PROPOSED

Species at Risk Act
Management Plan Series

Management Plan for the Blue Felt Lichen (*Degelia plumbea*) in Canada

Blue Felt Lichen

2020

Government of Canada
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For copies of the management plan, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk (SAR) Public Registry[1].

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[1] www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996)[2] 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 management plans for listed species of special concern and are required to report on progress within five years after the publication of the final document on the SAR Public Registry.

The Minister of Environment and Climate Change and the Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Blue Felt Lichen and has prepared this management plan, as per section 65 of SARA. To the extent possible, it has been prepared in cooperation with the Governments of New Brunswick, Nova Scotia, and Newfoundland and Labrador, and others as per section 66(1) of SARA.

Success in the conservation 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 plan and will not be achieved by Environment and Climate Change Canada, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this plan for the benefit of the Blue Felt Lichen and Canadian society as a whole.

Implementation of this management plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

[2] www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2

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Executive Summary

Blue Felt Lichen (*Degelia plumbea*[3]) is a large leaflike cyanolichen with longitudinal ridges and crescent-shaped curves. It is usually found on the trunks of old broad-leaved (hardwood) trees but has occasionally been found on moss covered rocks.

Blue Felt Lichen occurs in Canada, the United States, the British Isles, Scandinavia and the Iberian peninsula. It is the only species of this genus known from North America, where it is restricted to the northeastern part of the continent. In Canada, Blue Felt Lichen is known from Nova Scotia, New Brunswick, Newfoundland, and Labrador. In the United States, Blue Felt Lichen is known from only two coastal locations in Maine.

The North American population of Blue Felt Lichen is estimated to be over 2,000 thalli and over 99.9% of the population occurs in Canada. In Nova Scotia, over 900 lichen thalli were enumerated from 172 extant sites between 1999 and 2018. Blue Felt Lichen is most common in the southwestern and western counties of Nova Scotia and in Cumberland County. In New Brunswick, 61 thalli were reported from three sites. Surveys at these sites were not necessarily complete. In Newfoundland and Labrador, more than 295 thalli were counted from 19 natural-habitat sites in nine areas including a collection by Jim Hinds from southwestern insular Newfoundland and Labrador of the only occurrence on boulders near the Crabbe's River in 1977. Since the species was assessed by COSEWIC in November 2010, two new sites (Terra Nova National Park and O'Reagans) were documented.

Blue Felt Lichen requires habitats with high humidity and high rainfall throughout the year with cool summers and moderate winters and needs a clean environment free of air-borne pollutants (especially sulphur dioxide and nitrogen oxides) and acid precipitation. The primary threats to the species are air pollution, logging and wood harvesting, habitat shifting and alteration resulting from climate change, and invasive non-native/alien species.

The management objective for Blue Felt Lichen is to maintain a stable population within the species' known range (determined with data up to 2018) in Canada (as depicted in Figures 1 and 2).

The broad strategies and conservation measures to be taken to support the management objective and address threats to Blue Felt Lichen are presented in the conservation measures section (Section 6.2). It may not be possible to completely avoid or mitigate the effects of air-borne pollutants including acid precipitation on Blue Felt Lichen.

[3] Current taxon name: *Pectenia plumbea* (Lightf.) P.M. Jørg., L. Lindblom, Wedin & Ekman (Ekman et al. 2014).

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1. COSEWIC* Species Assessment Information

Date of Assessment: November 2010

Common Name (population): Blue Felt Lichen

Scientific Name: *Degelia plumbea*[4]

COSEWIC Status: Special Concern

Reason for Designation: Within Canada, this lichen occurs only in the Atlantic region. It is very rare in New Brunswick, uncommon in Newfoundland, but more frequent in Nova Scotia. It grows as an epiphyte, predominately on hardwoods in woodlands and is vulnerable to disturbance that leads to a reduction in habitat humidity. The species is also very sensitive to acid rain. Forest harvesting is a threat to the species through direct removal or through the creation of an edge effect, leading to reduced humidity within the stand. In Newfoundland, the browsing of the lichen's host tree by a high density of moose[5] is also of concern. Air pollution is a threat, especially in New Brunswick, but also in Nova Scotia.

Canadian Occurrence: New Brunswick, Nova Scotia, Newfoundland and Labrador

COSEWIC Status History: Designated Special Concern in November 2010

* COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

2. Species Status Information

Blue Felt Lichen (*Degelia plumbea*) was assessed by COSEWIC as Special Concern in 2010 and listed in Schedule 1 of the *Species at Risk Act* (SARA) in 2017. Approximately 5% of the global range is in North America and over 99.9% of the North American population of Blue Felt Lichen occurs in Canada (Consortium of North American Lichen Herbaria 2019, COSEWIC 2010). The species is listed as Vulnerable in Nova Scotia (Nova Scotia Endangered Species Act - N.S. Reg. 2017) and as Special Concern in New Brunswick and Newfoundland and Labrador (New Brunswick Species at Risk Public Registry 2019, Newfoundland and Labrador. 2015).

