Species at Risk Act
Recovery Strategy Series
Adopted under Section 44 of SARA

Recovery Strategy for the Rigid Apple Moss (*Bartramia stricta* Bridel) in Canada

Rigid Apple Moss

2011

Parks Canada Parcs Canada

Canada

About the *Species at Risk Act* Recovery Strategy Series

What is the *Species at Risk Act* (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003, and one of its purposes is *"to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity."*

What is recovery?

In the context of species at risk conservation, 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 the species' persistence in the wild. A species will be considered recovered when its long-term persistence in the wild has been secured.

What is a recovery strategy?

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets goals and objectives and identifies the main areas of activities to be undertaken. Detailed planning is done at the action plan stage.

Recovery strategy development is a commitment of all provinces and territories and of three federal agencies — Environment Canada, Parks Canada Agency, and Fisheries and Oceans Canada — under the Accord for the Protection of Species at Risk. Sections 37–46 of SARA (http://www.registrelep.gc.ca/approach/act/default_e.cfm) outline both the required content and the process for developing recovery strategies published in this series.

Depending on the status of the species and when it was assessed, a recovery strategy has to be developed within one to two years after the species is added to the List of Wildlife Species at Risk. Three to four years is allowed for those species that were automatically listed when SARA came into force.

What's next?

In most cases, one or more action plans will be developed to define and guide implementation of the recovery strategy. Nevertheless, directions set in the recovery strategy are sufficient to begin involving communities, land users, and conservationists in recovery implementation. Cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty.

The series

This series presents the recovery strategies prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as strategies are updated.

To learn more

To learn more about the *Species at Risk Act* and recovery initiatives, please consult the SARA Public Registry (http://www.sararegistry.gc.ca/).

Recovery Strategy for the Rigid Apple Moss (*Bartramia stricta* Bridel) in Canada

2011

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

In the spirit of cooperation of the Accord, the Government of British Columbia has provided the Recovery Strategy for the Rigid Apple Moss (*Bartramia stricta*) in British Columbia to the Government of Canada. The federal Minister of the Environment as the competent minister under *SARA* adopts this recovery strategy pursuant to Section 44 of the *Species at Risk Act*, with any exceptions or modifications as detailed within the body of this document.

This recovery strategy is the recovery strategy of the federal Minister of the Environment for this species. Amendments, if required, will be developed in accordance with Section 45 of the *Species at Risk Act*.

The federal Minister of the Environment's recovery strategy for the Rigid Apple Moss in Canada consists of two parts:

1. The federal text for the Rigid Apple Moss in Canada and
2. The *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 (2007) for the BC Ministry of Environment. (Appendix 1).

Recommended citation:

Parks Canada Agency. 2011. Recovery Strategy for the Rigid Apple Moss (*Bartramia stricta* Bridel) in Canada. *Species at Risk Act* Recovery Strategy Series. Parks Canada Agency. Ottawa. v + 44 pp

Additional copies:

Additional copies can be downloaded from the SARA Public Registry (http://www.sararegistry.gc.ca/).

Cover illustration: Terry McIntosh

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DECLARATION

Under the *Accord for the Protection of Species at Risk* (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada. The *Species at Risk Act* (S.C. 2002, c.29) (SARA) requires that federal competent ministers prepare recovery strategies for listed Extirpated, Endangered, and Threatened species. The Parks Canada Agency and Environment Canada are competent for the recovery of the Rigid Apple Moss.

The Minister of the Environment, as the competent minister under SARA, presents this document as the recovery strategy for the Rigid Apple Moss as required under SARA. It has been prepared in cooperation with the jurisdictions responsible for the species. The Minister invites other jurisdictions and organizations that may be involved in recovering the species to use this recovery strategy as advice to guide their actions.

The goals, objectives and recovery approaches identified in the strategy are based on the best existing knowledge and are subject to modifications resulting from new findings and revised objectives.

This recovery strategy will be the basis for one or more action plans that will provide details on specific recovery measures to be taken to support conservation and recovery of the species. Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the actions identified in this strategy. In the spirit of the *Accord for the Protection of Species at Risk*, all Canadians are invited to join in supporting and implementing this strategy for the benefit of the species and of Canadian society as a whole. The competent minister will report on progress within five years.

ACKNOWLEDGMENTS

Parks Canada Agency would like to thank the following organizations and individuals: The Garry Oak Ecosystems Recovery Team is the recovery team for the Rigid Apple Moss and was involved in the development of this recovery strategy. Further revision was the result of comments and edits provided by the Department of National Defence, the Province of British Columbia, and Environment Canada.

STRATEGIC ENVIRONMENTAL ASSESSMENT STATEMENT

A strategic environmental assessment (SEA) is conducted on all *Species at Risk Act* recovery strategies, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan, and Program Proposals* (2004). The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond their intended benefits. Environmental effects, including impacts to non-target species and the environment, were considered during recovery planning. The SEA is incorporated directly into the strategy and also summarized below.

The greatest potential for effects on the environmental and species comes from fieldwork activities aimed at habitat inventory, monitoring, and management; however, these effects can be mitigated or eliminated at the project level phase through proper field procedures and strong involvement of Parks Canada Agency and the Garry Oak Ecosystem Recovery Team (see the "Effects on other species" section in the federal text of this document). Some recovery strategy activities may require project-level environmental assessment, as required under the *Canadian Environmental Assessment Act*. Any activities found to require project-level environmental assessments will be assessed at that time pursuant to the provisions of the *Act*.

