. The lack of suitable habitat in these ecosystems limits the potential range of this species and further threatens the survival of the rigid apple moss. Another threat is encroachment by other plant species, partly as a result of fire suppression, which may shade out or outcompete the rigid apple moss.

Suitable habitat for the rigid apple moss can generally be described as the faces, crevices, and ledges of rock outcrops, as well as open, thin soil near the bases of outcrops within Garry oak and similar ecosystems. Activities that will result in the destruction of critical habitat include loss and degradation of suitable habitat, trampling, and encroachment by other species of plants. Ecological studies and inventory are required.

Recovery of rigid apple moss is feasible and population viability is rated as moderate. The main recovery goal is to protect and maintain the extant populations of the rigid apple moss. Recovery objectives include establishing protection for extant populations and determining the level of real and potential threats. The broad approaches for recovery of this species include protecting extant populations, researching the potential threats to the habitats, researching the known populations and habitats, and establishing a monitoring program on known and potential threats and on population attributes. The social and economic considerations of implementing this strategy are considered low to moderate for this species.

Protection measures for this species must be confirmed or assessed and more detailed information needs to be gathered about threats to this species, especially related to invasive plants. Data are needed to fully describe potential critical habitat attributes. A detailed investigation of Garry oak and open cliff habitats along the southwestern British Columbia coast is recommended. Impacts to other species or ecological processes are not anticipated. This

recovery strategy should be considered for integration within Garry oak ecosystem conservation efforts in the region.

For successful implementation in protecting species at risk, there will be a strong need to engage in stewardship on various land tenures.



## TABLE OF CONTENTS

RECOVERY TEAM MEMBERS .....	iii
AUTHOR .....	iii
RESPONSIBLE JURISDICTIONS .....	iii
ACKNOWLEDGEMENTS .....	iii
EXECUTIVE SUMMARY .....	iv
BACKGROUND .....	1
Species Assessment Information from COSEWIC .....	1
Description of the Species .....	1
Populations and Distribution .....	4
Needs of the rigid apple moss .....	7
Habitat needs .....	7
Biological needs, ecological role, and limiting factors .....	10
Threats .....	11
Knowledge Gaps .....	12
RECOVERY .....	12
Recovery Feasibility .....	12
Recovery Goal .....	13
Recovery Objectives .....	13
Broad Strategy Recommended to Address Threats .....	13
Approaches Recommended to Meet Recovery Objectives .....	14
Recovery Planning Table .....	14
Performance Measures .....	15
Critical Habitat .....	15
Identification of the species' critical habitat .....	16
Recommended schedule of studies to identify critical habitat .....	16
Existing and Recommended Approaches to Habitat Protection .....	17
Effects on Other Species .....	18
Socio-economic Considerations .....	18
Recommended Approach for Recovery Implementation .....	18
Statement on Action Plans .....	18
REFERENCES .....	19