[4] Current taxon name: *Pectenia plumbea* (Lightf.) P.M. Jørg., L. Lindblom, Wedin & Ekman (Ekman et al. 2014).
[5] *Alces alces americana*

Table 1. Conservation status ranks for Blue Felt Lichen (NatureServe 2018).

Global (G) Rank[a]	National (N) Rank	Subnational (S) Rank
GNR	Canada N3	New Brunswick (S1), Newfoundland Island (S2S3), Nova Scotia (S3)
	United States NNR	Maine (SNR)

[a]Conservation Status Rank: 1– critically imperiled; 2– imperiled; 3– vulnerable to extirpation or extinction; 4– apparently secure; 5– secure; X – presumed extirpated; H – historical/possibly extirpated; NR – status not ranked; U – unrankable

3. Species Information

3.1. Species Description

Blue Felt Lichen is a large, blue-grey, leaf-like cyanolichen[6] that has longitudinal ridges and crescent-shaped curves which often give it a scallop-like shape. It has a prominent beard-like fungal mat that is usually blue-black and protrudes beyond the margin of the body (thallus). The thallus can grow up to ten centimeters in diameter. It is usually found on the trunks of old broad-leaved (hardwood) trees but has occasionally been found on moss covered rocks.

3.2. Species Population and Distribution

Blue Felt Lichen occurs in Canada, the United States, the British Isles, Scandinavia and the Iberian peninsula. It is the only species of the genus known from North America and is restricted to the northeastern part of the continent (Hinds & Hinds 2007) (Figures 1 and 2).

In the United States, Blue Felt Lichen is currently known from only two coastal sites in Maine. A single thallus was found in 2005 on an ash tree (*Fraxinus species*) (D. Werier, personal communication) and a second location near Cobscook Bay State Park, Maine was on Eastern White Cedar (*Thuja occidentalis*) and discovered in 1981 by Maass. A single thallus was still present at this location in 2010 (Richardson & Seaward, unpublished data). A historical occurrence on Saint-Pierre et Miquelon[7] (France) could not be relocated during surveys in 2011 (R. Cameron, personal communication).

The North American population of Blue Felt Lichen is estimated to be over 2,000 thalli and over 99.9% of the North American population occurs in Canada (COSEWIC 2010). In Canada, Blue Felt Lichen is known from Nova Scotia, New Brunswick, Newfoundland, and Labrador. There is little documented evidence to assess

[6] A cyanolichen is a close association of fungi and cyanobacteria (also known as blue-green algae).
[7] Sainte-Pierre et Miquelon is overseas collectivity of France situated in the northwestern Atlantic Ocean near the Canadian province of Newfoundland and Labrador

fluctuations in this species in Nova Scotia and Newfoundland though the trend in these provinces may be downward as forestry activities occur in areas with Blue Felt Lichen. There is evidence to suggest a decline in New Brunswick (on Grand Manan and Campobello Islands) (COSEWIC 2010).

In Nova Scotia, Blue Felt Lichen is most common in the southwestern and western counties and in Cumberland County. Over 900 lichen thalli were enumerated from 172 extant sites[8] between 1999 and 2018 (ACCDC unpublished data).

In New Brunswick, 61 thalli were reported from three sites: three thalli from Dipper Creek (Maces Bay), 31 thalli from Ten Mile Creek (Bains Corner), and 27 thalli from Grand Manan Island (D Richardson, personal observation). Surveys at these sites were not necessarily complete.

In Newfoundland and Labrador, more than 295 thalli were counted from 19 natural-habitat sites in nine areas (ACCDC unpublished data) and more than 800 thalli were counted at two sites on non-native tree species (Pitcher and Chislett 2006). Since the species was assessed by COSEWIC, two new sites (Terra Nova National Park and O'Reagans) were documented (K. Tulk and C. Hanel, personal observation).

In addition to the disappearance of Blue Felt Lichen from Campobello Island, New Brunswick, a site on Grand Manan Island was lost (although a new site was found nearby) (D. Richardson, personal communication). There are three sites in Nova Scotia where the lichen was lost since more recent surveys began in 1999 (R. Cameron, personal communication), and four no longer extant sites in Newfoundland and Labrador (COSEWIC 2010).

[8] A "site" is defined as a place where the lichen occurs that is more than 1 km from another documented Blue Felt Lichen. "Site" is used interchangeably in this document with the term "occurrence" from the species' status report where an "occurrence" is defined as a site where this lichen occurs that is more than 1 km from a second occurrence.

