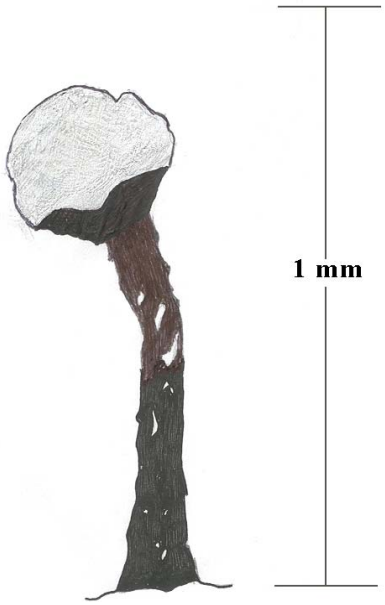
COSEWIC
Assessment and Status Report

on the

Frosted Glass-whiskers
Sclerophora peronella

in Canada

Nova Scotia population
British Columbia population



NOVA SCOTIA POPULATION - SPECIAL CONCERN
BRITISH COLUMBIA POPULATION - DATA DEFICIENT
2005

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

COSEWIC 2005. COSEWIC assessment and status report on the frosted glass-whiskers *Sclerophora peronella* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 28 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Production note:
COSEWIC would like to acknowledge Steven B. Selva for writing the status report on the frosted glass-whiskers *Sclerophora peronella* prepared under contract with Environment Canada, overseen and edited by René Belland, Co-chair (Mosses and Lichens), COSEWIC Plants and Lichens Subcommittee.

For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment Canada
Ottawa, ON
K1A 0H3

Tel.: (819) 997-4991 / (819) 953-3215
Fax: (819) 994-3684
E-mail: COSEWIC/COSEPAC@ec.gc.ca
http://www.cosewic.gc.ca

Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur le sclérophore givré (*Sclerophora peronella*) au Canada.

Cover illustration:
Frosted glass-whiskers — Illustration by Lisa Weiss.

Catalogue No. CW69-14/449-2005E-PDF
ISBN 0-662-40662-1
HTML: CW69-14/449-2005E-HTML
0-662-40663-X


Recycled paper

COSEWIC
Assessment Summary

Assessment Summary – May 2005

Common name
Frosted glass-whiskers (Nova Scotia population)

Scientific name
Sclerophora peronella

Status
Special Concern

Reason for designation
This tiny cryptic stubble lichen is very rare or threatened over much of its global range. Two of the three known locations of this species in Canada are in Nova Scotia. Despite considerable efforts to locate this and other rare calicioid lichens in the province, this lichen is known only from the exposed heartwood of red maple trees in mature/old growth hardwood forest. Threats include potential habitat loss and degradation associated with the decline of old growth forest ecosystems. However, in Nova Scotia each of the two populations appear healthy and are situated within large protected areas on Cape Breton Island.

Occurrence
Nova Scotia

Status history
Designated Special Concern in May 2005. Assessment based on a new status report.

Assessment Summary – May 2005

Common name
Frosted glass-whiskers (British Columbia population)

Scientific name
Sclerophora peronella

Status
Data Deficient

Reason for designation
This tiny cryptic stubble lichen is very rare or threatened over much of its global range. The species is known from only one site in the north-central part of the province where it was found once on a large cottonwood. Although search effort for stubble lichens has been extensive in regions farther south within the province, search effort in the northern region where the species was found was inadequate.

Occurrence
British Columbia

Status history
Species considered in May 2005 and placed in the Data Deficient category. Assessment based on a new status report.

COSEWIC
Executive Summary

Frosted Glass-whiskers
Sclerophora peronella

Nova Scotia population
British Columbia population

Species information

Frosted glass-whiskers (*Sclerophora peronella*) belongs to a group of lichenized fungi known, colloquially, as calicioid or “stubble” lichens because of their tiny stalked spore-bearing structures. The species has been found on the bark and wood of old trees and can be recognized by the pale colour of its spore-bearing apothecia that are raised on stalks 0.5 to 0.8 mm above the substrate. The main body (thallus) of the lichen is imbedded in the substrate.