## BACKGROUND

### Species Assessment Information from COSEWIC

**Scientific Name:** Moss, Rigid Apple

**Common Name:** *Bartramia stricta*

**Status:** Endangered

**Last Examination and Change:** May 2000 (In a higher risk category)

**Canadian Occurrence:** British Columbia

**Status Criteria:** B1+2C; D1

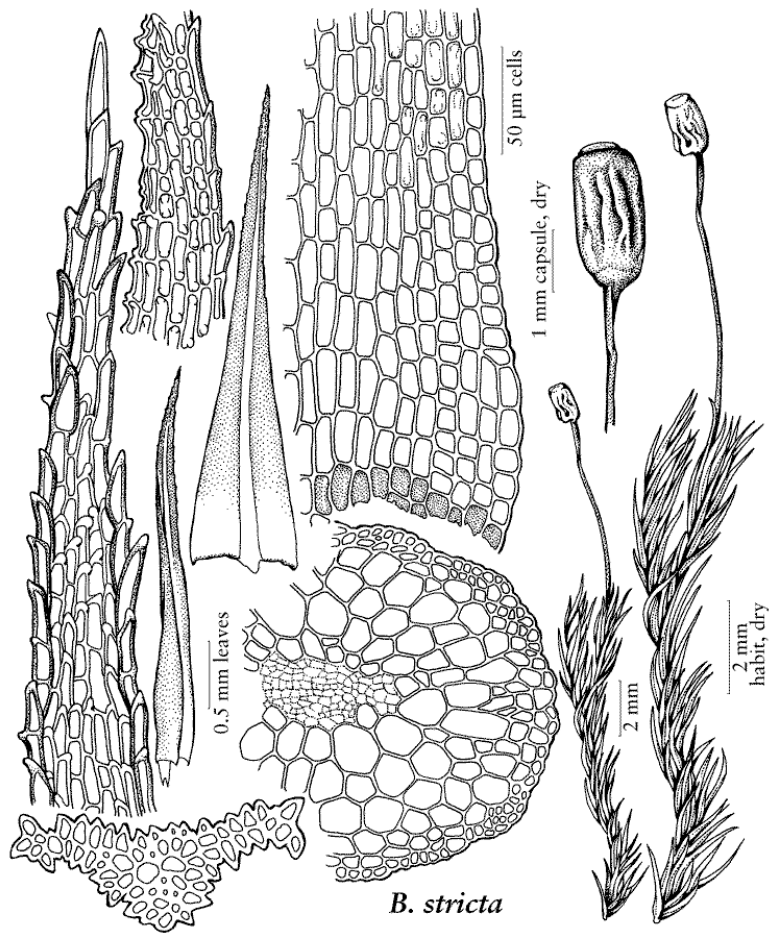
### Description of the Species

The rigid apple moss is a small, brownish-green moss, sometimes with a distinctive grayish cast (glaucous) that grows in small tufts or patches. Individual plants are erect, ranging from 1 to 3 cm in height, and are usually brown and somewhat fuzzy at their bases. The straight and erect leaves evenly spread when wet, and are appressed towards the stem when dry.

The rigid apple moss has both male and female plants in the same structure on individual stems. Because of this, plants often produce sporophytes and spores (Belland 1997). The seta, or stalk, of the sporophyte extends well beyond the plant and raises the capsule well above the plant at maturity. The capsules are globular and distinctively ribbed when dry. A peristome, consisting of teeth-like appendages, is present around the mouth of the capsule. According to Belland (1997, in the addendum), this species can probably reproduce by vegetative means, through fragmentation of patches and subsequent colonization of bare substrate by loose stems.

Its relatively small size, straight, erect leaves, and non-clasping leaf bases distinguish this species from the other three species of *Bartramia* found in the province.

Figure 1 illustrates key features of the rigid apple moss, and Figures 2 and 3 are photographs of the same patch eight years apart showing sporophytes. See Belland (1997), Lawton (1971), and Griffin (2003) for additional illustrations, identification keys, and descriptive details for this species.

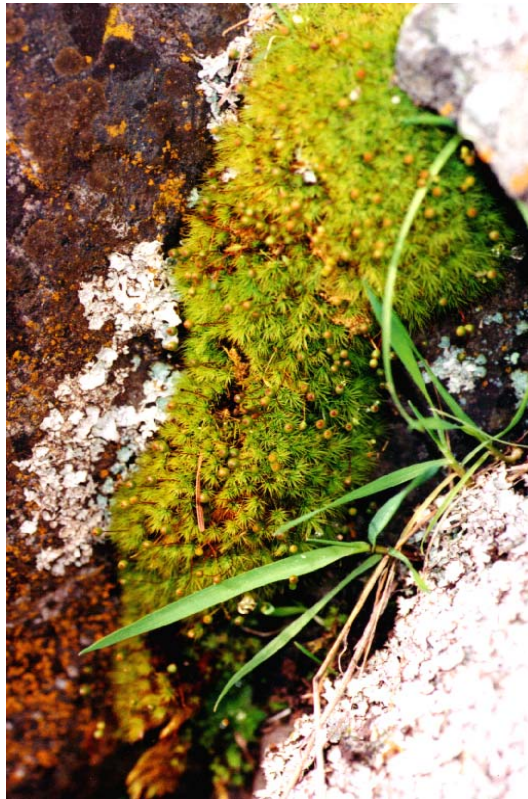


*B. stricta*

**BARTRAMIA**

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**Figure 1.** Key features of the rigid apple moss (from Griffin 2003, used with permission of the artist, P.M. Eckel).



**Figure 2.** Photograph of a hydrated patch of the rigid apple moss with young sporophytes (photo by M. Ryan; from Belland 1997).

