PROPOSED

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Vole Ears Lichen (*Erioderma mollissimum*) in Canada

Vole Ears Lichen

2014

Canada

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

Cover photo: Vole Ears Lichen — Frances Anderson

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PREFACE

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

The Minister of the Environment is the competent minister for the recovery of the Vole Ears Lichen and has prepared this strategy, as per section 37 of SARA. It has been prepared in cooperation with the Provinces of New Brunswick, Newfoundland and Labrador, and Nova Scotia and others as per section 39(1) of SARA.

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

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

ACKNOWLEDGMENTS

This recovery strategy was prepared by Julie McKnight (Environment Canada – Canadian Wildlife Service) and Rob Cameron (Nova Scotia – Environment) with extensive input from Mark Elderkin (Nova Scotia Department of Natural Resources), Maureen Toner (New Brunswick Department of Natural Resources), Newfoundland and Labrador Department of Environment and Conservation, and the Newfoundland and Labrador Department of Natural Resources Lichen Working Group. The efforts and contributions of the Nova Scotia Cyanolichen Recovery Team are gratefully acknowledged.

EXECUTIVE SUMMARY

Vole Ears Lichen is a large (up to 12 cm broad), leafy lichen with a felty, grey-brown upper surface that turns grey-green when moistened.

As of January 2012, Vole Ears Lichen was known from two populations at 29 sites along the Atlantic Coast of Nova Scotia comprised of 153 adult thalli and from one population at six sites on the Avalon Peninsula in Newfoundland and Labrador that had 26 adult thalli. The last report of Vole Ears Lichen in New Brunswick was from 1980. The species is listed as Endangered on Schedule 1 of the federal *Species at Risk Act* (SARA).

One of the most important requirements for cyanolichens is the need for a clean environment including pollutant-free air and precipitation that is free of acidifying contaminants. Acid precipitation may negatively impact the colonisation and survival of Vole Ears Lichen in areas that receive significant and continued acid deposition. In addition to air pollution, Vole Ears Lichen is threatened by tree harvesting and forestry activities, road construction, housing/cottage development, climate change, and herbivory.

There are unknowns regarding the feasibility of recovery of Vole Ears Lichen. In keeping with the precautionary principle, this recovery strategy has been prepared as per section 41(1) of SARA, as would be done when recovery is determined to be feasible. The population and distribution objectives are to ensure that the species' known range (2012) and the health and stability of the three known populations (2012) are not impacted by habitat loss, degradation, biological resource use of the species' host tree, or invasive gastropods. Broad strategies to be taken to address the threats to the survival and recovery of Vole Ears Lichen are presented in the section on Strategic Direction for Recovery (Section 6.2).

Critical habitat for Vole Ears Lichen is partially identified in this document based on the best available data. Critical habitat for Vole Ears Lichen is located entirely on non-federal land. As more information becomes available, additional critical habitat may be identified.

One or more action plan for Vole Ears Lichen will be completed within three years of the final version of this recovery strategy being posted on the Species at Risk Public Registry.

RECOVERY FEASIBILITY SUMMARY

Based on the following four criteria outlined in the draft SARA Policies (Government of Canada 2009), there are unknowns regarding the feasibility of recovery of the Vole Ears Lichen. In keeping with the precautionary principle, a recovery strategy has been prepared as per section 41(1) of SARA, as would be done when recovery is determined to be feasible. This recovery strategy addresses the unknowns surrounding the feasibility of recovery.

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

Yes. In North America, Vole Ears Lichen is known to occur in the Great Smoky Mountains (Tennessee and North Carolina), and in foggy, coastal areas of Atlantic Canada. Vegetative reproduction is either through fragmentation or specialized structures called soredia. However, lichen soredia have a limited dispersal capability; dispersal is likely not more than hundreds of meters and fragmentation provides dispersal, but only on the same host tree as the parent. Unaided immigration is thus very unlikely.

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

Unknown. It is unknown whether sufficient suitable habitat is available to support the species, or could be made available through habitat management or restoration. Air pollution and forestry management practices are the primary threats to Vole Ears Lichen habitat. Although habitat still exists in the form of mature/over-mature forests, air pollution affects this habitat by reducing a host tree's bark buffering capacity and increasing its acidity (Farmer et al 1991).

Best forest management practices that protect lichens have emerged and have received some support from the industry in recovery work on a similar species, the Boreal Felt Lichen (*Erioderma pedicellatum*). These may lead to practical recommendations for best management practices in the vicinity of Vole Ears Lichen habitat and unoccupied potential sites.

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

Unknown. Air pollution and forest harvesting (and associated activities such as tree harvesting, clear cutting, large scale harvesting, and road building) are the primary threats to Vole Ears Lichen and its habitat.

Cyanolichens are extremely sensitive to air pollution and acid precipitation (Richardson & Cameron 2004) due to their reliance on airborne nutrients and water, as well as lack of protective structures (Richardson & Cameron 2004). Sulphur dioxide (SO_2) dissolved in precipitation, water films, or within moist lichen thalli is highly toxic to cyanolichens and is most toxic under acidic conditions. Vole Ears Lichen may benefit from pollution prevention campaigns and industrial technologies that reduce emissions. However, despite such initiatives, air quality problems are anticipated to continue to be problem for the next 20 to 50 years and Environment Canada (2003) reports that growth in air pollution sources has the potential to outpace any gains made in recent years. At present, many areas in New Brunswick and Nova Scotia and, to a lesser extent, Newfoundland and Labrador, receive acid deposition in excess of critical loads. The amount of acid deposition that a habitat can tolerate without being significantly harmed is known as its critical load (COSEWIC 2009). Future industrial developments may further negatively impact Vole Ears Lichen and its habitat.

Formal and informal partnerships with industry, scientists, municipal governments, federal/provincial governments, conservation organizations, land owners, and the public may help achieve the long-term conservation and recovery of the Vole Ears Lichen.

International agreements, national commitments, and legislation may all contribute to sustainable forestry practices and the conservation of Vole Ears Lichen through threat reduction/mitigation. In some areas, the forestry industry has taken an interest in the protection of a similar endangered lichen, the Atlantic population of Boreal Felt Lichen, and their input may lead to practical recommendations for best management practices in the vicinity of Vole Ears Lichen habitat and unoccupied potential sites.

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

Yes. Some success has been achieved in transplanting Boreal Felt Lichen, Boreal population in Newfoundland and Labrador (The Gossan 2010). It is reasonable to assume that this recovery technique may be a viable option for Vole Ears Lichen, should it be required.

