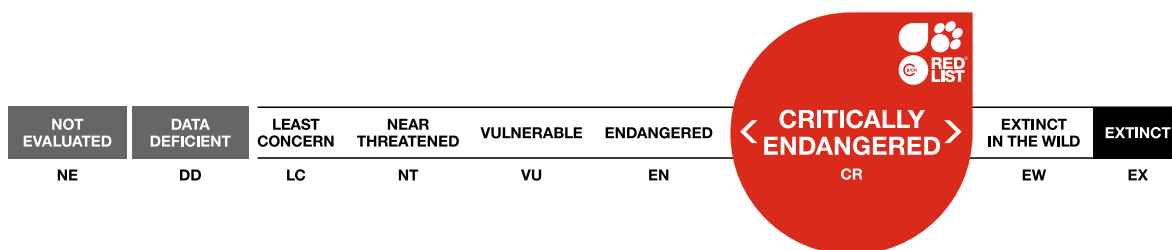


Bryoria salazinica, Smooth Horsehair Lichen

Assessment by: Paquette, H., Lendemer, J. & Yahr, R.



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Taxonomy

Kingdom	Phylum	Class	Order	Family
Fungi	Ascomycota	Lecanoromycetes	Lecanorales	Parmeliaceae

Scientific Name: *Bryoria salazinica* Brodo & D. Hawksw.

Common Name(s):

- English: Smooth Horsehair Lichen

Taxonomic Source(s):

Index Fungorum Partnership. 2021. Index Fungorum. Available at: <http://www.indexfungorum.org>.

Assessment Information

Red List Category & Criteria: Critically Endangered C2a(i); D [ver 3.1](#)

Year Published: 2021

Date Assessed: January 27, 2021

Justification:

Bryoria salazinica is endemic to north-eastern North America. In total, there is a maximum of 17-29 mature individuals, known from seven locations. There is a continuing population decline, with past declines inferred to have been caused by habitat loss and air pollution. The population is thought to be continuing to decline due to impacts from logging, climate change, and development. Therefore, this species is Critically Endangered; C2a(i); D.

Geographic Range

Range Description:

Bryoria salazinica is endemic to eastern North America. It is known from the Canadian provinces of New Brunswick, Newfoundland and Labrador, Nova Scotia, Prince Edward Island and Quebec (Brodo and Hawksworth 1977, Laflamme-Levesque *et al.* 1979, Gowan and Brodo 1988, Paquette and McMullin 2020). It was historically known in the United States (US) from Maine and Massachusetts (Brodo and Hawksworth 1977). Modern occurrences (post-1960) are exclusive to maritime Canada. Despite extensive study of macrolichens in north-eastern US, this lichen has not been found in the region since 1909, where it was known from only three records. The lack of new records from this highly studied region suggests that it has been extirpated from this part of its range.

Country Occurrence:

Native, Extant (resident): Canada (New Brunswick, Newfoundland I, Nova Scotia, Prince Edward I., Québec)

Native, Possibly Extinct: United States (Maine, Massachusetts)

Population

The extant global population appears to be locally rare and restricted to north-eastern North America, specifically hyper-coastal environments. A total of only 17 occurrences are known, and all contemporary records for this species are in Canada (12 occurrences from seven localities, only one reported in the last 40 years), with an estimated maximum number of 17-29 extant mature individuals. Although it has historically been reported from the US, these sites are presumed extirpated, and no new occurrences have been reported from the US since 1909, despite extensive study and collection activity in north-eastern, and specifically coastal US (e.g. Hinds and Hinds 2007, Seaward *et al.* 2017). Sites in the US were likely extirpated after 1930 due to increased development and industrialization at that time. For example, the record from Massachusetts (1878) is presumed extirpated due to development of the city of Springfield throughout the early 1900's.