Distribution

Sclerophora peronella is known from only three locations in Canada and is rare to extremely rare throughout its range. The current known global distribution includes Europe (Scotland, Germany, Moravia, Denmark, Sweden, Finland, Norway, France, Austria, Italy, and Estonia), where it had previously been considered endemic, the Caucases in Russia, western Oregon in the United States, and from British Columbia and Nova Scotia in Canada.

Habitat

Sclerophora peronella occurs on hardwoods, usually on exposed heartwood of living trunks, and more rarely on bark. It is often associated with mature and old-growth coniferous and deciduous forests, but also occurs in savannas and parklands. In Canada, the specimen from British Columbia was collected on bark at the base of a large black cottonwood in a rich, shady cottonwood stand. Both of the collections from Nova Scotia were on exposed heartwood of living red maple trees growing in old-growth northern hardwood stands.

Biology

Found exclusively on the wood and bark of older trees, *S. peronella* seems to prefer stable humidity and small temperature fluctuations in microhabitats of

intermediate light. Despite their small size, *S. peronella* thalli in Canada appear to be healthy, with apothecia containing mature spores. These spores are distributed by wind, rain, and probably by invertebrates.

Population sizes and trends

The entire known physical area of coverage for *S. peronella* in the three known Canadian locations is probably no more than one square metre. It is not possible to determine whether these populations are increasing, remaining stable, or are declining in size.

Limiting factors and threats

The available data suggests that *S. peronella* prefers the environmental stability associated with old-growth forests. Unfortunately, such habitat has been in decline across Canada and throughout most of the world. Habitat destruction from logging of old forests is a threat in parts of the species range. The threat to the habitat continues to be a problem by atmospheric pollutants in much of the worldwide range. Pollutants threaten both the tree and the lichen growing on the tree.

Special significance of the species

Sclerophora peronella is currently known from only three collections in Canada and from just a few locations in the United States, Russia and several European countries. The ecological significance is that the species is recognized as an old-growth forest indicator species. Calicioid lichens and fungi are considered our most sensitive biomonitors of forest ecosystem health.

Existing protection or other status designations

Besides being redlisted in several European countries, *S. peronella* is not explicitly protected by any federal laws or any state/provincial/territorial wildlife acts or endangered species acts, nor is it protected by any international agreements or conventions. It is protected in Nova Scotia, however, by the Wilderness Areas Act that governs collecting and habitat destruction in Crown Lands Wilderness Areas, within which it is known to occur. No such protection is provided in the recreation area where *S. peronella* is found in British Columbia.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government members and the co-chairs of the species specialist and the Aboriginal Traditional Knowledge subcommittees. The Committee meets to consider status reports on candidate species.

DEFINITIONS (NOVEMBER 2004)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and it is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A wildlife species for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.
** Formerly described as “Not In Any Category”, or “No Designation Required.”
*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.

Environment Canada | Environnement Canada
Canadian Wildlife Service | Service canadien de la faune
Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Frosted Glass-whiskers

Sclerophora peronella

in Canada

Nova Scotia population
British Columbia population

2005

TABLE OF CONTENTS

List of figures

List of appendices

SPECIES INFORMATION

Name and classification

Scientific name: *Sclerophora peronella* (Ach.) Tibell
Synonyms: *Coniocybe peronella* (Ach.) Tibell
Coniocybe hyalinella Nyl.
Lichen peronellus Ach.
Common name: frosted glass-whiskers
Family: Coniocybaceae
Major group: Caliciales

Sclerophora peronella is a lichenized fungus in the Coniocybaceae. It belongs to a group of species that house their spores in tiny (0.2-2.0 mm tall) stalked apothecia that resemble beard stubble. Colloquially they are known as “stubble lichens” or “pin lichens”.

Description

Sclerophora peronella is distinguished by its pale pinkish apothecia, the reddish central core of the apothecial stalk visible in water, and the small, single-celled, smooth spores. The short-stalked (0.5-0.8 mm tall) apothecia (Figure 1) rise above an endosubstratic thallus where the fungi are associated with the green algal genus *Trentepohlia*. The capitulum of young apothecia is covered with a faint, lemon yellow pruina. As in many of the calicioid lichens, the asci that initially contain the spores within the hymenial layer of the apothecium disintegrate early in development of the apothecia. The spores, remnants of asci and paraphyses produce a powdery mass on the surface of the apothecium known as a mazaedium. The mazaedium in *S. peronella* is pale flesh-colored to yellowish brown, and may be covered with white pruina at maturity. The sexual spores, or ascospores, are spherical, hyaline, 3.0-3.5 microns in diameter, and have a smooth surface. No secondary substances have been detected.