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1. COSEWIC* SPECIES ASSESSMENT INFORMATION

Date of Assessment: November 2009

Common Name (population): Lichen, Vole Ears

Scientific Name: *Erioderma mollissimum*

COSEWIC Status: Endangered

Reason for Designation: This large foliose lichen is known in Canada only from Nova Scotia, New Brunswick, and the island of Newfoundland, where it inhabits cool, humid and coastal conifer forests dominated by Balsam Fir. Although there are 24 known sites for the lichen in these regions, few individuals (133 thalli) are known. While recent surveys have increased the number of known locations, the lichen has been extirpated from 11 sites in the last 30 years. This lichen is a sensitive indicator of air pollution and acid precipitation, which are its main threats. Other threats include forest harvest and browsing by moose.

Canadian Occurrence: NB, NS, NL

COSEWIC Status History: Designated Endangered in November 2009

* COSEWIC = Committee on the Status of Endangered Wildlife in Canada

2. SPECIES STATUS INFORMATION

Table 1. Description of various conservation status ranks for the Vole Ears Lichen (NatureServe, 2011).

	Global (G) Rank	National (N) Rank	Subnational (S) Rank	COSEWIC Status	SARA Status
Vole Ears Lichen *(Erioderma mollissimum)*	G4 apparently secure	N1N2 critically imperiled/ imperiled	NB (S1) critically imperiled NS (S1S2) critically imperiled/ imperiled NL (S1) critically imperiled	Endangered	Endangered

3. SPECIES INFORMATION

3.1 Species Description

Vole Ears Lichen is a large leafy lichen with a felty, grey-brown upper surface that turns grey-green when moistened. The thallus is up to 12 cm broad and is comprised of radiating, loosely attached lobes up to 1 cm in width. The lower surface lacks an outer protective layer, and except near the pale, bare margins is densely hairy and light-brown. Granular, bluish vegetative reproductive structures are produced along the lobe margins and may also form in tiny patches on the upper surface of older lobes. Vole Ears Lichen can sometimes be found growing in clusters of individuals that result from fragmentation or regeneration close to the parent thallus.

The photosynthetic component of this lichen has been identified as *Scytonema*, a cyanobacterium that is considered rare in lichens occurring north of subtropical regions. Nevertheless, *Scytonema* is also found in other lichens, including *Coccocarpia palmicola* and *Lichinodium sirosiphoideum*, that are often found in the same habitats as Vole Ears Lichen.

3.2 Population and Distribution

Vole Ears Lichen has a highly disjunct global range and occurs mostly in tropical and subtropical cloud forests. It has been recorded in Central and South America, the Dominican Republic, Mexico, Costa Rica, Venezuela, Columbia, Ecuador, and Brazil (Jørgensen & Arvidsson 2001). It occurs more rarely on the eastern side of the Atlantic Ocean, in Portugal, Spain, the Azores, and the Canary Islands and is known to occur in the mountains of Kenya in East Africa. In North America, it has been recorded in the Great Smoky Mountains of Tennessee and North Carolina, and the coastal region of Atlantic Canada.

Evidence suggests a possible decline in the Canadian population, particularly in Nova Scotia where at least 80% of sites documented in the 1980s no longer support the lichen. As of January 2012, Vole Ears Lichen was known from two populations at 29 sites along the Atlantic Coast of Nova Scotia totaling 153 adults and 23 juveniles. In 2012, Vole Ears Lichen was confirmed to exist on 10 trees at six sites on the Avalon Peninsula in Newfoundland and Labrador totalling 26 adults and 30 juveniles. The last report of Vole Ears Lichen in New Brunswick was from 1980 and has not been relocated at that site despite recent searches; however, it may still occur in the province in small numbers.

A GIS-based predicted distribution model was developed for Vole Ears Lichen in Eastern Canada and results suggest that the population size and distribution of Vole Ears Lichen may be larger than is currently known (COSEWIC 2009).

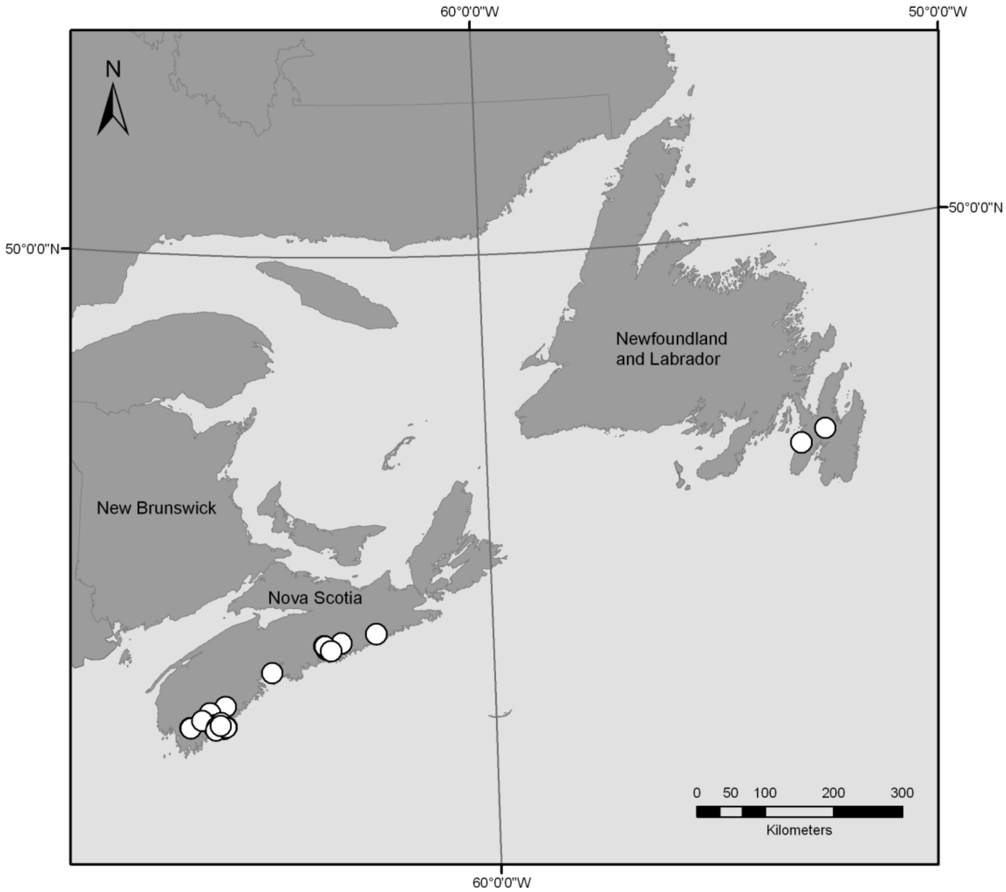

Figure 1. Distribution of Vole Ears Lichen in Canada (as of January 2012).