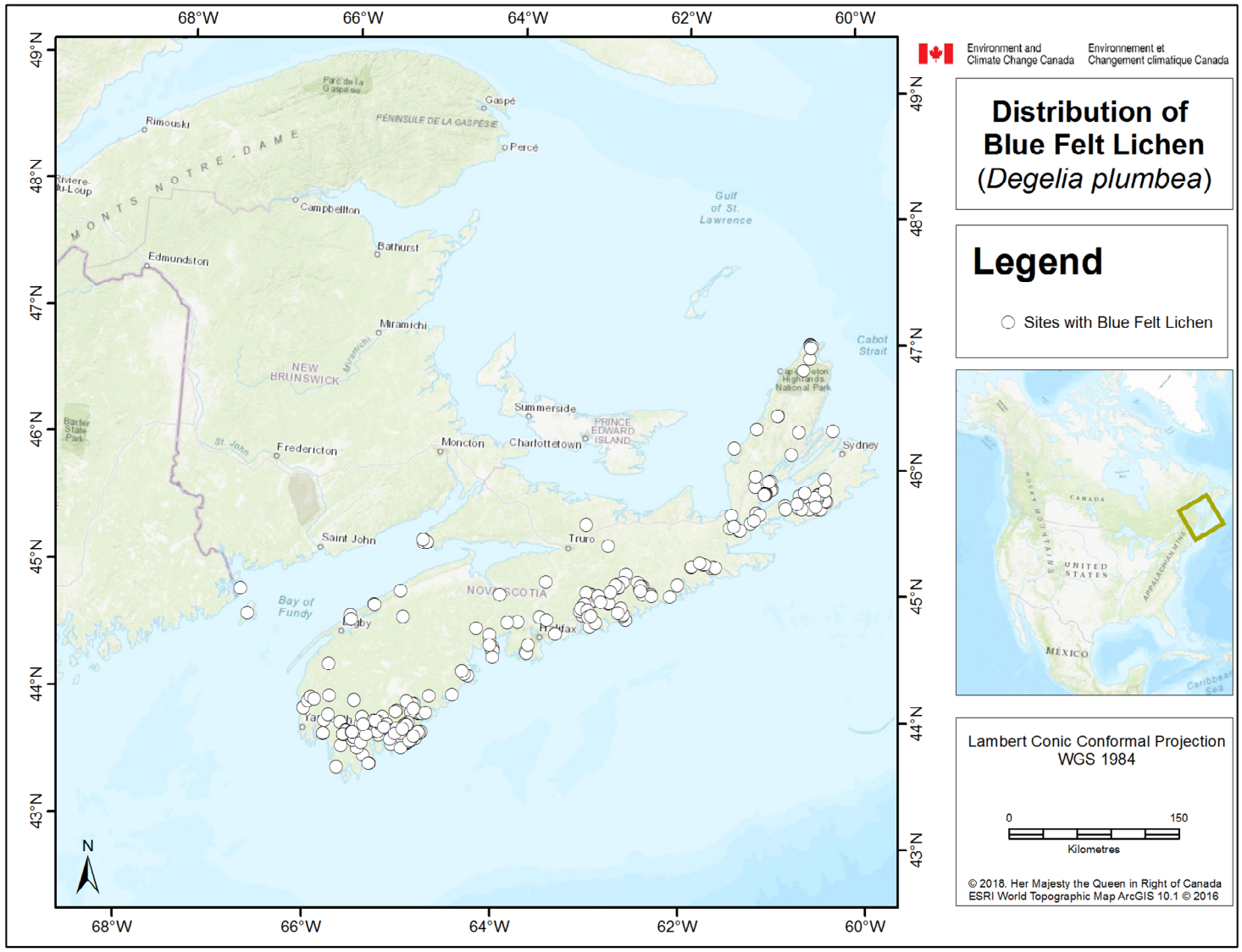

Figure 1. The current distribution of Blue Felt Lichen in New Brunswick and Nova Scotia. Each circle represents a site; note that some sites overlap due to the map's scale.