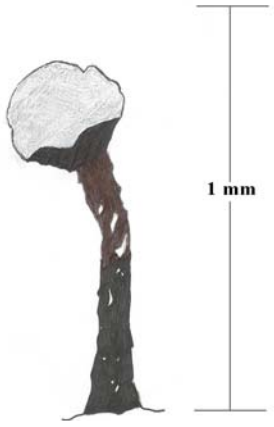


Figure 1. Spore-bearing apothecium of *Sclerophora peronella*. The lichen body (thallus) lies within the substrate (illustration by Ms. Lisa Weiss).

A detailed description of *S. peronella* can be found in Selva and Tibell (1999). This reference also includes a discussion of similar species of *Sclerophora* in North America. A photomicrograph of its apothecia can be found on the internet at the following address: http://csdept.umfk.maine.edu/LichensWebsite/images.asp (link last accessed May 2005).

Designatable units

Two designatable units are recognized in this report, based on the occurrence of two distinct populations occurring in widely separated COSEWIC ecozones (Atlantic and Pacific) and the very low likelihood of genetic exchange between the populations found in these zones.

DISTRIBUTION

Global range

The current known global distribution of *S. peronella* includes Europe (Scotland, Germany, Moravia, Denmark, Sweden, Finland, Norway, France, Austria, Italy, and Estonia), where it had previously been considered endemic (Tibell 1994), the Caucases in Russia (Titov 1998), the United States, and Canada (Figures 2 and 3).

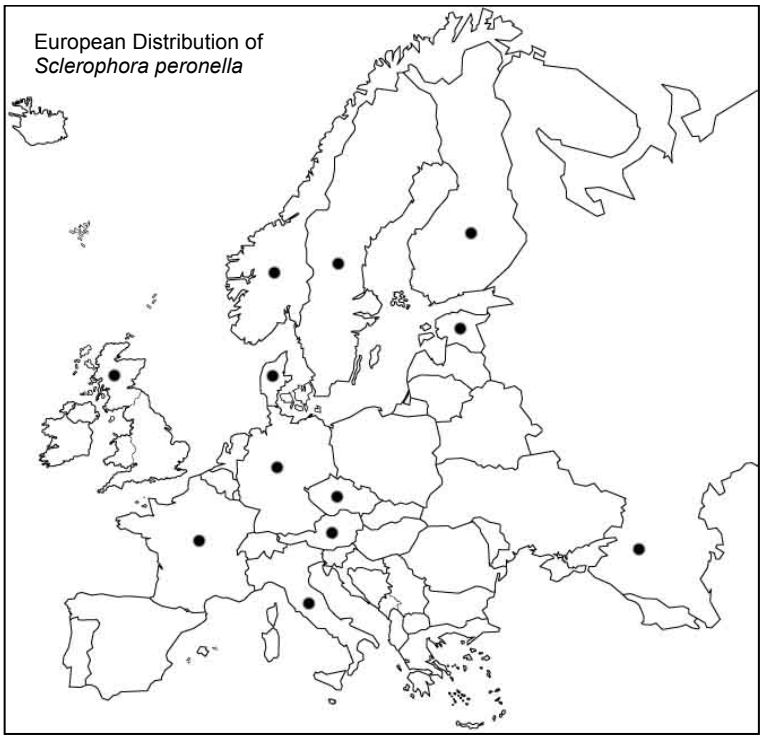


Figure 2. European distribution of *Sclerophora peronella*.