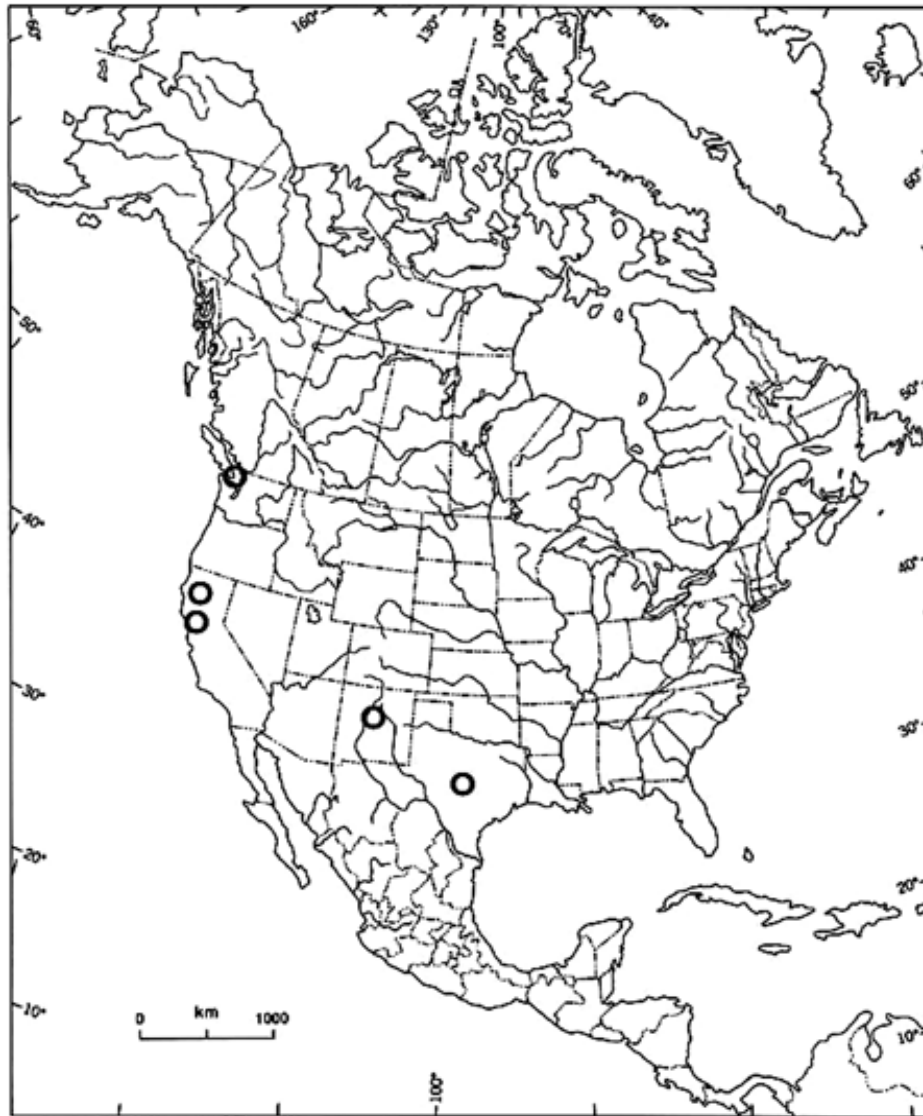


**Figure 3.** March 2005, photograph of a dry patch of the rigid apple moss with young sporophytes (the same patch as shown in Figure. 2; photo by C. Engelstoft).

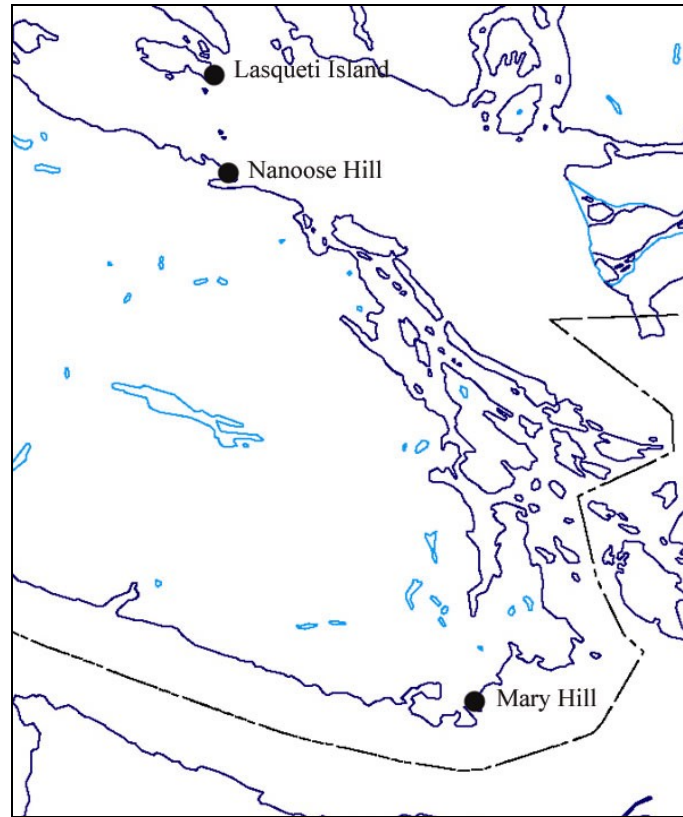
## Populations and Distribution

The rigid apple moss has been found in North America, Europe, western Asia, north and central Africa, and Australia. It is rare in North America, reported from California, New Mexico, Texas, and British Columbia (Griffin 2003). The Canadian records are at the northern limit of the distribution of this species in North America (Figure 4).

In Canada, this species has been found at four sites in British Columbia (Figure 5): on Nanoose Hill north of Nanaimo, on Lasqueti Island (about 20 km north of the Nanoose Hill site), and at two adjacent sites southwest of Victoria. The latter two sites are at Mary Hill and near Pedder Bay (northwest of the Pedder Bay Marina) where it was first discovered by W.B. Schofield in 1974 (see Table 3 for Land Tenure). However, it has probably been extirpated from the Pedder Bay site, possibly through shading by invasive vascular plants (Belland 1997). The Lasqueti Island population was discovered in 2002 by K. Sadler (pers. comm., 2004). Although UTM data are available for the populations at the Mary Hill site, only general UTM data are available for the Nanoose Hill site, and none are available for the Pedder Bay or Lasqueti Island populations.