This recovery strategy will clearly benefit the environment by promoting the protection of habitat for the Rigid Apple Moss. Activities to meet recovery objectives are unlikely to result in any important negative environmental effects as they are limited to habitat protection, research activities, fostering stewardship, increasing public awareness, improving knowledge of habitat requirements and population threats, and conducting habitat/species mapping, inventory, and restoration (see the "Approaches Recommended to Meet Recovery Objectives" section in Appendix 1).

In summary, the SEA process has concluded that this recovery strategy will likely have several positive effects on the environment and other species. There are no obvious adverse environmental effects anticipated with the implementation of this recovery strategy.

RESIDENCE

SARA defines residence as: *a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating* **[Subsection 2(1)]**.

Residence descriptions, or the rationale for why the residence concept does not apply to a given species, are posted on the SARA public registry: http://www.sararegistry.gc.ca/sar/recovery/residence_e.cfm.

PREFACE

This recovery strategy addresses the recovery of Rigid Apple Moss. In Canada, this species only occurs in British Columbia.

Subsection 44 (2) of the Species at Risk Act (SARA) provides that a competent minister may incorporate any part of an existing plan relating to a wildlife species into a proposed SARA recovery strategy for the species. The provincial government of British Columbia lead the

preparation of the Recovery Strategy for the Rigid Apple Moss in British Columbia in cooperation with the Parks Canada Agency, Environment Canada, and the Garry Oak Ecosystems Recovery Team. The Recovery Strategy for Rigid Apple Moss in Canada incorporates parts of the provincial strategy (Appendix 1) and adds to it the information needed to comply with the content requirements of a recovery strategy for which recovery is feasible, as per the SARA section 41(1). Rigid Apple Moss is a species of ephemeral wet areas in Garry oak Ecosystems and recovery of this species will be integrated with the recovery of species in the Recovery Strategy for Multi-Species at Risk in Vernal Pools and other Ephemeral Wet Areas Associated with Garry Oak Ecosystems in Canada (Parks Canada Agency 2006).

ADDITIONAL SECTIONS TO ACHIEVE SARA COMPLIANCY

The following sections address specific requirements of SARA that are either not addressed in the *Recovery Strategy for the Rigid Apple Moss (Bartramia stricta Bridel) in British Columbia* (Appendix 1) or need to be highlighted.

1. Population and Distribution Objective

This section replaces the "Recovery Goal" section in the provincial recovery strategy. The population and distribution objective is to maintain the extant populations of the Rigid Apple Moss at current or greater population sizes throughout the current range of the species.

2. Performance measures

This section replaces the "Performance Measures" section in the provincial recovery strategy. Progress towards recovering Rigid Apple Moss in Canada will be assessed using the following measures:

- The total Canadian population is maintained at, or has increased from, 2010 levels (assuming a natural range of annual variability).
- All populations extant in 2010 are maintained.

3. Critical Habitat

This section replaces the "Critical Habitat" section in the provincial recovery strategy. Areas of critical habitat for Rigid Apple Moss are identified in this recovery strategy. Critical habitat is defined in the *Species at Risk Act* as "the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in a recovery strategy or in an action plan for the species" (Subsection 2(1)). Habitat for a terrestrial wildlife species is defined in the *Species at Risk Act* as "...the area or type of site where an individual or wildlife species naturally occurs or depends on directly or indirectly in order to carry out its life processes or formerly occurred and has the potential to be reintroduced" (Subsection 2(1)).

3.1. Information used to identify critical habitat

McIntosh (2008, 2009a,b), building on previous work (Belland 1997a,b; Fairbarns 2008), recorded habitat characteristics and mapped Rigid Apple Moss patches (groups of individual plants growing together) and critical habitat. The Rigid Apple Moss depends directly on rock or soil substrates to grow. In addition, it depends directly on a supply of water from the surrounding habitat.

It is important to note that habitats surrounding patches are often large and are always complex which makes seepage areas difficult to identify. Habitats surrounding patches are composed of numerous features that could influence water flow (some of which may be underground). The complexity of these habitats makes an accurate determination of which gullies and seepage sites

influence patches of Rigid Apple Moss difficult. Despite these limitations, critical habitat is identified based on which gullies and seepage sites appeared to drain into or near Rigid Apple Moss patches, and on which flats had the potential to house the species.

To characterize Rigid Apple Moss habitat, site and vegetation data were collected from representative microsites at each extant location. A microsite is a small area where the plants are growing within the larger location. Common characteristics among microsites were then selected as critical habitat attributes (see "Critical habitat identification" below).

3.2. Critical habitat identification

The critical habitat identified here is necessary, but is not sufficient to achieve the population and distribution objective for Rigid Apple Moss in Canada[1]. Within the geographical boundaries identified in Figure 1, Figure 2, and Figure 3, critical habitat for Rigid Apple Moss is the growing substrate and the adjacent microcatchment associated with each patch. A microcatchment is the adjacent area where the topography directs water to the Rigid Apple Moss growing places. To account for a natural range of variability in each population, critical habitat is identified for all historic, current, and newly discovered patches of Rigid Apple Moss documented within the identified boundaries. As of 2009, studies have identified, in total, approximately 3 ha of habitat which is critical to Rigid Apple Moss survival.