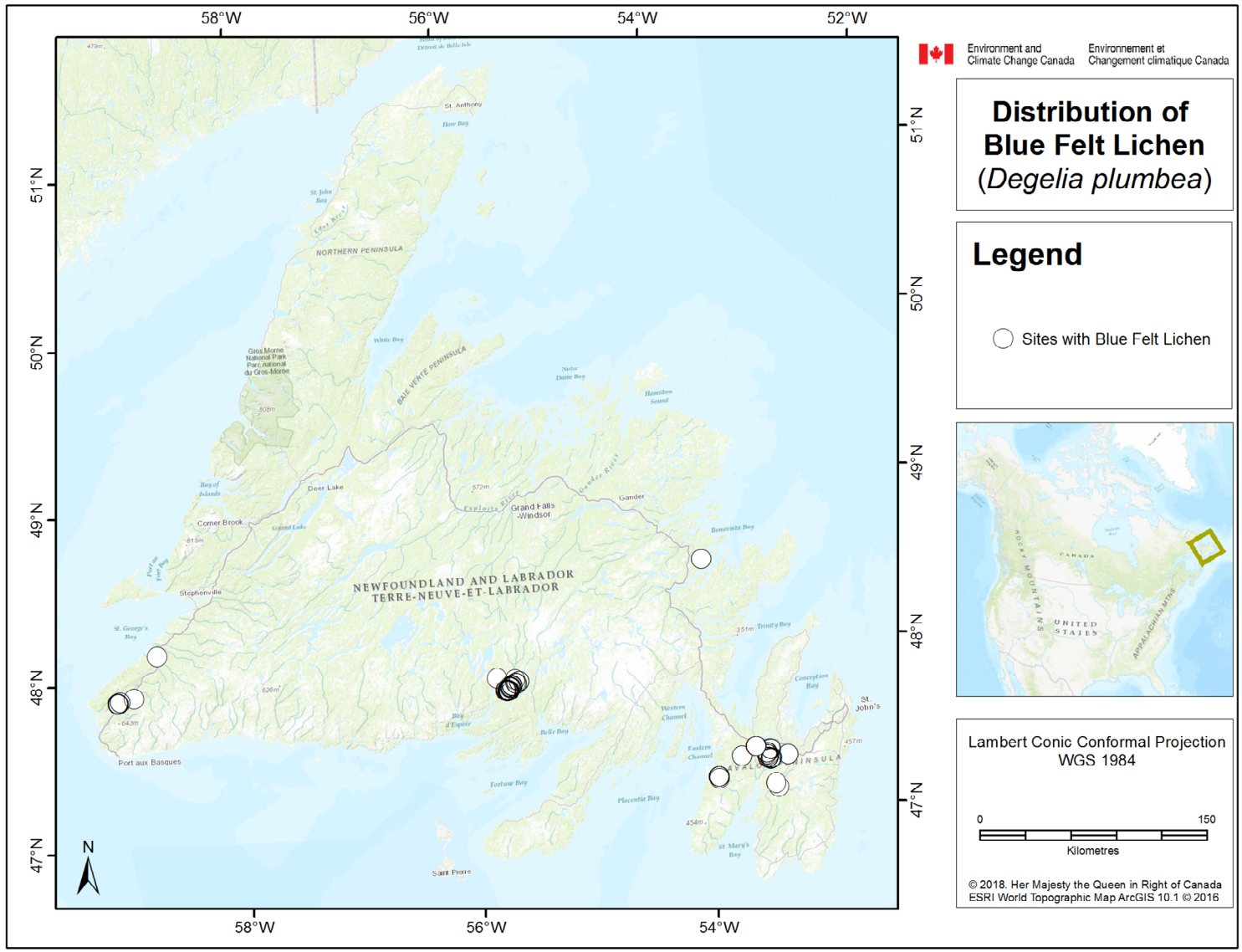

Figure 2. The current distribution of Blue Felt Lichen in Newfoundland and Labrador. Each circle represents a site; note that some sites overlap due to the map's scale.

3.3. Needs of the Blue Felt Lichen

Known Blue Felt Lichen needs include:

- macro- and micro-climates with high humidity and high rainfall throughout the year with cool summers and moderate winters (where topographic features trap moisture: e.g., valleys, gullies, wetlands, streams, vernal pools, seeps, lakes, bays, inlets) (COSEWIC 2010);
    - large amounts of moisture in the form of fog and rain, often in excess of 1200 mm annually (COSEWIC 2009, Davis and Browne 1996);
    - Broad-leaved (hardwood) forests or mixed tree forests providing increased light levels during winter and protective shade during summer;
- mature or over-mature coarse-barked host trees;
- forests containing several successional stages (e.g., wave/gap replacement (Mosseler et al. 2003). This allows the cyanolichen to disperse and colonize new trees when sites become too dense (Hultengren & Norden 1996) or when host trees collapse;
- favourable conditions of bark pH (not too acidified by air pollution or acid rain/precipitation);
- favourable environmental conditions relatively free from air pollution and acid rain (especially sulphur dioxide and nitrogen oxides). Acid precipitation may negatively impact the colonization and survival of Blue Felt Lichen (especially young thalli) in areas that receive significant and continued acid deposition. 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 (see COSEWIC 2010 for the application of the Canadian Deposition Assessment);
- presence of suitable strains of cyanobacteria (on tree trunks) (COSEWIC 2010).

4. Threats

Direct threats to Blue Felt Lichen and its habitat are assessed in Table 2.

The threat assessment for the species is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system.

Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational) (Salafsky et al. 2008). For the purposes of threat assessment, only present and future threats are considered. Historical threats, indirect or cumulative effects of the threats, or any other relevant information that would help understand the nature of the threats are presented in the Description of Threats section.

287
288 ## 4.1. Threat Assessment
289
290 **Table 2**. Threat calculator assessment.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]	Comments
1	Residential and commercial development	Low	Small	Serious	High	
1.1	Housing and urban areas	Low	Small	Serious	High	The Avalon Peninsula, Newfoundland and Labrador is under rapid development for cottages and only limited guidelines for the preservation of forest cover on building lots exist. Coastal development in Nova Scotia and New Brunswick also continues at a significant rate but no data seems to be available on the rate of forest loss in areas with Blue Felt Lichen.
3	Energy production and mining					
3.2	Mining and quarrying	Negligible	Negligible	Extreme	Moderate	Long Harbour Hydromet Nickel Processing facility (Placentia Bay, Newfoundland and Labrador) began operations in 2014. Renewed gold mining activity (deforestation for mine footprint, road development) in Halifax County, Nova Scotia may affect this lichen.
3.3	Renewable energy	Negligible	Negligible	Extreme	Moderate	Wind farm construction (deforestation for footprint. Associated roads assessed under 4.1 roads and railroads), biomass harvesting assessed under 5.3 logging & wood harvesting
4	Transportation and service corridors	Low	Restricted	Moderate	High	
4.1	Roads and railroads	Low	Restricted	Moderate	High	Roads may affect hydrology by concentrating water flow and diverting natural water drainage systems and may impose edge effects (drying, blow downs). This includes the construction and maintenance of roads for mining, logging and wood harvesting, biomass harvesting, wind farm development and access.