**Figure 4.** Confirmed distribution of the rigid apple moss in North America (based on Griffin 2003).



**Figure 5.** Distribution of the rigid apple moss in British Columbia (the Pedder Bay site is just west of the Mary Hill site).

Belland (1997) provides population data for the Nanoose Hill and Mary Hill locations (two populations). At Nanoose Hill location, he found 183 patches (groups of individual plants growing together) of the rigid apple moss; these patches ranged from 0.5 to 259 cm<sup>2</sup>. Most of these patches were clustered in groups, with only three isolated patches found. Twelve groups were present, consisting of 2–33 patches of moss. In a recent visit to the Nanoose Hill location (March 29, 2005; including W.B. Schofield, T. McIntosh, L. Byrne, W. Miles, A. Robinson, T. Lea, and B. Costanzo), two sites were found that contained the rigid apple moss. The first site, following general location data provided by R. Belland, was the site reported earlier by Belland (1997). The area covered by the rigid apple moss at this site was extensive, and comprised over 100 patches, in 3–4 closely associated groups; the largest patch was about 20 × 10 cm. Most of the patches were on stony soil among low-growing herbaceous vegetation, and only a few of the patches grew on outcrops and ledges. The second site, not reported by Belland (1997), was found about 60 m downslope of the first site. It is much smaller (about 10 m<sup>2</sup>), contains 25 patches, and consisted mainly of patches on stony soil.

Belland (1997) reported four groups of the rigid apple moss from the Mary Hill site, consisting of 1, 5, ~25, and 1 patch, respectively. They ranged from 9 to 70 cm<sup>2</sup>. No population data are available for the Lasqueti Island site for this moss. In recent visits to the Mary Hill site (in

February, 2005 by L. Byrne, and on March 14, 2005, by T. McIntosh, M. Ryan, L. Byrne, W. Miles, and A. Robinson), the original four populations were relocated and 12 new patches were found; three at one of the original locations and nine patches at three new locations (as groups), one of these on the side of the property close to Pedder Bay. Table 1 lists population data for the rigid apple moss in British Columbia.

**Table 1.** Population data for the rigid apple moss in British Columbia

<b>Site</b>	<b>Number of patches</b>	<b>Land tenure</b>
Nanoose Hill	183 (1997) ~160 patches ~ 25 patches	Federal Department of National Defence (DND) lands
Mary Hill	1 (+3 new in 2005) 5 ~25 1 6 2 1	Federal DND lands
Lasqueti Island	unknown	unknown
Pedder Bay	not relocated in 1997; probably extirpated	unknown

Globally, the rigid apple moss is listed as imperiled to apparently secure (G2G4) and is Red-listed (S1) for British Columbia (BC Species and Ecosystem Explorer 2005). NatureServe Explorer (2004) lists it as N1N2 (critically imperiled to imperiled for the United States) and N1 (critically imperiled) for Canada. It is not ranked for the American states where it is found.

There are no reported estimations of global distribution and abundance for this moss. However, based on its somewhat more widespread distribution in other areas, the Canadian populations probably represent under 0.01% of its global distribution and abundance.

The fieldwork that occurred in 2005 is not detailed enough to allow for an accurate assessment on trends in the Canadian populations.

## Needs of the rigid apple moss

### Habitat needs

The rigid apple moss is a temperate moss species requiring warm, summer-dry environments. All of the B.C. populations of the rigid apple moss are found on relatively open, dry and warm,



south-facing slopes in Garry oak (*Quercus garryana*) or open grass-dominated slopes, or in environmentally similar habitats (such as on Lasqueti Island). Both the Nanoose Hill and Mary Hill sites for this moss are characterized as dry grassy slopes and outcrops within an open forest of Garry oak, Douglas-fir (*Pseudotsuga menziesii*), and arbutus (*Arbutus menziesii*).

Belland (1997) notes that there is little detailed information about the habitat needs for the rigid apple moss across its global range. Habitat descriptions range from on soil in rock crevices and on ledges to on thin soil over rock or boulders. The UK Biodiversity Action Plan (2004) notes that in Britain this species “grows on thin, often disturbed soil on ledges and in crevices amongst rocks. It prefers sunny, sheltered situations on south-facing slopes. The remaining known population is on basaltic rocks, but there has also been a record from limestone and another from sandstone in Sussex.”