Critical habitat attributes are as follows:

- the presence of either rocky outcrops: irregular rock faces (more or less vertical) with sheltering overhangs or shallow soil,
- few trees or shrubs (tree cover 0% to 35%, native shrub cover <1%),
- native grasses and other herbaceous plants largely absent (up to 1% cover) except Wallace's Selaginella (*Selaginella wallacei*) which can reach up to 30% cover on some sites,
- often dominated by the moss *Niphotrichum elongatum* (5% to 85% cover),
- elevations of between 10 and 190 m above sea level,
- southern aspects (south-west to south-east), and
- seepage and/or surface runoff—the timing of water is a critical attribute: the sites are dry in summer and wet in winter and spring. Habitat surrounding each patch has a topography that directs rain water to the site.

Critical habitat for Rigid Apple Moss occurs at Mary Hill (Metchosin Land District), within the Mary Hill Training Area and at Nanoose Hill (Nanoose Land District), within the Canadian Forces Maritime Experimental and Test Ranges facility (Figure 1 and Figure 2). These properties are administered by the Department of National Defence, Canadian Forces Base Esquimalt. McIntosh (2009a) mapped eight different areas of critical habitat at Mary Hill, approximately 0.43 hectares located within a rectangular area of 4.2 hectares. Mcintosh (2009b) mapped twelve

[1] Two additional Rigid Apple Moss locations have been identified since the Recovery Strategy for the Rigid Apple Moss (*Bartramia stricta* Bridel) in British Columbia was prepared. Critical Habitat for these recently discovered locations will be included in the federal action plan.

different areas of critical habitat at Nanoose Hill, approximately 2.4 hectares located within a rectangular area of 22.6 hectares. While recent studies could not relocate all reported patches of Rigid Apple Moss at these sites to map their critical habitat in detail, the locations of the previously reported patches fall within the geographical boundaries identified below and the critical habitat identification above includes the habitat associated with these patches.

Critical habitat for Rigid Apple Moss occurs on Lasqueti Island (Nanaimo Land District) within the Lasqueti Island Ecological Reserve (Figure 3). This property is administered by BC Parks, Province of British Columbia, in accordance with the Ecological Reserve Act (RSBC 1996). McIntosh (2008) mapped three different areas of critical habitat, approximately 0.11 hectares located within a rectangular area of 5.9 hectares.