Table 2. Distribution details of Vole Ears Lichen in Newfoundland and Labrador and Nova Scotia. Sites in Nova Scotia are derived from locations with separation distances of greater than 0.5 km based on expected dispersal distances and historical predicted habitat distances. The number of phorophytes (host trees) was not documented at all sites and this is denoted as n.d.

Population Name	Site	Year of discovery	Most recent survey	Number of phorophytes	Number of Juvenile thalli	Number of Adult thalli
Avalon (NL)	Halls Gullies 1	2007	2012	1	2	1
	Halls Gullies 2	2007	2012	1	21	13
	Halls Gullies 3	2007	2012	4	4	6
	Halls Gullies 4	2008	2012	1	1	1
	Halls Gullies 5	2008	2012	1	0	1
	South East Placentia	2007	2012	2	2	4
South Shore (NS)	Blandford	2006	2011	n.d.	0	5
	Bon Mature Lake	2008	2008	1	0	1
	Canada Hill / MacKenzies Barren[1]	2008	2011	> 9	0	29
	Clyde River Road1	2008	2008	n.d.	0	1
	Clyde River Road2	2008	2008	n.d.	0	1
	Duck Hole	2010	2010	1	0	1
	Four Mile Brook	2007	2007	n.d.	0	6
	Fresh Water Brook	2011	2011	2	0	2
	Haley Lake	1981	2008	n.d.	0	7
	Johnstons Pond	2011	2011	1	0	1
	Jones Harbour	2008	2008	n.d.	0	2
	Jordan River	2011	2011	1	0	1
	Lake John Road[2]	2007	2007	n.d.	2	22
	Martin Brook	2008	2008	n.d.	0	1
	Misery Lake	2011	2011	2	0	2
	Misery Lake Brook	2010	2010	1	0	1
	Oakhill	2011	2011	1	0	1
	Port L'Hebert	2008	2008	n.d.	1	1
	Pumpkinvine Brook	2010	2010	1	0	1
	Robarts Pond	2008	2008	n.d.	0	1
	Robs Lake	2009	2009	4	0	4
	Thomas Raddall, Provincial Park	1980	2008	n.d.	11	32
	Tidney	2010	2010	1	0	1
Eastern Shore (NS)	Bear Lake	2006	2007	n.d.	0	2
	Burnt Hill Lake Brook	2010	2010	2	0	2
	Dooks Pond	2005	2007	n.d.	0	4
	Fuller Lake	2006	2007	n.d.	8	8
	Otter Pond	2006	2007	n.d.	1	6
	Webber Lake	2007	2007	n.d.	0	7

[1] This site corresponds to occurrences Lake John Road1 & Lake John Road 2 as stated in the 2010 COSEWIC status report.

[2] This site corresponds to occurrences Canada Hill 1 & Canada Hill 2 as stated in the 2010 COSEWIC status report, and has expanded following the discovery of new Vole Ears thalli.

3.3 Needs of the Vole Ears Lichen

In Atlantic Canada, the species occurs within 30 km of the coast at elevations less than 200 m where it experiences warm winters and cool summers. These highly humid coastal forests receive large amounts of moisture in the form of fog and rain, which is often in excess of 1400 mm annually (COSEWIC 2009, Davis and Browne 1996). Vole Ears Lichen is often found in, or very near to, wetlands. A wetland is land that is either periodically or permanently saturated with water and sustains aquatic processes (interpreted from NS Wetland Conservation Policy 2011; refer to Appendix C for provincial definitions).

In the Boreal Forest Region in Newfoundland, Vole Ears Lichen is found in mature to overmature coniferous forest patches dominated by Balsam Fir (*Abies balsamea*) of even ages with characteristically varying tree diameters. These patches occur on flat to gently sloping, imperfectly- to poorly-drained sites in close proximity to wetlands as part of a fragmented landscape which includes coniferous stands in different age classes. Preliminary observations of Vole Ears Lichen in Newfoundland, suggest that it may be found on particularly slow growing trees, however the significance of these observations with respect to its habitat requirements is unknown. In the Acadian Forest Region in Nova Scotia, Vole Ears Lichen is most often found in poorly drained depressions with mature coniferous or mixed forests dominated by Balsam Fir and/or Red Maple (*Acer rubrum*) and/or Yellow Birch (*Betula alleghaniensis*), where *Sphagnum* species cover the ground. In New Brunswick, one thallus was found on a moss–covered rock.

One of the most important habitat requirements for cyanolichens is the need for a clean environment including pollutant-free air and precipitation that is free of acidifying contaminants. Cyanolichens are particularly sensitive to acid rain, sulphur dioxide and nitrogen oxides (Gilbert 1986, Hallingback 1989, Hawksworth and Rose 1970, Sigal and Johnston 1986). Maass and Yetman (2002) partially attribute the decline in Boreal Felt Lichen (*Erioderma pedicellatum*) in Atlantic Canada to acid rain and air pollution.

4. THREATS

4.1 Threat Assessment

Table 3. Threat Assessment Table

General Threat	Level of Concern[1]	Extent	Occurrence	Frequency	Severity[2]	Causal Certainty[3]
Pollution						
Air pollution	High	Widespread	Current & Anticipated	Continuous	High	High
Habitat Loss or Degradation						
Tree harvesting and forestry activities	High	Widespread	Current & Anticipated	Recurrent	High	High
Road construction	Medium	Widespread	Current & Anticipated	One-time	High	Medium
Housing/ cottage development	Medium	Unknown	Anticipated	One-time	High	Medium
Climate and Natural Disasters						
Climate change	Medium	Widespread	Current & Anticipated	Recurrent	Unknown	Medium
Exotic Invasive or Introduced species						
Herbivory	Medium	Localized	Current & anticipated	Continuous / Seasonal	Medium	Low

[1]*Level of Concern: signifies that managing the threat is of (high, medium or low) concern for the recovery of the species, consistent with the population and distribution objectives. This criterion considers the assessment of all the information in the table.*

[2] *Severity: reflects the population-level effect (High: very large population-level effect, Moderate, Low, Unknown).*

[3] *Causal certainty: reflects the degree of evidence that is known for the threat (High: available evidence strongly links the threat to stresses on population viability; Medium: there is a correlation between the threat and population viability e.g. expert opinion; Low: the threat is assumed or plausible).*

4.2 Description of Threats

Air pollution

Cyanolichens are extremely sensitive to air pollution and acid precipitation due to their reliance on airborne nutrients and water, as well as their lack of protective structures (Richardson & Cameron 2004). Sulphur dioxide (SO_2) dissolved in precipitation, water films, or within moist lichen thalli is highly toxic to cyanolichens and is most toxic under acidic conditions. Sulphur dioxide and nitrogen oxides (NOx) emitted during the high temperature burning of coal or oil remain in the atmosphere for relatively long periods of time before being washed out by rain and forming acid rain. Acid rain is a combination of sulphuric acid and nitric acid formed from the nitrogen oxides. It is the hydrogen ion component of acid rain that is toxic; it affects cell membranes, leaches metals such as calcium from the lichen, and acidifies the substrata of the host (Richardson 2008). Continued exposure to acid precipitation eventually results in the buffering capacity of the substratum being exceeded so that it becomes too acid for cyanolichens, especially for very young thalli to thrive (Nieboer et al., 1984).