5	Biological resource use	High - Medium	Large	Serious – Moderate	High	
5.3	Logging and wood harvesting	High - Medium	Large	Serious – Moderate	High	Logging & wood harvesting may remove potential host trees available for colonization and may remove Blue Felt Lichen. Wood is harvested for biomass energy production. In Nova Scotia, host trees may be increasingly harvested on private lands (due to a shortage of supply and recent adoption of Special Management Practices for at risk lichens on Crown lands). Pre-harvest lichen surveys are not required on private lands in Nova Scotia. In Newfoundland and Labrador, Yellow Birch is targeted for firewood and sawlogs.
8	Invasive and other problematic species and genes	Medium - Low	Pervasive	Moderate – Slight	High	
8.1	Invasive non-native/alien species	Medium - Low	Pervasive	Moderate – Slight	High	Two invasive slug species are widespread in Nova Scotia and have caused grazing damage to lichens. The impact of grazing slugs on Blue Felt Lichen has yet to be studied although observations to date suggest that grazing is less common than on other rare lichens. In Newfoundland and Labrador, regeneration of Yellow Birch is inhibited by browsing moose.
9	Pollution	High - Medium	Large	Serious – Moderate	High	
9.5	Air-borne pollutants	High - Medium	Large	Serious – Moderate	High	Cyanolichens are extremely sensitive to air pollution and acid precipitation. Acid precipitation may overcome the buffering capacity of host tree's bark making it unsuitable for colonization by cyanolichens or for the growth of the cyanobacterium which has to be present for the fungal spores to associate with in each generation to form a new lichen.

11	Climate change and severe weather	High - Low	Large - Small	Serious – Slight	High	
11.1	Habitat shifting and alteration	High - Low	Large - Small	Serious – Slight	High	Milder winters resulting from climate change may increase the survival and activity of invasive slug species. A reduction of fog frequency documented in Nova Scotia may particularly affect this cyanolichen. There is uncertainty about the timing and severity of this threat.
11.4	Storms and flooding	Low	Small	Extreme	High	Extreme wind events may increase the incidence of blow downs and result in the loss of host trees and result in microclimate changes (increase drying effects).

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or 3-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

4.2. Description of Threats

Threats with low to high impact are listed as above in the threat calculator assessment table (Table 2) and are described in more detail below.

1.1 Housing and urban areas and 4.1 Roads and railroads

The development of land for residences creates disturbance, landscape alterations, and affects micro-climates of nearby forests. Road building can affect the micro-climate of nearby forests by concentrating water flow and diverting natural water drainage systems (Cameron 2006). This can change the moisture regimes in nearby moist deciduous or mixed woodlands where Blue Felt Lichen is typically found. New roads also provide access to remote areas that may foster the expansion of cottage country (Maass and Yetman 2002).

The Newfoundland and Labrador Department of Natural Resources estimates a conversion rate of forest to other uses (cottages, agriculture, residential housing, roadways, and other) to be c. 12 km^2 per five years on the Avalon Peninsula (Anon. 2006). Developments in New Brunswick and in Nova Scotia also pose a threat to this lichen especially in areas near the coast where Blue Felt Lichen is common.

5.3 Logging and wood harvesting

Blue Felt Lichen and its habitat could be threatened by tree harvesting. Forestry practices such as clear cutting or harvesting on a large scale may cause fragmentation and would temporally alter biodiversity and age class structure of potential Blue Felt Lichen habitat. Forestry activities within a few hundred metres may enhance drying effects to which Blue Felt Lichen is sensitive (Gauslaa & Saulhaug 1998, Hunter 1990). In the last 10 years, clear cutting in wet maple swale areas where this lichen is most common has occurred infrequently because the focus has been in drier areas with coniferous species. In some areas in Newfoundland and Labrador where the Balsam Fir (*Abies balsamea*) has been harvested, Yellow Birch (the main native host for Blue Felt Lichen in Newfoundland and Labrador) have been left as seed trees. However, mature trees of this species tend not to adapt well to an open environment (caused by natural disturbance and/or harvesting) and die or are blown down (C. Hanel, personal communication). In addition, regeneration of Yellow Birch is inhibited by browsing moose (see Invasive non-native/alien species below).

In Nova Scotia, the Port Hawkesbury biomass plant uses “low grade” hardwood that has no other commercial use (generally crooked, knotty, or diseased) as a source of energy (Emera 2017). Hardwoods are sought for their higher calorific value and may include maple and Yellow Birch that are hosts for Blue Felt Lichen. This may result in greater removal of trees from maple swales which could dramatically threaten Blue Felt Lichen populations.