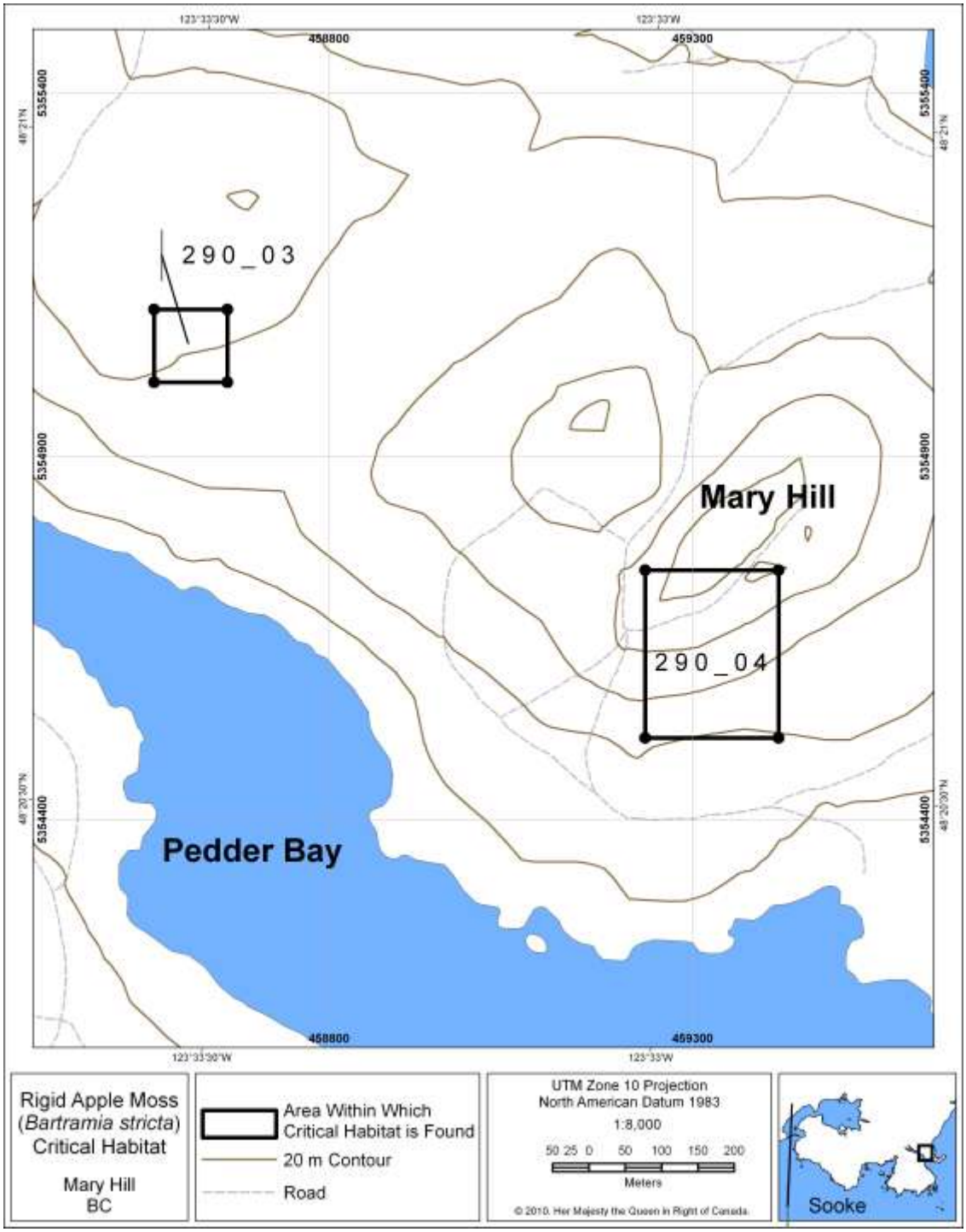

Figure 1. Areas (~1 ha and ~4.2 ha) within which critical habitat for Rigid Apple Moss is found at Mary Hill Training Area, Mary Hill. This property is managed by the Department of National Defence (CFB Esquimalt). Approximately 0.43 ha of critical habitat has been identified within these areas (McIntosh 2009a).

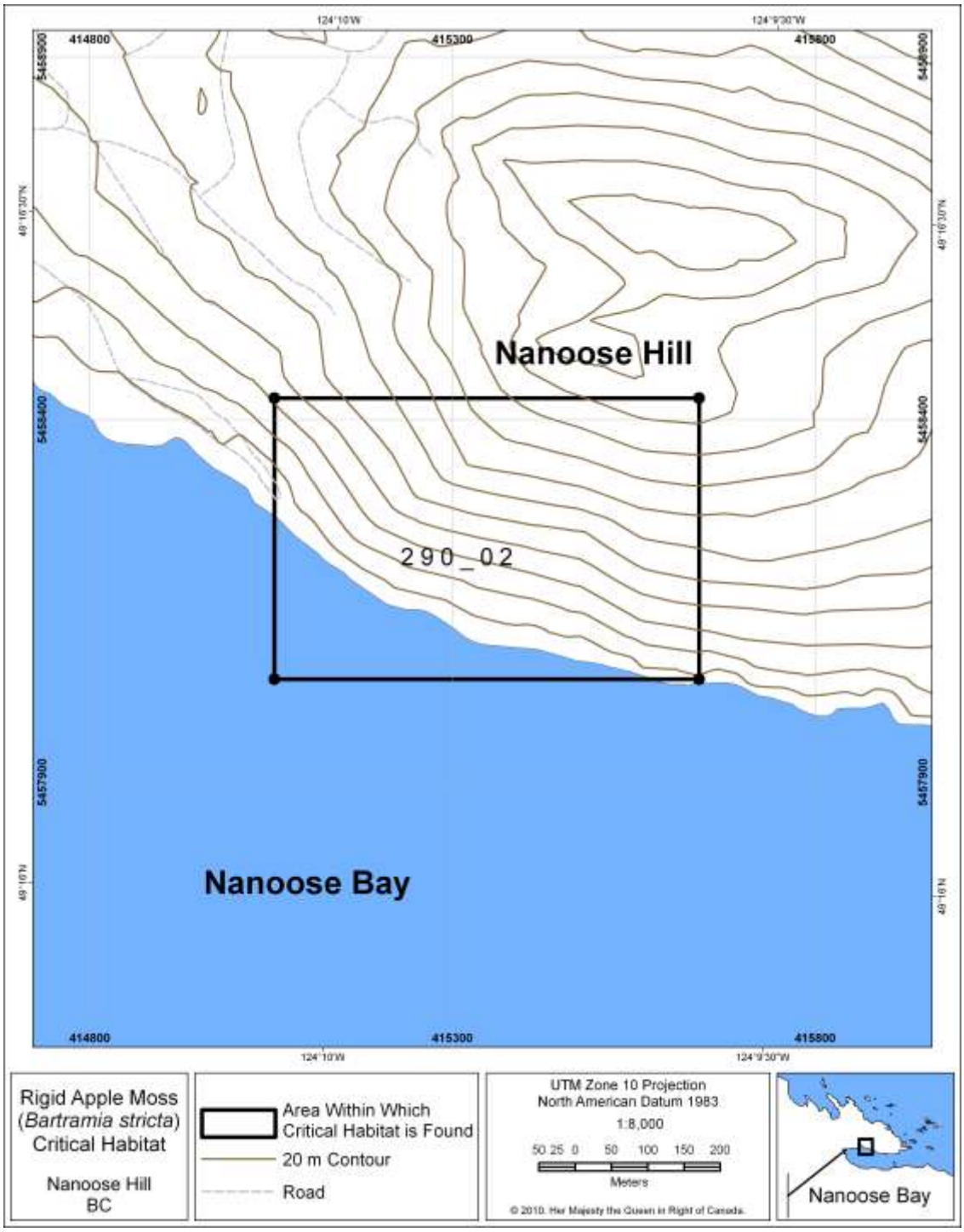

Figure 2. Area (~22.6 ha) within which critical habitat for Rigid Apple Moss is found at Canadian Forces Maritime Experimental and Test Ranges facility, Nanoose Hill. This property is managed by the Department of National Defence (CFB Esquimalt). Approximately 2.4 ha of critical habitat has been identified within this area (McIntosh 2009b).