Vole Ears Lichen may benefit from pollution prevention campaigns and industrial technologies that reduce emissions. However, despite such initiatives, air quality problems are anticipated to continue for the next 20 to 50 years and Environment Canada (2003) reports that growth in air pollution sources has the potential to outpace any gains made in recent years. At present, many areas in New Brunswick and Nova Scotia and, to a lesser extent, Newfoundland and Labrador, receive acid deposition in excess of critical loads. The amount of acid deposition that a habitat can tolerate without being significantly harmed is known as its critical load (COSEWIC 2009). Future industrial developments may further negatively impact the habitat for Vole Ears Lichen.

Tree Harvesting and Forestry Activities

Besides acid precipitation, forestry activities are considered the other major threat to the species. Forestry practices such as clear cutting or harvesting on a large scale may cause fragmentation and would alter biodiversity and age class structure of potential Vole Ears Lichen habitat. Scheduling of forest harvesting affects habitat availability and, where forest succession is known, can be used to provide mid-term and long-term habitat inputs for modelling exercises. The effect of forest fragmentation on epiphytic lichens has been the subject of much work (Esseen and Renhorn 1998; Rheault et al. 2003; Pykälä 2004; Richardson and Cameron 2004). When lichens are suddenly at the edge of a forest or in a fragmented forest, there is a reduction in dispersal ability and opportunity to recolonize in cutover areas (Rheault et al. 2003). Large-scale logging can increase wind and drying effects (Hunter 1990) and greatly reduce the ability of a forest stand to buffer against times of low humidity while at particular seral stages (Maass and Yetman 2002).

Road Construction and Housing/Cottage Development

The development of land for activities such as industry, residences, and agriculture creates disturbance, landscape alterations, and affects micro-climates of nearby forests. New road development may alter the landscape hydrology (Cameron 2006) and also provide access to remote areas that may foster the expansion of cottage county (Maass and Yetman 2002).

Climate change

Preliminary analyses along the Atlantic coast suggest a significant decline in fog frequency in Nova Scotia and the Avalon Peninsula of southeastern Newfoundland and Labrador over the past few decades (Beauchamp et al. 1998, Muraca et al. 2001). Vole Ears Lichen, like several other cyanolichens that mainly occur in coastal fog forests, is very drought–sensitive, and could be negatively impacted if a decline in fog occurs.

Herbivory

Since the arrival of Europeans, there have been both deliberate and accidental introductions of animal species. The following species are implicated in successional changes to forest composition in Newfoundland and were all introduced: Red-backed Voles (*Clethrionomys gapperi*), Red Squirrels (*Tamiasciurus hudsonicus*), Snowshoe Hare (*Lepus americanus*) and Moose (*Alces alces*) (McLaren et al. 2009; McLaren et al. 2004). Moose were introduced to the island of Newfoundland in 1878 and 1904 and the population quickly expanded; densities are currently much higher than elsewhere in North America. Balsam Fir, the only known substrate for Vole Ears Lichen in Newfoundland, is browsed by Moose resulting in the understocking of Balsam Fir, various hardwood and other native vegetation and a relatively higher spruce proportion, thus potentially limiting the available habitat for the lichen.

Evidence of gastropod grazing on Vole Ears Lichen was recorded in NS (Cameron 2009). Three species of gastropods were found feeding on cyanolichens in Nova Scotia (Cameron 2009): *Pallifera dorsalis*, a small native gastropod; and *Arion subfuscus* and *Deroceras reticulatum*, larger aggressive species introduced from Europe (Davis 1992). Non-native gastropods may also pose a problem for Vole Ears Lichen in Newfoundland (Moss and Hermanutz 2010). Surveys in Newfoundland have noted occurrences of Vole Ears Lichen being lightly grazed, but the taxa / species responsible for the grazing is unknown. Mollusc grazing can play an important part in shaping the epiphytic vegetation of deciduous forests and juvenile thalli seem to be at particular risk (Asplund & Gauslaa 2008).

5. POPULATION AND DISTRIBUTION OBJECTIVES

The objectives of this strategy are to ensure that the species' known range (2012) and the health and stability of the three known populations (2012) are not impacted by habitat loss, degradation, biological resource use of the species' host tree, or invasive gastropods.

As of January 2012, three populations of Vole Ears Lichen were known from the Avalon Peninsula in Newfoundland and Labrador (26 adult thalli), the Eastern Shore of Nova Scotia (29 adult thalli), and the South Shore of Nova Scotia (124 adult thalli).

A GIS-based predicted distribution model was developed for Vole Ears Lichen in Eastern Canada and results from this model suggest that the population size and distribution of Vole Ears Lichen may be larger than is currently known.

6. BROAD STRATEGIES AND GENERAL APPROACHES TO MEET OBJECTIVES

6.1 Actions Already Completed or Currently Underway

In Newfoundland and Labrador, lichen inventories, surveys, pre-harvest forest surveys and opportunistic searching have been ongoing since 1996 by contract staff, Department of Environment and Conservation (Parks and Natural Areas Division and Wildlife Division), Department of Natural Resources, Miawpukek First Nation, and, where required, for proponents of proposals registered in the Environmental Assessments process. Vole Ears Lichen monitoring has been underway since 2010. Some Boreal Felt Lichen sites on the Avalon Peninsula have been re-visited to ensure that Vole Ears Lichen were not misidentified as Boreal Felt Lichen and more sites are slated to be re-visited. As well, numerous lichen photos initially identified as Boreal Felt Lichen were re-examined to locate any potentially misidentified Vole Ears Lichen. The provincial Forestry and Agrifoods Agency has deferred harvest in existing Vole Ears Lichen sites via the Forest Management Planning Process and formal protection for areas of conservation interest is currently being pursued. In Nova Scotia, lichen inventories, surveys, pre-harvest forest surveys, and opportunistic searching have been ongoing since 2003. Informal outreach has been underway since 2006.