8.1 Invasive non-native/alien species

In Newfoundland and Labrador, a progressive loss of old Yellow Birch is occurring as a result of old age, harvesting, and blow-down. In addition, there has been a lack of replacement by younger trees due to browsing by the high population of introduced moose (McLaren et al. 2004). Mature Yellow Birch is required in Newfoundland and Labrador for Blue Felt Lichen as a host tree so widespread browsing of young trees by moose that prevent survival of Yellow Birch to maturity is a serious cause for concern (M. Pitcher, personal communication).

Two slugs, *Arion subfuscus* and *Deroceras reticulatum*, that are larger and more aggressive than native species were introduced from Europe. They have been found feeding on several rare cyanolichens including the Boreal Felt Lichen (*Erioderma pedicellatum*) in Nova Scotia (Cameron 2009). 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). Climate change has resulted in increased lichen grazing by molluscs and has contributed to the reported extirpation of Yellow Specklebelly Lichen (*Pseudocyphellaria crocata*) from southwest Norway (Gauslaa 2008). The vegetative propagules (soredia) of this lichen in Nova Scotia may be one source of compatible Nostoc strains for the Blue Felt Lichen. The impact of grazing gastropods on Blue Felt Lichen populations in Canada has yet to be studied although the few observations to date suggest that grazing is less common on Blue Felt Lichen than on Boreal Felt Lichen (F. Anderson, personal communication).

9.5 Air-borne pollutants

Cyanolichens are extremely sensitive to air pollution and acid precipitation (Cameron & Richardson 2006, Henderson 2000) due to their reliance on airborne nutrients and water, as well as lack of protective structures (Richardson & Cameron 2004). Indirectly, cyanolichens may be impacted by pollution's effect on the pH of tree bark (Batty et al. 2003). A long history of exposure to air pollution and acid precipitation results in tree bark too acid for cyanolichens, especially for very young thalli, to colonize and/or thrive (Nieboer et al.1984, Batty et al. 2003).

Blue Felt Lichen may benefit from pollution prevention campaigns and industrial technologies that reduce emissions. However, despite such initiatives, many areas in New Brunswick and Nova Scotia and, to a lesser extent, Newfoundland and Labrador, are presently exposed to concentrations of acidifying pollutants in excess of what the habitat can tolerate without being significantly harmed. (COSEWIC 2010, Environment and Climate Change Canada 2016). Current or projected developments on the Avalon Peninsula of Newfoundland and Labrador that release sulphur and nitrogen oxides may pose a threat to nearby populations of Blue Felt Lichen.

11.1 Habitat shifting & alteration and 11.4 Storms & flooding

Lichens, including Blue Felt Lichen, may be particularly sensitive to climate change. Region-wide birch dieback in Eastern Canada and in the adjacent parts of the United States has been attributed to extreme climactic fluctuations (Auclair 1987, Auclair et al. 1992 and Braathe 1995). This may limit the available habitat for Blue Felt Lichen.

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, Clayden 2010). Blue Felt Lichen, like several other cyanolichens occurring mainly in coastal fog forests, is a drought-sensitive species and could be negatively impacted if declines in fog continue (Gauslaa & Solhaug 1998).

Based on field observations of the similar Boreal Felt Lichen, Blue Felt Lichen may be vulnerable to desiccation caused by extreme weather events such as droughts and storms (as storms may result in the loss of sheltering trees) (Maass and Yetman 2002). A severe storm in Guysborough County, Nova Scotia, created a windfall that destroyed one of the Boreal Felt Lichen populations discovered in the 1980s (Maass and Yetman 2002). Similarly, an extreme windstorm in Bond Park, Newfoundland and Labrador, resulted in the loss of five Blue Felt Lichen host trees in 2010 (C. Hanel, personal observation).

5. Management Objective

The management objective for Blue Felt Lichen is to maintain a stable population within the species' known range (determined with data up to 2018) in Canada (as depicted in Figures 1 and 2).

Blue Felt Lichen was assessed as Special Concern on the basis of its vulnerability to human-caused threats. COSEWIC (2010) also considered the species' small amount of occupied habitat (index of area of occupancy < 500 km²) and a continuing decline in the species' range (extent of occurrence), amount of occupied habitat, the quality of that habitat, and a decline in the number of mature individuals. As such, the management objective to maintain a stable population (preventing further losses in number and sizes of population, and range) is considered appropriate.

It may not be possible to completely avoid or mitigate the effects of air-borne pollutants including acid precipitation on Blue Felt Lichen. The proposed conservation measures identified below are set out to support the management objective, to the extent possible.

6. Broad Strategies and Conservation Measures

The management objective for the Blue Felt Lichen will be supported by the conservation measures detailed in Table 3.

6.1. Actions Already Completed or Currently Underway

Conservation measures targeting Blue Felt Lichen and/or its habitat are currently underway or completed in New Brunswick, Nova Scotia, and Newfoundland and Labrador.