This species has been found only once in the last decade (in the province of Quebec; Paquette and McMullin 2020), despite large-scale activity throughout the Canadian Maritimes by expert lichenologists (e.g. Selva 1999, Anderson 2014, McMullin *et al.* 2012, 2017b, McCarthy *et al.* 2015, McMullin and Wiersma 2017, McMullin and Arsenault 2019, Tumur and Richardson 2019); and the US (as noted). The exact number of mature individuals at each site is unknown; however, given overall rarity and that it is represented by a single voucher from all but one site (the three collections from Prince Edward Island National Park in Prince Edward Island, Canada are represented by a single occurrence point), we estimate that the modern sites host five or fewer functional individuals. We infer a population reduction, given the likelihood of the US subpopulations being extirpated within the last 90 years and the continued infrequent detection of this species in Canada.

Current Population Trend: Decreasing

Habitat and Ecology (see Appendix for additional information)

This species is an epiphyte on coniferous trees (primarily balsam fir) (Brodo and Hawksworth 1977, Hinds and Hinds 2007). It is restricted to exposed coastal environments away from urban development. Exceptionally, it has been reported from *Acer rubrum* and not immediately coastal, but in proximity to maritime influences from the Bay of Fundy in New Brunswick, Canada (Gowan and Brodo 1988). It is a greenish-brown pendant fruticose lichen with a smooth cortex, lacks isidia or soredia, and its branches are characteristically curled and twisted (Brodo and Hawksworth 1977, Paquette and McMullin 2020). Chemically, it is distinguished from other *Bryoria* species by the presence of salazinic acid in its cortex (Brodo and Hawksworth 1977).

Systems: Terrestrial

Use and Trade

Presently, no economic use or trade is known for this species; however, collection due to its rarity does pose a threat. Pressures from collection should be mitigated in research conducted on this lichen.

Threats (see Appendix for additional information)

In addition to loss of habitat due to development and/or logging, climate change related impacts, such as changes to humidity regimes (including rain, dew and fog), increasing severity of storms and sea-level rise are the most severe threats to this species. Although *Bryoria salazinica* has not been studied in detail, studies of other *Bryoria* species have identified climate-related threats. For example, Gauslaa (2014) outlined the importance of humidity, dew and rainfall as drivers of distribution in hair lichens, including *Bryoria* species. Additionally, a Swedish study by Esseen *et al.* (2016) showed *Bryoria* occurrence to decrease with warming temperature (warming temperatures have already been observed in Canada and are predicted to continue; ECCC 2019) and predicted large distribution shifts as a result of climate change, nitrogen deposition and forest structure in the hair lichens they studied. Phinney *et al.* (2021) found additional support for climate change driven distributional shifts in hair lichens (including *Bryoria*) and showed that *Bryoria* species are likely to decrease as a result of warmer, wetter winters and thicker forest canopies, which aligns with predictions for the Canadian Maritimes (ECCC 2017). On the west coast of North America, Glavich *et al.* (2005) also found evidence of temperature negatively effecting occurrence of two rare *Bryoria* species with hyper-coastal distributions. In addition to these atmospheric climate change threats, the physical threat of diminishing habitat from sea-level rise and severe storms destroying host trees is expected as extreme weather events are predicted to increase under most scenarios, corresponding with increased warming (ECCC 2017). Declining air quality is an additional suspected threat; however, more research is needed to understand the extent of this threat. Pollution responses in lichens are complex (e.g. Ellis *et al.* 2014, 2015), due to the varying compounds and their effects as directly toxic or as modifiers of their environments, but several *Bryoria* species are known to be sensitive to nitrogen (as NHx) deposition and present only where air quality is high and fertility (i.e., nutrient deposition) is low (e.g. Geiser and Neitlich 2007). The balance of nitrogen deposition has strongly shifted towards NHx over the past decades, a trend that has overwhelmingly grown across the area of distribution of this species (Zhang *et al.* 2018), suggesting a potential risk. Finally, no economic use or trade is presently known for this species; however, collection due to its rarity does pose a threat.