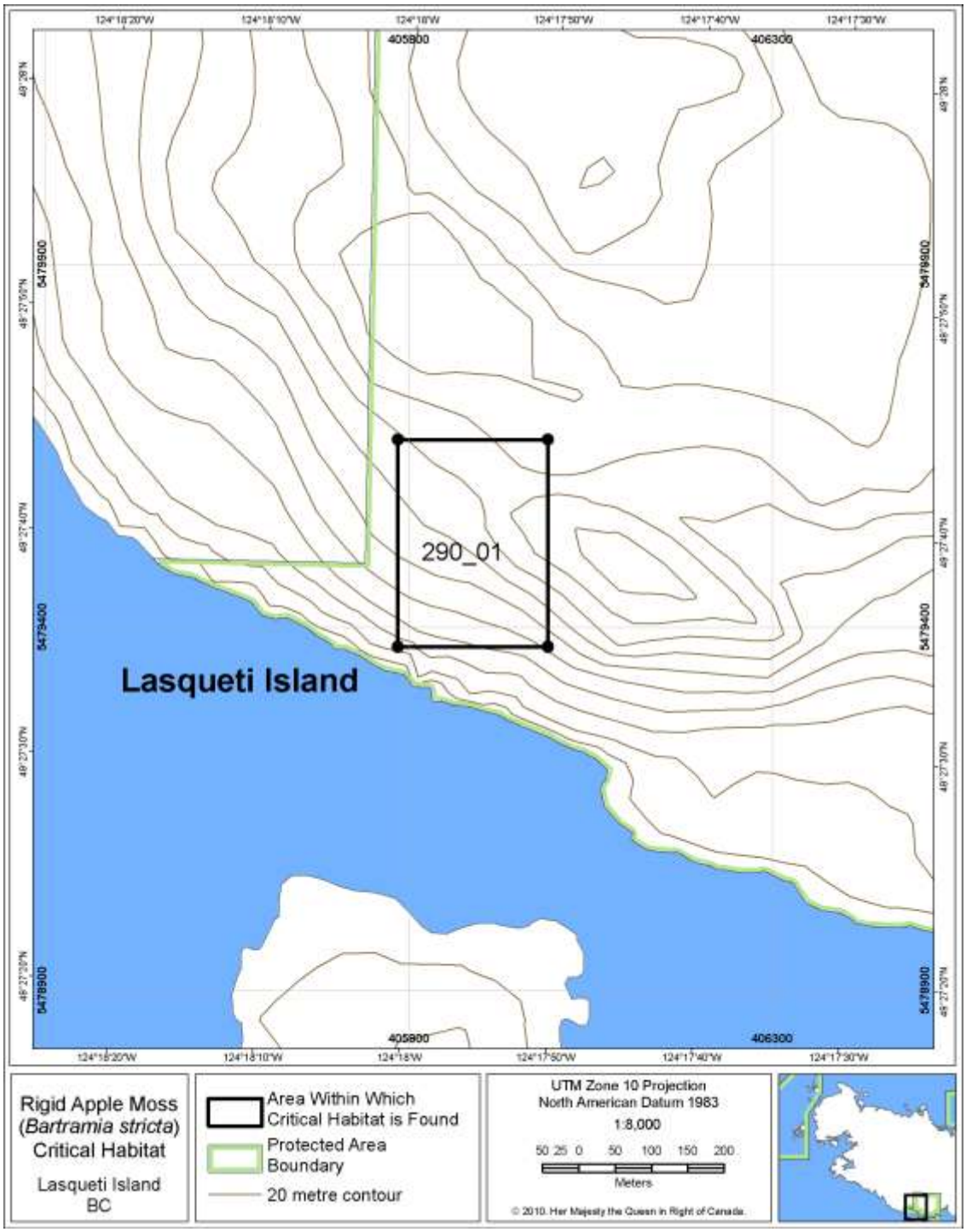

Figure 3. Area (~5.9 ha) within which critical habitat for Rigid Apple Moss is found in Lasqueti Island Ecological Reserve, Lasqueti Island. This property is managed by BC Parks in accordance with the Ecological Reserve Act (RSBC 1996). Approximately 0.11 ha of critical habitat has been identified within this area (McIntosh 2008).

3.3. Activities likely to destroy critical habitat

Activities that alter the critical habitat attributes are likely to destroy critical habitat. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time. Examples of such activities are provided below (Table 1). It is important to note that some activities have the potential to destroy critical habitat from outside the critical habitat area.

All species exhibit some level of resilience, unfortunately, in the case of Rigid Apple Moss the threshold between acceptable and unacceptable habitat disturbance is not known. It is precautionary to assume that Rigid Apple Moss is highly sensitive to habitat disturbance until data indicate otherwise. With this in mind, examples of activities likely to destroy critical habitat are provided below.

Table 1. Examples of activities likely to destroy critical habitat and their effect on critical habitat attributes.