Non-targeted surveys in New Brunswick (Eastern White Cedar forests), Newfoundland and Labrador, and Nova Scotia have resulted in new/additional discoveries of Blue Felt Lichen, and have thus improved our understanding of the range of the species.

A number of Blue Felt Lichen in Nova Scotia are currently in areas managed for conservation (e.g., provincial parks, designated Wilderness Areas, conservation land owned by the Nature Conservancy of Canada, Department of National Defense property, and Kejimkujik National Park Seaside). Nova Scotia released a set of Special Management Practices for “At-Risk Lichens” (SMPs) in May 2018 (Nova Scotia Natural Resources 2018) and Blue Felt Lichen is included. These SMPs only apply to provincial Crown land. The lichen is provided a 100m radius around its host tree to be managed for minimal disturbance (e.g., no active clearing, removal or disturbance of trees, soil or wetlands).

In Newfoundland and Labrador, the species occurs within a municipal park (Sir Robert Bond Park in Whitbourne) established for conservation. The species also occurs in Terra Nova National Park where best management practices were developed and implemented to provide additional protection measures for rare lichens (e.g., surveys are conducted in high visitor use areas and prior to new activities, infrastructure maintenance or development). The site at St. Catherines, Salmonier River, is privately owned and the owner is aware of the importance of conserving this population of Blue Felt Lichen. In the Bay D'Espoir area, two sites are located in Jipujijkuei Kuespem Provincial Park, and thereby afforded some measure of provincial protection from threats. The four sites in the Miawpukek First Nation forest management area, Conne River, are not conserved by any known/specific protection measures, however, harvest practices are modified in areas where Blue Felt Lichen are located.

There are recovery documents for cyanolichens in Atlantic Canada and some of the accomplished or proposed measures with respect to these lichens (e.g. gathering data on airborne pollutants in Nova Scotia and Newfoundland and Labrador) are pertinent to the management of Blue Felt Lichen (e.g., Environment and Climate Change Canada 2018a, Environment and Climate Change Canada 2018b, Environment Canada 2011, Environment Canada 2010).

6.2. Conservation Measures

Table 3. Conservation Measures and Implementation Schedule

Conservation Measure	Priority[a]	Threats or Concerns Addressed	Timeline
Awareness raising: outreach and communications			
Raise awareness of Blue Felt Lichen (e.g., species needs, sites, direct threats) with relevant government agencies, land owners and managers, forestry and mining industry, recreational users	High	all	2022
Conservation and planning: conservation planning			
Plan for conserving and managing Blue Felt Lichen at occupied sites (e.g., develop a monitoring plan and protocols, include Blue Felt Lichen in pre-harvest plans and forest planning exercises)	High	all	2023
Livelihood, Economic & Moral Incentives: Better products and management practices			
Change behaviours by developing and promoting better management practices for cyanolichens and provide training and/or technical assistance to land managers so practices are adopted.	Medium	roads and railroads, logging and wood harvesting, mining and quarrying	2025
Conservation Designation & Planning: Protected Area Designation &/or Acquisition and Easements & Resource Rights			
Establish or demarcate Government protected areas, private conservation areas or other types of conserve areas for the species and its habitat.	Medium	roads and railroads, logging and wood harvesting, mining and quarrying, climate change and severe weather	2024
Promote conservation easements			2024
Research & Monitoring: Basic Research & Status Monitoring			
Conduct Research on Blue Felt Lichen (to address knowledge gaps and develop a species-specific suitable habitat model; e.g., species' distribution, host substratum attributes, investigate impacts of herbivory in Newfoundland and Labrador on host tree regeneration, investigate impacts of gastropods, investigate microhabitat needs and impacts of harvest regimes on species survival, and determine how to detect individuals high in the canopy in Newfoundland and Labrador)	High	knowledge gaps	2025

Conservation Measure	Priority[a]	Threats or Concerns Addressed	Timeline
Research & Monitoring: Evaluation, Effectiveness Measures and Learning			
Collect information about conservation work (e.g., collate data collected by lichen experts, store data with Atlantic Canada Conservation Data Centre)	Medium	knowledge gaps	ongoing
Legal & Policy Frameworks: Laws, Regulations & Codes and Policies & Guidelines			
Create, amend, or influence laws, regulations, and codes regarding the release of air-borne pollutants (especially sulphur dioxide and nitrogen oxides) such that environmental levels do not exceed what cyanolichens can tolerate	Medium	air-borne pollutants, climate change and severe weather	ongoing
Assess and amend, if necessary, existing Special Management Practices for cyanolichens in Nova Scotia if standards are determined insufficient to ensure survival of Blue Felt Lichen	Low	roads and railroads, logging and wood harvesting, and mining and quarrying	2024

[a] "Priority" reflects the degree to which the measure contributes directly to the conservation of the species or is an essential precursor to a measure that contributes to the conservation of the species. High priority measures are considered those most likely to have an immediate and/or direct influence on attaining the management objective for the species. Medium priority measures may have a less immediate or less direct influence on reaching the management objective, but are still important for the management of the population. Low priority conservation measures will likely have an indirect or gradual influence on reaching the management objective, but are considered important contributions to the knowledge base and/or public involvement and acceptance of the species.