There are other recovery and guidance documents pertaining to cyanolichens in Atlantic Canada that propose additional activities and measures that may be pertinent for the conservation of Vole Ears Lichen: *The Recovery Strategy for Boreal Felt Lichen, Atlantic population* (Environment Canada 2007), *The Management Plan for the Blue Felt Lichen [DRAFT]* (Environment Canada, in prep), *The Management Plan for the Boreal Felt Lichen, Boreal population* (Environment Canada 2010), *A Five Year Management Plan for the Boreal Felt Lichen in Newfoundland and Labrador* (Keeping and Hanel 2006), and *Endangered Boreal Felt Lichen Special Management Practices* (Nova Scotia Department of Natural Resources 2012).

6.2 Strategic Direction for Recovery

Table 4. Recovery Planning Table

Threats or concerns addressed	Priority	Broad Strategy to Recovery	General Description of Research and Management Approaches
Air pollution, climate change, herbivory (direct and causing habitat conversion)	High Medium Low Low	Mitigate threats to the species	• Engage in existing pollution reduction programs for pollution and greenhouse gasses • In NL: Support existing relevant programs by the provincial Department of Natural Resources • Prevent gastropods from ascending host trees • Develop a protocol for transplanting cyanolichens if host tree is lost
Tree harvesting and forestry activities, forestry road development, housing/cottage development	High Medium	Ensure enough suitable habitat to maintain the current populations (January 2012) and allow for colonisation	• Stewardship and compliance promotion • Outreach and education: foster cooperative relationships with landowners, foresters, industry, and volunteers to maintain critical habitat
Knowledge gaps	High Medium High	Refine population size and distribution information Address key knowledge gaps to recovery	• Develop and implement inventory and monitoring protocol(s) • Research (Appendix B) • Identify and examine sensitivity to, and effects of, air pollutants

6.3 Narrative to Support the Recovery Planning Table

Mitigate threats to the species

Vole Ears Lichen will benefit from reductions in air pollutants such as sulphur dioxide and nitrogen oxides. It is not feasible to initiate a massive campaign to reduce local and transboundary sources of pollution specifically for the benefit of lichens. Instead, partnerships should be strengthened with government departments to encourage compliance with the *Canadian Environmental Protection Act* and to continue implementing the Canada-Wide Acid Rain Strategy for Post-2000, the Nova Scotia Energy Strategy, the Nova Scotia Climate Change Action Plan, the Newfoundland and Labrador Climate Change Action Plan, and the New Brunswick Climate Change Action Plan.

Managing the effects of herbivory by voles, squirrels, snowshoe hare, and moose on forests is an ongoing challenge in Newfoundland and Labrador. Similar to the plans to mitigate air pollution and greenhouse gasses by supporting partnerships and implementing existing programs, the way forward for this issue will be to support existing research and management programs.

Gastropods will ascend trees to graze lichens. The climbing of trees can be prevented by a variety of devices such as collars, tapes and traps. These devices can be applied to phorophytes to determine the most effective method to prevent gastropod access to Vole Ears Lichen.

Researching a successful protocol for transplanting cyanolichens to nearby host trees when a parent tree is threatened by uncontrollable factors (e.g., storms, blow-downs) may be necessary for the maintenance of this lichen at some sites. Transplantation may also provide a means for rescuing rare populations or maintaining the species’ range, but would only be considered in exceptional circumstances. Some success has been achieved in transplanting Boreal Felt Lichen, Boreal population in Newfoundland and Labrador (The Gossan 2010).

Ensure enough suitable habitat to maintain the populations (January 2012) and allow for colonisation

Efforts to communicate with landowners, resource users, developers, land managers, and other stakeholders to promote stewardship are an important part of protecting habitat. It will be necessary to determine best practices for forest management in the vicinity of Vole Ears Lichen sites, in unoccupied potential sites adjacent to critical habitat, and to maintain Balsam Fir across the landscape in Newfoundland and mixed forests of Balsam Fir and/or Red Maple and/or Yellow Birch and associated ground *Sphagnum* species in Nova Scotia. The experience and knowledge of stakeholders will be important in making management decisions on private and public lands. Protected areas also have a role to play in the conservation of lichens and should be pursued where feasible.

Cyanolichens can be difficult to identify and often take considerable effort to study and learn, but the right educational materials and delivery may pique the interest of industry, foresters, land managers, students, and naturalists. Identification workshops and seminars for various cyanolichens species will provide a foundation for initial steps towards recovery.

Refine population size and distribution information and address key knowledge gaps to recovery

Monitoring is necessary to evaluate the success of recovery efforts. Monitoring will assess the abundance, overall condition of the thalli, habitat characteristics, and apparent threats. Monitoring the health and succession of individual thalli and colonies as well as the long-term habitat conditions will also address some research questions.

Since the GIS predicted distribution model suggested that other Vole Ears Lichen locations may exist, continued lichen surveys / inventories are necessary to gain accurate distribution information for the species. Where appropriate, the model results can be used to prioritize new survey locations.

It is important to identify the lichen's sensitivity to specific types and levels of pollutants and determine under what conditions (timing, duration, life stage of exposure, etc.) these pose the greatest threat. Through identification of local point sources of air pollution and atmospheric conditions, the impact of these point sources on the location and survival of cyanolichens can be assessed. Permanent lichen pollution sampling plots managed by Nova Scotia Environment may provide some insights into the impact of air quality on the distribution and abundance of cyanolichens.

Information regarding air pollution, acid deposition, and meteorological events is available through federal and provincial environment departments and should be assembled and interpreted as it relates to the recovery of cyanolichens. Other threats, such as forestry activity and gastropod grazing, will be researched and monitored directly.

Microhabitat parameters such as humidity, forest composition, forest age structure, and indicator species should be monitored at occupied sites to better define the conditions the species requires.

Other knowledge gaps to recovery that should be addressed, such as life cycle characteristics and dispersal distance, are identified in Appendix B.

7. CRITICAL HABITAT

7.1 Identification of the Species' Critical Habitat

Critical habitat is identified in this document to the extent possible given the best available information. However, at this time, identification is considered to be partial. Distribution-prediction modeling provided convincing evidence that the known habitat preferences of Vole Ears Lichen exist in locations other than currently confirmed sites, meaning that more sites with Vole Ears Lichen in Atlantic Canada will likely be found. Ecological requisites and physical attributes of critical habitat in Nova Scotia and Newfoundland and Labrador are not fully understood at this time and require further study.

Vole Ears Lichen habitat characteristics

The existing Vole Ears Lichen sites share the following habitat characteristics:

In northeastern North America, Vole Ears Lichen is found within 30 km of the coast where winters are warm (mean temperature −4.5 °C) and summers are cool (mean temperature of 16.4 °C). Over 80 % of the precipitation in these sites falls as rain and fog frequency is high. Vole Ears Lichen is limited to elevations of less than 200 m in Atlantic Canada and occurs at sites with high precipitation, often exceeding 1400 mm (COSEWIC 2009, Davis and Browne 1996).