Example activity	Potential effect of activity on critical habitat	Most likely sites
Traffic (e.g., vehicle use, frequent foot traffic, climbing) due to recreational use, military training, and land development or, maintenance.	Such activities compact soils, cause erosion, introduce alien species, and may alter hydrology. Soil compaction and development of ruts or trails alters hydrology (e.g., decreased water infiltration and increased runoff). Altered hydrology can cause increased Rigid Apple Moss mortality through the following mechanisms: moisture stress, because Rigid Apple Moss is washed away during peak flows, or because changes in the moisture regime favour increased growth of vegetation that may compete with Rigid Apple Moss or change habitat attributes (e.g., light, nutrient, and moisture availability). Erosion leading to direct loss of rock or soil is likely to limit space for individuals to grow and maintain populations. Erosion may also result in hydrological changes (e.g., decreased water storage capacity, or altered flow direction) that reduce the ability of the habitat to support Rigid Apple Moss. Traffic through critical habitat will increase the likelihood that invasive alien plant species will be introduced and / or spread, especially when clothing or equipment is not cleaned between uses in different areas. Invasive alien plant species are likely to lead to altered critical habitat attributes (e.g., changes in light, moisture, and / or nutrient availability). Such changes are likely to increase mortality as habitat will no longer be suitable for the species. Invasive alien plant species introduced outside of critical habitat may directly affect hydrological attributes within critical habitat areas or may spread into critical habitat areas.	Mary and Nanoose Hills

Example activity	Potential effect of activity on critical habitat	Most likely sites
Landscape modification (e.g., development, maintenance, or modification of existing structures, or landscaping such as digging, or blasting)	Such activity is likely to result in direct habitat loss through land conversion. Land conversion is likely to limit space for individuals to grow and maintain populations. These activities are also likely to alter habitat attributes (e.g., hydrology, and light availability) and destroy critical habitat. Increased mortality would be caused through related stresses. In addition, these activities often introduce invasive alien plant species which are likely to result in changes to critical habitat attributes (e.g., light, nutrient, or moisture availability). Depending on the specific activity, effects on habitat attributes are likely at different distances. For example: Altered light availability is a concern within the shadow length of a nearby building. Blasting and ditching can alter hydrology by altering the flow of (subsurface and surface) water over fairly large distances downstream. Invasive alien species can spread and have wide ranging effects.	Mary and Nanoose Hills

3.4. Schedule of studies to identify critical habitat

It is not known if the critical habitat identified above is sufficient for the survival of this species. Table 2 outlines key areas of study that will assist with the identification of sufficient critical habitat. These studies will be encouraged through interested partners (e.g., affected land managers, the Garry Oak Ecosystems Recovery Team, the British Columbia Bryophyte Recovery Team, and the Government of British Columbia), and the academic community. Further study may result in Rigid Apple Moss critical habitat addition or revision.

Table 2. Schedule of Studies to identify critical habitat

Description of Activity	Outcome/Rationale	Estimated completion date
Habitat assessment and mapping at recently discovered locations.	Critical habitat identified at for all known occurrences.	Dec. 2015

4. Effects on other species

This section replaces the “Effects on Other Species” section in the provincial recovery strategy.

It is impossible to discuss all possible environmental interactions associated with recovery; however, actions to assist in the recovery of Rigid Apple Moss will likely benefit other species. For example, increased public education and awareness may limit harmful recreational activities in locations with species at risk and site protection, monitoring, and management may protect habitat for other plant species at risk.

However, actions to assist in the recovery of Rigid Apple Moss may negatively affect other species. For example, trampling or other disturbance due to on-site recovery activities (e.g.,

surveys, research, and landscape management) pose a threat to the co-occurring rare species which have been recorded in or near sites with Rigid Apple Moss. If not planned and implemented carefully, recovery activities may have a negative effect on other plants at risk.

Parks Canada Agency and partners such as the Garry Oak Ecosystems Recovery Team are guiding recovery actions for this and other Garry oak ecosystem species in the area to ensure that recovery actions for one species do not unduly hinder the recovery of another.

5. Socio-economic considerations

This section replaces the “Socio-economic considerations” section in the provincial recovery strategy. The Province of British Columbia's *Recovery Strategy for the Rigid Apple Moss (Bartramia stricta Bridel) in British Columbia* includes a section entitled "Socio-economic Considerations." Although the strategy indicates that socio-economic impacts are considered to be low to moderate, a formal evaluation of the socio-economic costs and benefits of recovery implementation has not yet been conducted by the federal government. The federal Minister of Environment will include socio-economic evaluation in one or more action plan(s) as required by SARA (section 49(e)). For this reason, and because a socio-economic analysis is not required in a recovery strategy under Section 41(1) of SARA, the “Socio-economic Considerations” section of this adopted recovery strategy is not considered part of the federal Minister of Environment's recovery strategy for this species. Nor did Socio-economic Considerations influence the preparation of any part of the federal addition.

6. Action Plans

This section replaces the “Statement on Action Plans” section in the provincial recovery strategy. A recovery action plan will be completed by July 2016.

7. References

This section adds references for the federal text.

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McIntosh, T. 2009a. Report on an Inventory and a Critical Habitat Assessment for Rigid Apple Moss (*Bartramia stricta*) at Mary Hill (DND), Vancouver Island. Public Works and Government Services Canada, Office of Greening Government Operations, Pacific Region. iv + 34 pp.

McIntosh, T. 2009b. Report on an Inventory and a Critical Habitat Assessment for Rigid Apple Moss (*Bartramia stricta*) at Notch Hill (CFMETR - DND), Vancouver Island. Public Works and Government Services Canada, Office of Greening Government Operations, Pacific Region. iv + 30 pp.