6.3. Narrative to Support Conservation Measures and Implementation Schedule

Awareness Raising: Outreach & Communications

Efforts to communicate with landowners, resource users, developers, land managers, and other stakeholders to promote stewardship and private land conservation are an important part of conserving habitat. Inform landowners and land users of sites where the Blue Felt Lichen occurs, and in areas nearby, of the presence and significance of this and other associated rare lichens.

Conservation Designation & Planning: Conservation Planning

A monitoring plan and protocol, especially for known sites in New Brunswick and Newfoundland and Labrador where the Blue Felt Lichen is uncommon or rare and where there has been evidence of a decline, must be developed and put in place. The final monitoring plan should also consider the collection of ecological indices at extant locations.

Better products and management practices

Beneficial management practices (BMPs) to help landowners and land managers act as stewards of the environment should be developed for cyanolichens in Atlantic Canada. The Cyanolichen Recovery Team in Nova Scotia developed a series of recommendations specifically for Boreal Felt Lichen (Atlantic population) that influenced the provincial At-Risk Lichen Special Management Practices (SMPs).

Conservation Designation & Planning: Protected Area Designation &/or Acquisition and Easements and Resource Rights

Government protected areas, as well as private lands conserved through private land conservation mechanisms, have a role to play in the conservation of lichens and should be pursued where feasible. The experience and knowledge of stakeholders will be important in making management decisions on private and public lands.

Research & Monitoring: Basic research & Status Monitoring

A significant knowledge gap in directing management actions for the Blue Felt Lichen and in assessing the conservation status of the species is the extent to which the population is stable or declining.

Permanent monitoring plots could be set up where Blue Felt Lichen is most common in Nova Scotia and Newfoundland and Labrador to monitor trees for the persistence of mature thalli and the establishment of juveniles. Microclimate measurements (e.g., humidity, forest composition, forest age structure, and indicator species) could be undertaken before and after buffer establishment to assess the impact of edge effects and nearby forestry activity.

As part of inventories and monitoring known locations, data should be collected to document presence and impact of moose herbivory on Yellow Birch in Newfoundland

and Labrador and the frequency of gastropod herbivory on the Blue Felt Lichen throughout its range to assess its impact on populations of this lichen.

Research & Monitoring: Evaluation, Effectiveness Measures and Learning

Data should be collated, stored, and made available for landscape and resource planning purposes, and updated as new information becomes available. Finally, previously un-surveyed potential habitat within the species range should be prioritised for inventory as past surveys were general in nature (not specifically targeting Blue Felt Lichen) and potential habitat in Newfoundland is believed to be under-surveyed (Hanel, personal communication *in* COSEWIC 2010).

Legal & Policy Frameworks: Laws, Regulations & Codes

In Nova Scotia, SMPs were developed for cyanolichens and apply to provincial Crown lands. These SMPs require expert-conducted pre-cut surveys for all areas with a high potential for the lichen.

Blue Felt Lichen would benefit from reductions in air pollutants such as acid rain, 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.

7. Measuring Progress

The performance indicators presented below provide a way to measure progress towards achieving the management objectives and monitoring the implementation of the management plan.

- No observed, estimated, inferred, or suspected reduction in the total number of mature individuals of Blue Felt Lichen in Canada from 2018 levels.
- No significant observed or inferred decline in the species' range (extent of occurrence).

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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*[9]. 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 and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[10] (FSDS) goals and targets.

Conservation planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that implementation of management plans 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 management plan itself, but are also summarized below in this statement.

The implementation of this management plan will clearly benefit the environment by promoting the conservation of Blue Felt Lichen which may also benefit co-occurring species. Federally listed co-occurring species may include Canada Warbler (*Cardellina canadensis*) (Threatened), Oliver-sided Flycatcher (*Contopus cooperi*) (Threatened), Rusty Blackbird (*Euphagus carolinus*) (Special Concern), Boreal Felt Lichen, Atlantic population (Endangered), Vole Ears Lichen (*Erioderma mollissimum*) (Endangered), Boreal Felt Lichen, Boreal population (Special Concern), and Frosted Glass-whiskers, Atlantic population (*Phrynosoma hernandesi*) (Special Concern). 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 known significant adverse effects. Blue Felt 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 Blue Felt Lichen will almost certainly support the conservation of populations of other rare cyanolichens. At a regional level, any progress in reducing air pollution will benefit not only Blue Felt Lichen, but most (if not all) of the flora and fauna of the Atlantic forest region as well.

[9] www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html
[10] www.fsds-sfdd.ca/index.html#/en/goals/

Appendix B: Knowledge Gaps to Recovery

- Identify life cycle of the species and critical life stages
- Investigate genetic diversity
- Determine dispersal distance: distance and mechanisms
- Identify microclimate requirements and specific effects of pollution and acid deposition
- Identify microclimate requirements and effects of adjacent tree harvesting
- Identify mortality factors and determine their population effect
- Track resilience of the lichen in face of threats
- Determine effects of gastropod herbivory