Belland (1997), using his field notes and those of M. Ryan in the addendum of the COSEWIC report, provides detailed microhabitat data for two of the known B.C. sites; most of these observations have been confirmed during field visits in 2005. At the Nanoose Hill site near Nanaimo, the rigid apple moss occupies two distinct microhabitats (Belland 1997 provides photographs of these sites):

1. exposed, either humus-rich and somewhat disturbed or stony, soil in areas of generally shallow soils and gentle slopes near rock outcrops (Figure 6); the microsites are relatively open, although leaves of grasses often overhang patches; a number of mosses live in close proximity, including *Bryum capillare*, *Bryum miniatum*, *Ceratodon purpureus*, *Didymodon vinealis*, the banded cord-moss (*Entothodon fascicularis*), *Philonotis fontana*, *Polytrichum juniperinum*, *Racomitrium elongatum*, *Timmiella crassinervis*, and *Weissia controversa*. A few of these mosses, *Bryum miniatum*, the banded cord-moss, and *Philonotis fontana*, indicate that there is groundwater seepage in these sites.
2. thin soils in crevices or directly on the rock surface of a rock outcrop; grass stems also lay over this site; nearby mosses include *Bryum miniatum*, *Ceratodon purpureus*, *Polytrichum juniperinum*, *Racomitrium elongatum*, *Timmiella crassinervis*, and *Weissia controversa*.



**Figure 6.** The microhabitat of the rigid apple moss on stony soil at the Nanoose Bay site (photograph by Belland 1997).

Four different microhabitats for this species were described at the Mary Hill site near Victoria:

1. on vertical rock faces,
2. on humus and fine litter at the base of an outcrop face,
3. on rock at the base of an outcrop face, and
4. in crevices and on small ledges on a rock face (Figure 7).

A few other species were associated with these microhabitats, including the mosses *Bryum capillare* and *Racomitrium heterostichum*, lichens, a grass species, broad-leafed stonecrop (*Sedum spathulifolium*), and Wallace's selaginella (*Selaginella wallacei*). Most of the microhabitats were slightly protected from direct precipitation. Belland (1997) provides photographs of these sites. Also, he notes that patches exposed to sunlight were smaller than those that were somewhat protected.



**Figure 7.** The rigid apple moss (circled) in crevices and on small ledges on a rock face at the Mary Hill site; this site harbours 25 patches (photograph by M.W. Ryan).

### **Biological needs, ecological role, and limiting factors**

As with most mosses, little is known about the biological attributes that may influence the recovery potential of the rigid apple moss. Belland (1997) notes that published information about the general biology and reproductive capacity of this species is lacking, although some field observations on microhabitat and spore production are available from herbarium vouchers. As with most moss species, the primary means of dispersal and reproduction is probably by spores. The rigid apple moss has male and female structures on the same plant, which helps to ensure successful fertilization and consequent production of sporangia and spores. This species appears to produce spores regularly at both the Nanaimo and Mary Hill sites (as illustrated in Figures 2 and 3; however, few patches (<5%) produced sporophytes in 2005, possibly in part due to the dry fall and winter in the area, the time when fertilization likely occurs. However, most specimens collected over 20 years contain plants with sporangia, indicating that the populations are reproducing most years (Belland 1997). There are no data on spore dispersal distances, viability, or germination success for this species, although moss spores in this type of habitat are most frequently wind-dispersed (Belland 1997).

Although Belland (1997) stated that there is no evidence of asexual reproduction by specialized propagules or by fragmentation, which would limit its ability to disperse, in the addendum to the COSEWIC Status Report, he stated “fragmentation of patches appears to be common and, barring abundant litter, fragments, comprising a few stems, seem to become established at the

base or rock faces where they form new patches.” Therefore, it appears that this species possesses the ability to reproduce asexually, at least over short distances. This process has recently been confirmed during a field visit to the Nanoose Hill and Mary Hill sites where fragments of this species have successfully colonized soil adjacent to outcrops below patches on the rock face. However, this means of vegetative reproduction may be uncharacteristic for this species, and may reflect an unusual ecological tendency that is expressed at the edge of its northern range (W.B. Schofield, pers. comm., 2005).

The size of this species may also influence recovery potential. It is a relatively small moss that may not have the competitive ability that adjacent mosses possess. As it may require relatively open spaces to survive, this moss may readily be shaded out if the microhabitat is altered.

## **Threats**

### **Loss and degradation of suitable habitat**

In British Columbia, the rigid apple moss requires relatively open outcrop and adjacent stony soil and, in some cases, seasonally wet habitats in warm, summer-dry sites, principally in or near Garry oak ecosystems. This ecosystem type is restricted to relatively small areas of southwestern British Columbia, which because of its favourable climate, has been the centre for extensive urban development and agricultural activities for well over a century. Large areas of Garry oak habitat have been lost (Lea 2002) and many of the remaining areas are threatened by ongoing development. Further, many of the Garry oak habitats that remain close to developed areas have been degraded by associated activities (e.g., recreational activities, property maintenance, clearing of vegetation). Some populations and suitable habitat of the rigid apple moss may have been lost or threatened by these activities. The lack of suitable habitat in these ecosystems limits its potential range and further threatens the survival of the rigid apple moss (Belland 1997). Although Belland (1997) stated that rocky slopes, the main habitat of the rigid apple moss, are less at risk than other types of Garry oak habitat, these habitats are increasingly being threatened by development, either because of their preferred open exposure or because adjacent available habitats have already been developed. Less than 5% of Garry oak habitat exists in undisturbed condition, making it one of the most imperiled natural communities in Canada (Fuchs 2001; Lea 2002).