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APPENDIX 1: RECOVERY STRATEGY FOR THE RIGID APPLE MOSS (*BARTRAMIA STRICTA* BRIDEL) IN BRITISH COLUMBIA

AS PROVIDED BY THE GOVERNMENT OF BRITISH COLUMBIA

British Columbia Bryophyte Recovery Team and Garry Oak Ecosystems Recovery Team. 2007. Recovery Strategy for the Rigid Apple Moss (*Bartramia stricta* Bridel) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC. 20pp.

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

BRITISH COLUMBIA
The Best Place on Earth

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>

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

June 2007

Recommended citation

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Cover illustration/photograph

Christian Engelstoft

Additional copies

Additional copies can be downloaded from the B.C. 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.

RECOVERY TEAM MEMBERS

British Columbia Bryophyte Recovery Team

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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.

ACKNOWLEDGEMENTS

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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.

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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 caste (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.

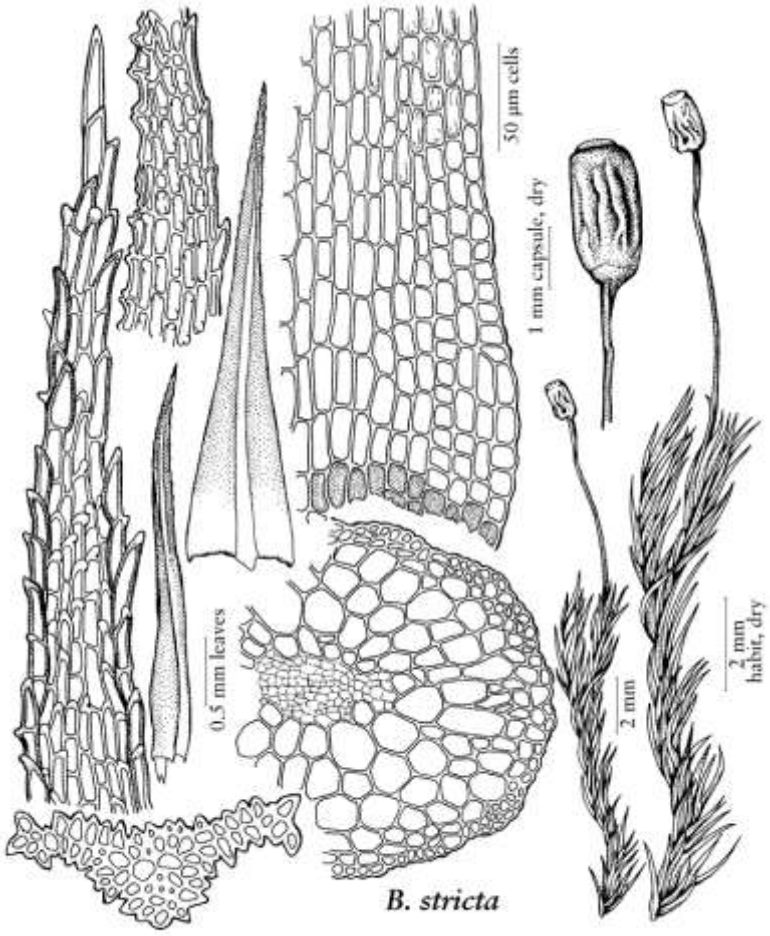

Figure 1. Key features of the rigid apple moss (from Griffin 2003, used with permission of the artist, P.M. Eckel).

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.