All trees on which Vole Ears Lichen has been found have been mature or old. Stand tree ages average 65 years in Nova Scotia and 73 years in Newfoundland and Labrador. Dead trees are found at all occurrences and make up as much as 50 % of the forest composition in several stands.

Cinnamon Fern *(Osmunda cinnamomea)* dominates the herb layer at all occurrences and *Sphagnum* species are present at all occurrences with a total ground cover of 70 % or more at each location. Other species of moss are present in smaller amounts (5 to 15 % of the ground cover). In Newfoundland, Vole Ears Lichen is frequently found growing alongside or on liverworts, particularly *Frullania* species and Bryophyte ground cover is high at all sites (dominated by *Hylocomium, Pleurozium, Sphagnum, Rhytidiadelphus, Ptilium,* and *Bazzania).*

The Nova Scotia and Newfoundland Vole Ears Lichen habitats are highly humid coastal forests. Host trees are almost always located in, or within 80 m of, a wetland or peatland (COSEWIC 2009). In other respects the habitats are different. In Newfoundland, Vole Ears Lichen is found in mature to overmature coniferous forest patches dominated by Balsam Fir of even ages with characteristically varying tree diameters. These patches occur on flat to gently sloping, imperfectly- to poorly-drained sites in close proximity to wetlands as part of a fragmented landscape which include coniferous stands in different age classes. In Nova Scotia, Vole Ears Lichen habitat is typically in poorly drained depressions with mature coniferous or mixed forests dominated by Balsam Fir and/or Red Maple.

Vole Ears Lichen is found on a variety of substrata. In Newfoundland and Labrador it has been found only on Balsam Fir, while in Nova Scotia it occurs on Balsam Fir as well as Red Maple and Yellow Birch. In New Brunswick one historical record was from a moss–covered rock.

One of the most important habitat requirements for cyanolichens is the presence of precipitation free of acidifying contaminants. Nutrient enrichment from the upper branches of nearby hardwoods may counter the low buffering capacity of coniferous bark in areas with highly acidic precipitation, thus allowing the lichen to survive (Richardson and Cameron 2004). As a result, there may be a critical threshold for the proportion of Red Maple needed for an area to support Vole Ears Lichen in Nova Scotia. This requires further study.

Critical habitat description

Critical habitat sites are identified in Table 5. At each site, critical habitat for Vole Ears Lichen is identified as the substrata (at present only known from trees), the wetland (which is defined as land that either periodically or permanently has a water table at, near, or above the land's surface and includes marsh, swamp, fen, bogs, and other shallow open water areas) in which the substrata occurs, or is adjacent to, and a critical function zone. The critical function zone is believed to be necessary to maintain microhabitat characteristics, especially moisture attributes, required for the survival of the lichen and to allow for colonization. The critical function zone is identified as 100 m around the lichen and its substratum and an area around the wetland in which it occurs, or is adjacent to, dependent on wetland size as follows: for wetlands smaller than 100 m^2, a critical function zone of 100 m radius surrounding the wetland is identified and for wetlands greater than 100 m^2, a critical function zone of 50 m surrounding the wetland is identified. More detailed information on the location of critical habitat to support protection of the species and its habitat may be requested, on a need-to-know basis, by contacting Environment Canada's Recovery Planning section at: RecoveryPlanning_Pl@ec.gc.ca.

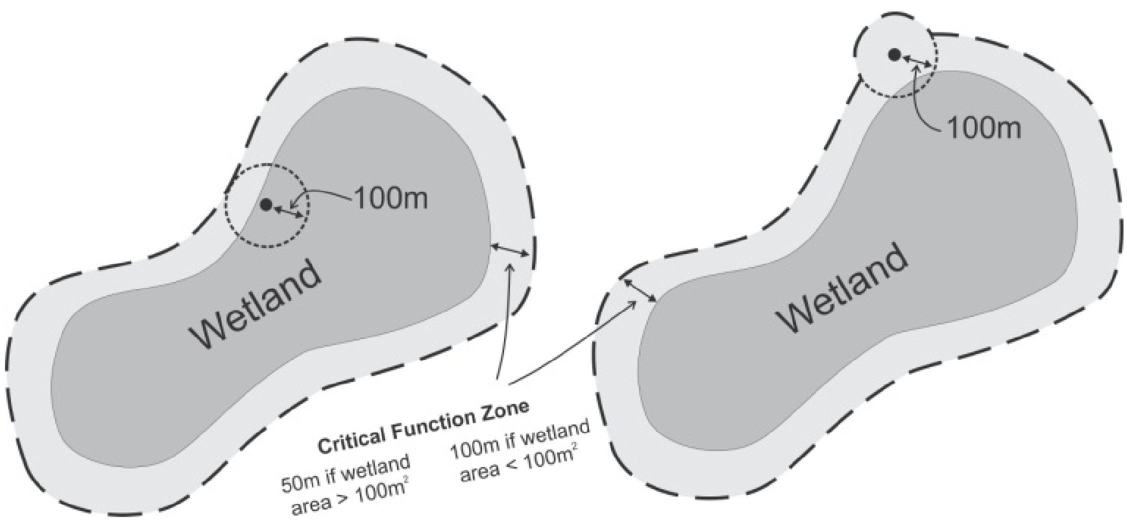

Figure 2. Examples of critical habitat; all areas within the dashed line are included as critical habitat.

Critical habitat is not identified in New Brunswick at this time. If surveys reveal the presence of lichens in the province, critical habitat for the species will be revised.

Table 5. Sites containing critical habitat for Vole Ears Lichen in Canada. Critical habitat for Vole Ears Lichen occurs within these 1 km squares where the criteria described in Section 7.1 are met.