The two sites on DND properties (Mary Hill and Nanoose Hill) appear to be protected for now (Belland 1997; A. Robinson, pers. comm., 2005).

We have no detailed information on potential habitat threats to the Lasqueti Island population.

### **Encroachment by other species**

Concurrent with habitat degradation is the threat to the rigid apple moss posed by the encroachment of open habitats by both native and introduced vascular plants. In part because of fire suppression (historically, both natural and First Nations fires were relatively common across Garry oak ecosystems) (Hebda and Aitkens, eds. 1993; Turner 1999; Fuchs 2001), there has been increased encroachment of vascular plants throughout Garry oak habitats, including around outcrops and on outcrop ledges, microhabitats favourable to this species. Invasive species markedly alter the habitat by either growing over soil, including on rock ledges, thus eliminating

habitat for this moss, or by increasing shade and litter, altering the conditions of the microsite. Encroaching species include native taxa, in particular Douglas-fir and snowberry (*Symphoricarpos albus*); and non-native species such as shrubs, most notably Scotch broom (*Cytisus scoparius*); forbs, such as hairy cat's-ear (*Hypochaeris radicata*); and grasses, such as sweet vernalgrass (*Anthoxanthum odoratum*).

A further threat to this moss is the colonization of formerly open sites by native mosses. Following vascular plant encroachment, shade and relative moisture availability increase under the canopy, allowing shade-requiring forest mosses such as *Dicranum* spp. to colonize areas from which they are normally excluded, including along the edges of outcrops and on ledges. They will grow into these sites and eliminate open area mosses such as *Racomitrium* spp. and potentially the rigid apple moss.

Encroachment by vascular plants has probably led to the extirpation of the Pedder Bay population of the rigid apple moss (Belland 1997). Encroachment by vascular plants is also a threat to this species in Britain (UK Biodiversity Action Plan 2004).

## Knowledge Gaps

- Detailed habitat requirements (e.g., geology, soil characteristics, seepage, aspect) are not well known.
- The effects from competition from invasive species, both native and non-native, are not well known.
- Little is known about other rare species near populations of the rigid apple moss.
- Sites already surveyed by bryologists for this moss need to be compiled.

## RECOVERY

### Recovery Feasibility

The National Recovery Working Group (2004) defines recovery as “restoring a species to a viable, self-sustaining population level, able to withstand stochastic events and other environmental variables of a non-catastrophic nature.” In contrast, recovery is defined by Environment Canada *et al.* (2004) as “any improvement in a species’ probability of long-term persistence in the wild.” For the rigid apple moss, the feasibility of recovery may depend on ensuring the survival of the existing populations and the elimination of threats.

As with many other Garry oak-associated rare plant species, we lack adequate information about the historical distribution of the rigid apple moss. There is no evidence to indicate that this species was ever abundant or widespread in coastal British Columbia; therefore, recovery of the rigid apple moss should focus on improving its probability of persistence in the wild. Successful recovery, however, will depend on a combination of research investigations, habitat protection and management activities, and long-term population monitoring. In most cases, further studies and trials will be needed to determine whether there are barriers to the recovery of existing populations. The ecological and technical feasibility of recovery may have to be re-evaluated

once further research is conducted. The criteria for technical and biological feasibility for recovery of the rigid apple moss are assessed in Table 2.

Although the biology and ecology of the rigid apple moss are poorly understood, field observations suggest that regular recruitment may be occurring, at least at the Nanoose Bay site. Also, the populations appear to be large enough to be self-sustaining. Thus, the current estimation of population viability is moderate.

Overall, based on current known populations, recovery is feasible. Recovery feasibility may increase if other larger or more significant populations are discovered in areas that have not been thoroughly searched or never searched at all.

**Table 2.** Technical and biological feasibility for recovery of the rigid apple moss; criteria from Environment Canada *et al.* (2005)

<b>Feasibility criteria</b>	
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<sup>1</sup> and maintain the extant populations of the rigid apple moss.

## Recovery Objectives

- I. To establish protection for extant populations and their habitats through conjunction with land managers.
- II. To determine the level of real and potential threats to this species and its habitat.

## Broad Strategy Recommended to Address Threats

<sup>1</sup> Protection can be achieved through various mechanisms including: voluntary stewardship agreements; conservation covenants; sale by willing vendors on private lands; land use designations on Crown lands; and legal or other protection in federal, provincial, and local government lands.