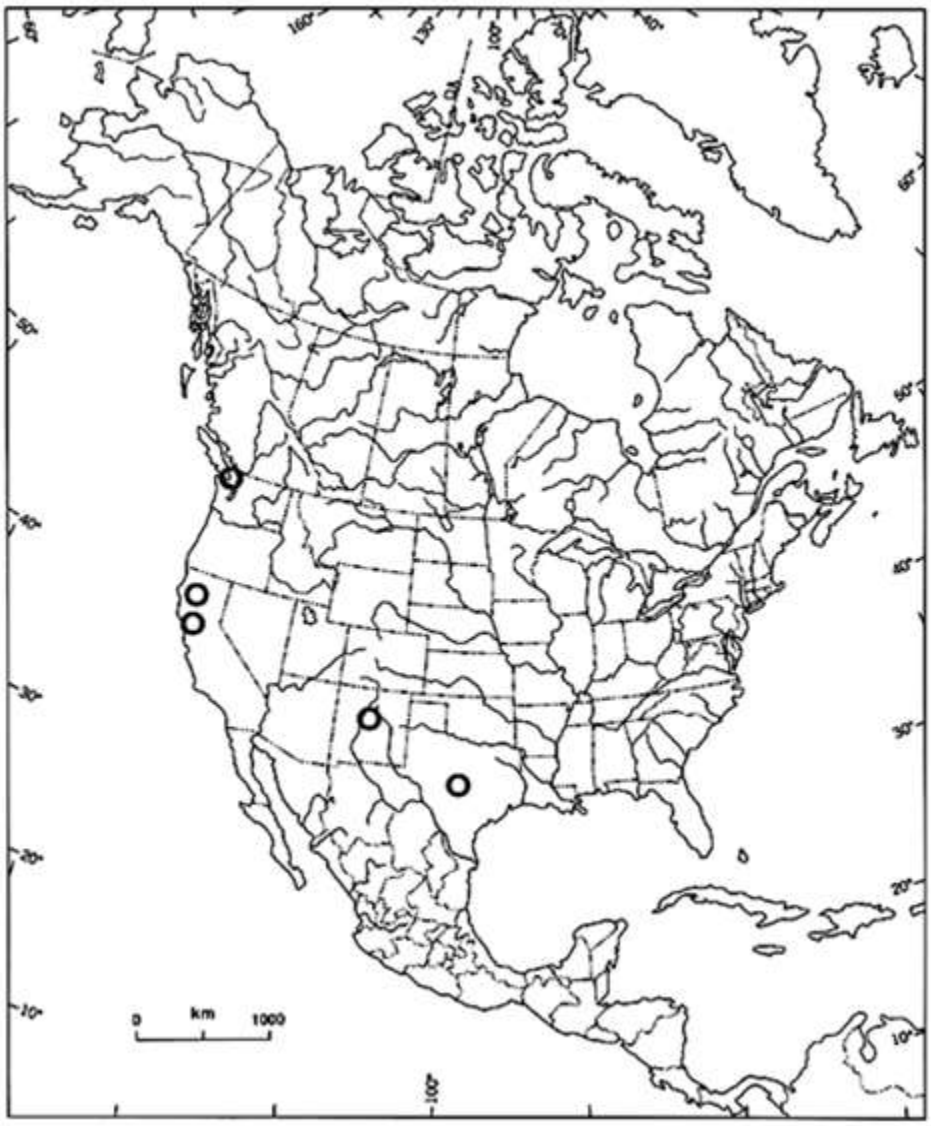

Figure 4. Confirmed distribution of the rigid apple moss in North America (based on Griffin 2003).

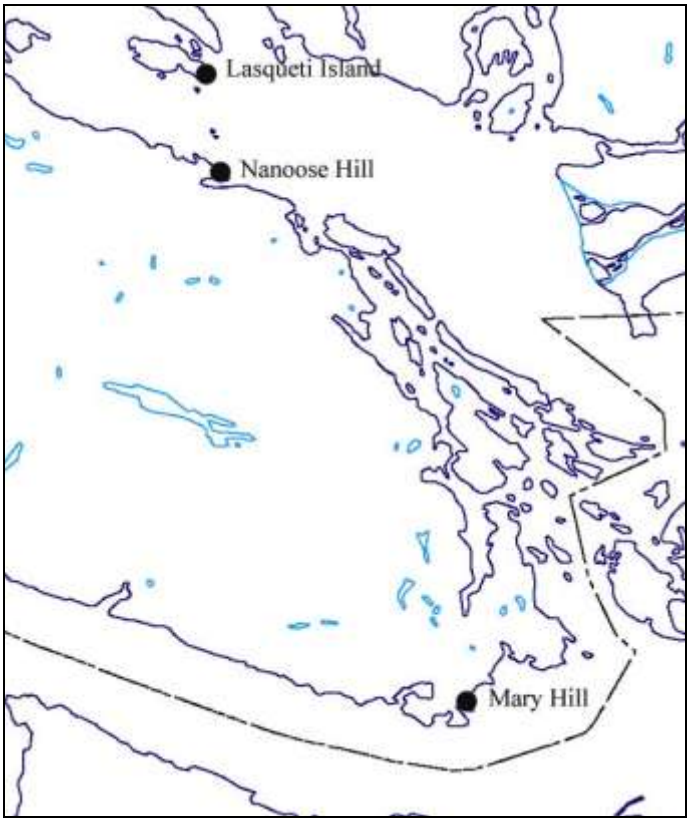

Figure 5. Distribution of the rigid apple moss in British Columbia (the Pedder Bay site is just west of the Mary Hill site).

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^2. 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^2), 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^2. 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

Site	Number of patches	Land tenure
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)

Feasibility criteria	
1. Are individuals capable of reproduction currently available to improve the population growth rate or population abundance?	YES
2. Is sufficient suitable habitat available to support the species or could it be made available through habitat management or restoration?	YES
3. Can significant threats to the species or its habitat be avoided or mitigated through recovery actions?	YES
4. Do the necessary recovery techniques exist and are they demonstrated to be effective?	YES

Recovery Goal

To protect[2] and maintain the extant populations of the rigid apple moss.

[2] 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.

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

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	• Investigate protection in area, if any • Establish critical habitat designations • Communicate with property owners about the presence of the species and the importance of protecting habitat	• Securing of populations and habitats • Increased awareness and assistance by the public in the protection and recovery of this species.
Medium	II	Research on potential threats	Loss and degradation of suitable habitat; encroachment by other species	• Research and document threats to habitat at each of the known sites • Define and describe specific populations and habitats	• Detailed location information of species • Population numbers and habitat data • List of sites for protection and monitoring under SARA • Precise information on habitats and threats
Medium	II	Research on potential threats	Loss and degradation of suitable habitat; encroachment by other species	• Research and document population sizes and health, and population change from first survey • Develop and implement standardized monitoring protocol • Report monitoring results annually and assess trends in populations, area of occupancy and habitat condition every 5 years • Submit all data to BC CDC	• Data on population sizes, reproduction status, and health • Detailed data on habitat attributes • Regular and standardized monitoring of populations and habitats • Annual summary of monitoring results • Assessment of status of populations and effects of recovery actions
Low	I	Inventory		• List areas to be surveyed • Inventory new areas	• New populations for potential protection • New information on threats, ecology, and populations

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

Study	Completion date
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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