Conservation Actions (see Appendix for additional information)

Four of the Canadian locations of *Bryoria salazinica* (one each in New Brunswick, Newfoundland & Labrador, Quebec, and Prince Edward Island) are found in National Parks which are legally protected through the National Parks Act in Canada. This species is not otherwise legally protected in Canada or the US. Protection of the known sites and habitats is recommended for the preservation of this rare species. Education for local land managers and owners should be provided to raise awareness of its status and sensitive habitat needs.

The Canadian occurrences reported prior to 2017 should be examined to verify that they are extant as is presumed here. Analyses of habitat availability in north-eastern North America that a) identify the amount of available habitat and b) predict potential shift and/or loss of its habitat under different climate change scenarios would be valuable contributions for managing this species. Additionally, the impact of air quality on *B. salazinica* should be studied to clarify the extent of this threat.

Credits

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External Resources

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Appendix

Habitats

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Habitat	Season	Suitability	Major Importance?
1. Forest -> 1.1. Forest - Boreal	Resident	Suitable	Yes

Plant Growth Forms

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Plant Growth Form
LC. Lichen

Use and Trade

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

End Use	Local	National	International
Sport hunting/specimen collecting	No	Yes	Yes

Threats

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Threat	Timing	Scope	Severity	Impact Score
1. Residential & commercial development -> 1.1. Housing & urban areas	Ongoing	Minority (50%)	Slow, significant declines	Low impact: 5
1. Residential & commercial development -> 1.2. Commercial & industrial areas	Ongoing	Minority (50%)	Slow, significant declines	Low impact: 5
5. Biological resource use -> 5.2. Gathering terrestrial plants -> 5.2.1. Intentional use (species is the target)	Ongoing	Unknown	Unknown	Unknown
5. Biological resource use -> 5.3. Logging & wood harvesting -> 5.3.4. Unintentional effects: (large scale) [harvest]	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
9. Pollution -> 9.5. Air-borne pollutants -> 9.5.4. Type Unknown/Unrecorded	Ongoing	Whole (>90%)	Unknown	Unknown
11. Climate change & severe weather -> 11.1. Habitat shifting & alteration	Ongoing	Whole (>90%)	Unknown	Unknown
11. Climate change & severe weather -> 11.4. Storms & flooding	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6

Conservation Actions in Place

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Conservation Action in Place
In-place research and monitoring
Action Recovery Plan: No
Systematic monitoring scheme: No
In-place land/water protection
Conservation sites identified: Yes, over entire range
Percentage of population protected by PAs: 71-80
Area based regional management plan: No
Occurs in at least one protected area: Yes

Conservation Actions Needed

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Conservation Action Needed
1. Land/water protection -> 1.1. Site/area protection
1. Land/water protection -> 1.2. Resource & habitat protection
4. Education & awareness -> 4.3. Awareness & communications

Research Needed

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Research Needed
1. Research -> 1.2. Population size, distribution & trends
1. Research -> 1.5. Threats

Additional Data Fields

Distribution
Estimated area of occupancy (AOO) (km ²): 28-56
Continuing decline in area of occupancy (AOO): Yes
Extreme fluctuations in area of occupancy (AOO): No
Estimated extent of occurrence (EOO) (km ²): 153403
Continuing decline in extent of occurrence (EOO): Yes

Distribution
Extreme fluctuations in extent of occurrence (EOO): No
Number of Locations: 7
Continuing decline in number of locations: Yes
Extreme fluctuations in the number of locations: No
Population
Number of mature individuals: 17-29
Continuing decline of mature individuals: Yes
Extreme fluctuations: No
Population severely fragmented: No
No. of subpopulations: 7
Continuing decline in subpopulations: Yes
Extreme fluctuations in subpopulations: No
All individuals in one subpopulation: No
No. of individuals in largest subpopulation: 5
Habitats and Ecology
Continuing decline in area, extent and/or quality of habitat: Yes
Generation Length (years): 30

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