Population Name	Grid Number	Site Name	Easting[1]	Northing[1]	Number of CH Site Centroids within Grid	CH Site Area (ha)[2] within Grid	Land Tenure[3]
Avalon Peninsula (NL)	22BT83_15	South East Placentia	281000	5235000	0	1	Non federal
	22BT83_16	South East Placentia	281000	5236000	1	3	Non federal
	22CT14_37	Halls Gullies 4	313000	5247000	1	2	Non federal
	22CT14_47	Halls Gullies 4	314000	5247000	0	1	Non federal
	22CT14_48	Halls Gullies 1	314000	5248000	0	3	Non federal
	22CT14_58	Halls Gullies 1 Halls Gullies 2	315000	5248000	2	27	Non federal
	22CT14_59	Halls Gullies 3 Halls Gullies 5	315000	5249000	2	19	Non federal
	22CT15_50	Halls Gullies 3	315000	5250000	1	19	Non federal
	22CT15_60	Halls Gullies 3	316000	5250000	0	20	Non federal
	22CT14_68	Halls Gullies 2	316000	5248000	0	1	Non federal
South Shore (NS)	20KP95_31	Clyde River Road1	293000	4851000	0	2	Non federal
	20KP95_32	Clyde River Road1	293000	4852000	0	0.4	Non federal
	20KP95_40	Clyde River Road2	294000	4850000	0	2	Non federal
	20KP95_41	Clyde River Road1 Clyde River Road2	294000	4851000	2	25	Non federal
	20KP95_42	Clyde River Road1	294000	4852000	0	2	Non federal
	20LP16_01	Oakhill	310000	4861000	0	0.2	Non federal
	20LP16_11	Oakhill	311000	4861000	1	3	Non federal
	20LP16_80	Jordan River	318000	4860000	1	3	Non federal
	20LP24_99	Canada Hill / MacKenzies Barren[5]	329000	4849000	0	6	Non federal
	20LP25_90	Canada Hill / MacKenzies Barren	329000	4850000	0	18	Non federal

Population Name	Grid Number	Site Name	Easting[1]	Northing[1]	Number of CH Site Centroids within Grid	CH Site Area (ha)[2] within Grid	Land Tenure[3]
	20LP25_91	Canada Hill / MacKenzies Barren	329000	4851000	0	7	Non federal
	20LP25_92	Canada Hill / MacKenzies Barren	329000	4852000	0	1	Non federal
	20LP25_95	Misery Lake	329000	4855000	1	3	Non federal
	20LP26_00	Lake John Road[4] Four Mile Brook	320000	4860000	1	14	Non federal
	20LP26_01	Four Mile Brook	320000	4861000	1	34	Non federal
	20LP26_02	Four Mile Brook	320000	4862000	0	5	Non federal
	20LP26_10	Four Mile Brook	321000	4860000	0	5	Non federal
	20LP26_11	Four Mile Brook	321000	4861000	0	9	Non federal
	20LP27_22	Martin Brook	322000	4872000	0	3	Non federal
	20LP27_23	Martin Brook	322000	4873000	1	6	Non federal
	20LP34_09	Canada Hill / MacKenzies Barren[5]	323000	4849000	0	16	Non federal
	20LP34_17	Robs Lake	331000	4847000	0	3	Non federal
	20LP34_18	Canada Hill / MacKenzies Barren Robs Lake	331000	4848000	1	43	Non federal
	20LP34_19	Canada Hill / MacKenzies Barren	331000	4849000	0	40	Non federal
	20LP35_00	Canada Hill / MacKenzies Barren	330000	4850000	1	87	Non federal
	20LP35_01	Canada Hill / MacKenzies Barren	330000	4851000	0	45	Non federal
	20LP35_02	Canada Hill / MacKenzies Barren	330000	4852000	0	9	Non federal
	20LP35_03	Misery Lake Brook	330000	4853000	0	2	Non federal
	20LP35_13	Misery Lake Brook	331000	4853000	1	24	Non federal

Population Name	Grid Number	Site Name	Easting[1]	Northing[1]	Number of CH Site Centroids within Grid	CH Site Area (ha)[2] within Grid	Land Tenure[3]
	20LP35_14	Misery Lake Brook	331000	4854000	0	12	Non federal
	20LP35_21	Robarts Pond	332000	4851000	1	2	Non federal
	20LP35_31	Robarts Pond	333000	4851000	0	1	Non federal
	20LP35_65	Tidney	336000	4856000	0	7	Non federal
	20LP35_66	Tidney	336000	4855000	0	35	Non federal
	20LP35_73	Fresh Water Brook	337000	4853000	1	4	Non federal
	20LP35_74	Tidney	337000	4854000	0	11	Non federal
	20LP35_75	Tidney	337000	4855000	1	82	Non federal
	20LP35_76	Tidney	337000	4856000	0	47	Non federal
	20LP35_77	Tidney	337000	4865700	0	2	Non federal
	20LP35_83	Duck Hole Haley Lake	338000	4853000	0	2	Non federal
	20LP35_84	Tidney Duck Hole	338000	4854000	1	19	Non federal
	20LP35_85	Tidney	338000	4855000	0	30	Non federal
	20LP35_86	Tidney	338000	4856000	0	73	Non federal
	20LP35_87	Tidney	338000	4857000	0	11	Non federal
	20LP35_88	Pumpkinvine Brook	338000	4858000	0	0.3	Non federal
	20LP35_89	Pumpkinvine Brook	338000	4859000	1	3	Non federal
	20LP35_90	Jones Harbour	339000	4850000	1	3	Non federal
	20LP35_93	Haley Lake	339000	4853000	1	2	Non federal
	20LP35_96	Tidney	339000	4856000	0	1	Non federal
	20LP44_29	Johnstons Pond	342000	4849000	0	60	Non federal
	20LP44_39	Johnstons Pond	343	4849000	0	15	Non federal
	20LP45_10	Johnstons Pond	341000	4850000	0	2	Non federal
	20LP45_20	Johnstons Pond	342000	4850000	1	70	Non federal

Population Name	Grid Number	Site Name	Easting[1]	Northing[1]	Number of CH Site Centroids within Grid	CH Site Area (ha)[2] within Grid	Land Tenure[3]
	20LP45_30	Johnstons Pond	343000	4850000	0	12	Non federal
	20LP45_51	Thomas Randall Provincial Park	345000	4851000	1	3	Non federal
	20LP45_62	Port L'Hebert	346000	4852000	1	3	Non federal
	20LP45_63	Port L'Hebert	346000	4853000	0	0.1	Non federal
	20LP48_42	Bon Mature Lake	344000	4882000	1	9	Non federal
	20LP48_52	Bon Mature Lake	345000	4882000	0	7	Non federal
	20MQ13_31	Blandford	413000	4931000	1	7	Non federal
Eastern Shore (NS)	20MQ87_91	Fuller Lake	489000	4971000	1	3	Non federal
	20MQ96_26	Dooks Pond	492000	4966000	1	5	Non federal
	20MQ96_93	Webber Lake	499000	4963000	0	2	Non federal
	20MQ96_94	Webber Lake	499000	4964000	1	20	Non federal
	20MQ97_00	Otter Pond	490000	4970000	1	3	Non federal
	20NQ17_45	Bear Lake	514000	4975000	1	3	Non federal
	20NQ68_58	Burnt Hill Lake Brook	565000	4988000	1	3	Non federal
	20NQ68_59	Burnt Hill Lake Brook	565000	4989000	0	0.01	Non federal

[1] The listed coordinates represent the southwest corner of the 1 km Universal Transverse Mercator (UTM) Military Grid Reference System square containing critical habitat sites (see http://maps.nrcan.gc.ca/topo101/mil_ref_e.php for more information on the reference system). The coordinates may not fall within critical habitat and are provided as a general location only.