The broad approaches for recovery of this species include:

- I. Protect extant populations through stewardship activities and other mechanisms;
- II. Research the potential threats to the habitats for all known populations;
- III. Scientific research on known populations and habitats, including the remeasurement of known population attributes, ecological and habitat requirements, and initiate a monitoring program at the known site;
- IV. Inventory areas of suitable habitat and document any new populations (UTM coordinates), determine land ownership, and provide protection through various stewardship activities and other mechanisms; and
- V. Education and outreach.

## Approaches Recommended to Meet Recovery Objectives

Protection measures for this species must be confirmed or assessed (especially at the Lasqueti Island site), and more detailed information needs to be gathered on the threats to this species, especially with respect to invasive plants. Although some characteristics for the habitat are known for the rigid apple moss, more data are needed to fully describe critical habitat attributes. A detailed inventory of Garry oak and open cliff habitats along the southwestern B.C. coast is recommended. Even though a great deal of bryological inventory has been completed by W.B. Schofield and his students in this region, most of these surveys are broad-based and designed to collect mosses over wide areas; they have not been focused on one particular species or its known habitat. Table 3 summarizes proposed research and management activities needed to meet the recovery objectives.

### Recovery Planning Table

**Table 3.** Recovery Planning Table

Priority	Obj. no.	Broad approach / strategy	Threat addressed	Specific steps	Outcomes or deliverables
High	I	Protect extant populations	Loss and degradation of suitable habitat; encroachment by other species	<ul style="list-style-type: none"> <li>• Investigate protection in area, if any</li> <li>• Establish critical habitat designations</li> <li>• Communicate with property owners about the presence of the species and the importance of protecting habitat</li> </ul>	<ul style="list-style-type: none"> <li>• Securing of populations and habitats</li> <li>• Increased awareness and assistance by the public in the protection and recovery of this species.</li> </ul>
Medium	II	Research on potential threats	Loss and degradation of suitable habitat; encroachment by other species	<ul style="list-style-type: none"> <li>• Research and document threats to habitat at each of the known sites</li> <li>• Define and describe</li> </ul>	<ul style="list-style-type: none"> <li>• Detailed location information of species</li> <li>• Population numbers and habitat data</li> <li>• List of sites for protection</li> </ul>

				specific populations and habitats	and monitoring under SARA
					<ul style="list-style-type: none"> <li>• Precise information on habitats and threats</li> </ul>
Medium	II	Research on potential threats	Loss and degradation of suitable habitat; encroachment by other species	<ul style="list-style-type: none"> <li>• Research and document population sizes and health, and population change from first survey</li> <li>• Develop and implement standardized monitoring protocol</li> <li>• Report monitoring results annually and assess trends in populations, area of occupancy and habitat condition every 5 years</li> <li>• Submit all data to BC CDC</li> </ul>	<ul style="list-style-type: none"> <li>• Data on population sizes, reproduction status, and health</li> <li>• Detailed data on habitat attributes</li> <li>• Regular and standardized monitoring of populations and habitats</li> <li>• Annual summary of monitoring results</li> <li>• Assessment of status of populations and effects of recovery actions</li> </ul>
Low	I	Inventory		<ul style="list-style-type: none"> <li>• List areas to be surveyed</li> <li>• Inventory new areas</li> </ul>	<ul style="list-style-type: none"> <li>• New populations for potential protection</li> <li>• New information on threats, ecology, and populations</li> </ul>

## Performance Measures

Criteria for evaluation of the progress towards the goals and objectives of this strategy include:

1. The species and habitat are protected through stewardship activities and other mechanisms at all known sites.
2. All stakeholders are notified and informed of the importance of this species, and, where applicable, relevant information supplied to the public.
3. The threats to the species' survival and recovery are determined and mitigated.
4. A monitoring program has been put in place that will measure critical values that will benefit the survival and recovery of this moss.
5. Areas of suitable habitat for this species in sites within its natural range have been inventoried and, if found, the new populations documented with UTM coordinates and land ownership determined and protection has been provided through various stewardship activities and other mechanisms.

## Critical Habitat



## Identification of the species' critical habitat

No critical habitat, as defined under the federal *Species at Risk Act* (Environment Canada 2004), is proposed for identification at this time.

While much is known about the habitat needs of the species included within this recovery strategy, more definitive work must be completed before any specific sites can be formally proposed as critical habitat. It is expected that critical habitat will be proposed within one or more recovery action plans following: (1) consultation and development of stewardship options with affected landowners and organizations, and (2) completion of outstanding work required to quantify specific habitat and area requirements for these species. A schedule of studies outlining work necessary to identify critical habitat is found below.