[2] The area presented is of the site boundary containing areas of critical habitat and not necessarily the area of critical habitat itself. Refer to Section 7.1 for a description of how critical habitat within these areas is defined.

[3] Land Tenure is provided as an approximation of land ownership of the site containing critical habitat and should be used for guidance purposes only. Accurate land tenure will require cross referencing critical habitat boundaries with surveyed land parcel information

[4] This site corresponds to occurrences Lake John Road1 & Lake John Road 2 as stated in the 2010 COSEWIC status report.

[5] This site corresponds to occurrences Canada Hill 1 & Canada Hill 2 as stated in the 2010 COSEWIC status report, and has expanded following the discovery of new Vole Ears thalli.

7.2 Schedule of Studies to Identify Critical Habitat

Table 6. Schedule of Studies

Description of Activity	Rationale	Timeline
Determine macro-scale physical environment and functional features that are vital for survival and colonisation.	Understand requirements of species and is necessary to determine whether the current identification of critical habitat includes sufficient habitat at each site to ensure long-term survival and ability to colonise new areas	preliminary results by 2016; further analysis by 2022
Determine microclimate requirements that are vital for survival. Determine whether Red Maple component provides critical microclimate requirements in NS.	Understand requirements of species and is necessary to determine whether the current identification of critical habitat includes sufficient habitat at each site to ensure long-term survival; Determines whether additional Red Maple outside the critical function zone should be conserved (in NS) to ensure characteristics at the critical habitat sites are maintained (pH).	2016
Assess the relationship between wetland size and recharge area required to maintain wetland functionality. Determine necessity of critical function zone and area required to maintain critical habitat characteristics.	May lead to refinement of critical habitat. Determines if zone surrounding wetland is necessary to protect the wetland function and mitigate effects of fragmentation. If deemed necessary, refines area of critical function zone.	2017
Determine the necessity of protecting suitable unoccupied habitat for connectivity and colonisation.	May lead to refinement of critical habitat. Determines whether the current identification of critical habitat is sufficient at each site to ensure long-term survival and ability to colonise new areas.	preliminary results by 2016; further analysis by 2022

7.3 Activities Likely to Result in the Destruction of Critical Habitat

Destruction of critical habitat is determined on a case by case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time (Government of Canada, 2009). When critical habitat is identified in a recovery strategy, examples of activities that are likely to result in its destruction will be provided. Activities likely to result in destruction of critical habitat include, but are not limited to the following:

- Activities that remove or damage host trees. Such activities remove the host trees that are essential for the lichen or may alter the suitability of the tree as a host for the lichen.

Examples include tree blazing, clear cutting, logging, and tree harvesting.

- Activities that result in the loss or removal of trees from adjacent areas (including unoccupied trees). The loss of such trees may indirectly lead to a decrease in bark pH in the remaining softwoods; conditions which reduce the survival of cyanolichens (Richardson and Cameron 2004). Such removal may also decrease humidity and increase wind-speeds (and associated wind-throw damage) within critical habitat.

Examples include clear cutting, logging, tree harvesting, road construction, and cottage development in adjacent areas.

At this time, it is not possible to define the extent of the area adjacent to critical habitat that may result in the destruction of critical habitat. Additional guidance will be developed once the schedule of studies for Vole Ears Lichen is complete.

- Activities that alter the hydrology of the wetland adjacent to or hosting the lichen.

Examples include road construction, infilling, clear cutting, tree harvesting, and cottage development.

Proposed recovery actions and existing legislation may be insufficient to prevent the destruction of Vole Ears Lichen critical habitat via air pollution, including acid rain/fog.

8. MEASURING PROGRESS

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives for Vole Ears Lichen.

This recovery strategy and supporting action plan(s) will be subject to an adaptive management approach, whereby new information will be integrated on an ongoing basis. A five-year evaluation of the recovery strategy will be based upon the performance measures listed below.

Success of the recovery strategy implementation will be measured against the following performance indicators:

- stability of the three known populations of Vole Ears Lichen (as of January 2012) and no loss of adult thalli due to habitat loss, degradation, biological resource use of the species' host tree, or invasive gastropods.
- no loss in the known range of the three populations (as of January 2012) due to habitat loss, degradation, biological resource use of the species' host tree, or invasive gastropods.
- improved stewardship of Vole Ears Lichen sites through increased awareness among landowners, land managers, and those approving development plans. Improved stewardship can be measured through landowner and land-manager stewardship agreements, either formal or informal (i.e. 'hand-shake' agreements).
- reduced knowledge gaps regarding the distribution, dispersal patterns, population dynamics, threats and ecology of the species.

9. STATEMENT ON ACTION PLANS

One or more action plans will be completed within three years of the final version of this recovery strategy being posted on the Species at Risk Public Registry.

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APPENDIX A: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

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

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

This action plan will clearly benefit the environment by promoting the recovery of the Vole Ears Lichen. The potential for the plan to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this plan will clearly benefit the environment and will not entail any significant adverse effects.

The effects on other species were also considered. Vole Ears Lichen is one of a suite of rare cyanolichens, many of which occur in similar habitats within the humid Atlantic forest region of Nova Scotia, New Brunswick, and Newfoundland and Labrador. Because these species share similar habitat requirements, actions directed towards better understanding ecosystem-level associations and securing habitat for Vole Ears Lichen will almost certainly result in the protection of populations of other rare cyanolichens. At a regional level, any progress in reducing air pollution will benefit not only Vole Ears Lichen, but most (if not all) of the flora and fauna of the Atlantic forest region as well.

APPENDIX B: KNOWLEDGE GAPS TO RECOVERY

- Identify life cycle of the species
- Genetic diversity (Newfoundland and Labrador vs. Nova Scotia)
- Dispersal distance: distance and mechanisms
- Track resilience of the lichen
- Identify microclimate requirements and specific effects of pollution and acid deposition
- Determine how invasive species are affecting forest regeneration and identify efficient and acceptable management actions to reduce invasive species
- Identify mortality factors and determine their population effect
- Effects of gastropod herbivory

APPENDIX C: PROVINCIAL DEFINITIONS OF A WETLAND

A wetland, as defined under the *Newfoundland and Labrador Water Resources Act,* is land that has the water table at, near or above the land surface and includes bogs, fens, marshes, swamps and other shallow open water areas.

As defined under the *Environment Act* (Nova Scotia) a wetland is a marsh, swamp, fen or bog that either periodically or permanently has a water table at, near or above the land's surface or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation (*Sphagnum* species and Cinnamon Fern) and biological activities adapted to wet conditions.