Critical habitat will be identified during the recovery action plan stage. Suitable habitat can generally be described to include faces, crevices, and ledges of rock outcrops, as well as open, thin, and stony soil on gentle slopes near the bases of outcrops, often characterized by seepage conditions in winter and spring. In British Columbia, these habitats are found on relatively open, dry and warm, south-facing slopes in Mediterranean-type climates in Garry oak (*Quercus garryana*) or associated ecosystems. A more complete definition of proposed critical habitat that also incorporates potential habitat will be addressed at a later date, through the Recovery Action Plan.

## Recommended schedule of studies to identify critical habitat

Recommended studies that can be developed in the Recovery Action Plan (subject to availability of resources) include determination of habitat attributes including:

- determination of rock and soil mineral properties required for growth and reproduction (e.g., pH, composition), as well as soil moisture and depth.
- determination of other environmental attributes, including slope and aspect and light and humidity requirements for growth and reproduction, slope, and aspect.
- determination of associated plant and lichen species, and a determination of these species' potential for competing with the rigid apple moss.

Inventory is still required across the range of this species in British Columbia, even though some areas have been thoroughly searched by bryologists. Belland (1997) notes that at least 10 Garry oak woodlands have been fairly well surveyed for mosses over time (these include Colwood, Royal Oak, William Head, Thetis Lake, Mount Tolmie, Clovelly Terrace, and Mary Hill, all near Victoria; as well as Mount Maxwell on Saltspring Island, Mount Tzuhalem near Duncan, and Nanoose Hill). However, other areas that have potential habitat for the rigid apple moss and have not been searched should be inventoried for the presence of this species. Also, there remains a need to re-inventory some of the areas already surveyed, and to search for the rigid apple moss along with other rare bryophytes, including the banded cord-moss. A proposed timeline for completion of these studies is given in Table 4.

**Table 4.** Timeline for completion of studies to identify critical habitat for the rigid apple moss

<b>Study</b>	<b>Completion date</b>
Determination of habitat attributes	2010
Inventory of other areas of suitable habitat	2010
Re-inventory of areas already searched	2010

## **Existing and Recommended Approaches to Habitat Protection**

The landowners (DND) at the Nanoose Bay site and the Mary Hill site are aware of the presence of the rigid apple moss and other plant species at risk on their properties and are taking steps to protect the species at risk habitat. DND is protecting the rigid apple moss habitat through voluntary stewardship activities such as controlling access to habitat areas, maintaining habitat structure, and monitoring the populations. Access to the property at Nanoose Bay is restricted as the property has been fenced with controlled access and is posted against trespassing. Access to the Mary Hill property is restricted as the property is posted against trespassing.

As there is no information regarding protection of the populations on Lasqueti Island or Pedder Bay, this needs to be assessed by future inventory.

### **Stewardship Approach**

For successful implementation in protecting species at risk, there will be a strong need to engage in stewardship on various land tenures. Stewardship involves the voluntary cooperation of landowners to protect species at risk and the ecosystems they rely on. The preamble to the federal *Species at Risk Act* (SARA) recognizes that “stewardship activities contributing to the conservation of wildlife species and their habitat should be supported” and that “all Canadians have a role to play in the conservation of wildlife in this country, including the prevention of wildlife species from becoming extirpated or extinct.” The Bilateral Agreement on Species at Risk between British Columbia and Canada recognizes that “stewardship by land and water owners and users is fundamental to preventing species from becoming at risk and in protecting and recovering species that are at risk” and that “cooperative, voluntary measures are the first approach to securing the protection and recovery of species at risk.”

### **Stewardship Approach for Private Lands**

Additional populations of this species may occur on private lands. As with other species at risk found on private property, stewardship efforts would be the key to their conservation and recovery. To successfully protect many species at risk in British Columbia, there will have to be voluntary initiatives by landowners to help maintain areas of natural ecosystems that support these species. This stewardship approach will cover many different kinds of activities, such as following guidelines or best management practices to support species at risk; voluntarily protecting important areas of habitat on private property; creating conservation covenants on property titles; ecogifting property (in whole or in part) to protect certain ecosystems or species

at risk; or selling property for conservation. Both government and non-governmental organizations have had good success in conserving lands in the province.

## **Effects on Other Species**

Effects on other species or ecological processes are not anticipated during the initial stages of the recovery process. Some actions regarding the recovery of the rigid apple moss, such as the maintenance and the establishment of protected sites, may benefit other species, and this will be assessed as work is undertaken. At least two COSEWIC and SARA-listed species, the banded cord-moss (*Entosthodon fascicularis*) and twisted oak moss (*Syntrichia laevipila*), are present at the Nanoose Hill site.

## **Socio-economic Considerations**

The social and economic considerations of implementing this strategy are considered low to moderate for this species. Further considerations will be explored during the recovery action plan stage with landowners and land managers.

## **Recommended Approach for Recovery Implementation**

This recovery strategy should be considered for integration within conservation efforts in the region, and as such, this strategy is part of the Garry Oak Ecosystems Recovery Team's effort to recover species at risk.

## **Statement on Action Plans**

A recovery action plan will be completed by December 31, 2009.

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