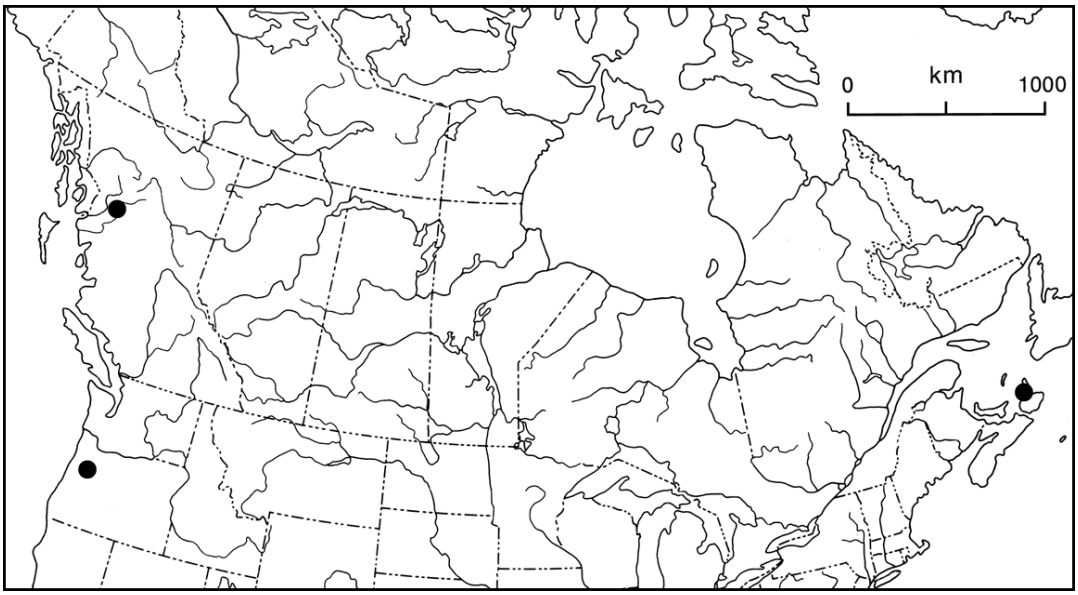


Figure 3. North American distribution of *Sclerophora peronella*.

The species is rare to extremely rare throughout its Eurasian range. According to Tibell (pers. comm.), *S. peronella* "it is rare—becoming more so particularly in Central Europe now." Fewer than 20 collections have been made by Eric Peterson and Jouko Rikkinen in western Oregon (Willamette Valley) (Figure 5).

Canadian range

In Canada, *S. peronella* is only known from one collection in British Columbia made in 1991 (Goward *et al*. 1996) and two collections in Nova Scotia discovered in 1998 (Selva 1999). Recent attempts to locate it on Prince Edward Island (Selva 1998a), as well as during fieldwork conducted by S. Selva in 2001, have been unsuccessful.

Given the small size of the apothecia of *S. peronella* and its apparent rarity throughout its global range, it is not surprising that it has been found only recently in Canada. The same can be said for its recent discovery in the United States, as well as Russia. Many of the collectors cited in this report, e.g., Leif Tibell, Trevor Goward, Steve Selva, Eric Peterson, and Jouko Rikkinen have been engaged in numerous and intensive lichen surveys in Canada and the United States and are all recognized as students of the calicioid lichens and fungi. Yet, they have managed to collect relatively few specimens of *S. peronella*. The species prefers a substrate and a microhabitat that is not foreign to the majority of calicioid taxa: It has been collected on exposed heartwood and/or bark of trees that would harbour any number of other calicioid species on a typical day of collecting. *Sclerophora peronella* collections can only be verified with certainty in the lab after the spores have been examined and chemical tests

conducted on the thallus. However, the genus is in fact easily recognized in the field, which is enough to cause a collector to make a collection. Furthermore, any fieldwork that inventories calicioid lichens in general would be sufficient to confirm the species presence at a site, particularly as one of its substrates, exposed heartwood, is easily recognized. In other words, a targeted search is not necessary to provide good inventory data for the species.

Herbarium visits were made by S. Selva in 2001 (see “Collections examined”) to determine present collections and the locations of those collections. However, no records were discovered at the regional herbaria visited as part of this investigation.

The apparent rarity of *S. peronella* in British Columbia is supported by considerable negative evidence (Appendix 1), as calicioid diversity has been intensively studied in this province over a period of 30 years. In 1972 Leif Tibell (Tibell 1975) undertook a comprehensive assessment of calicioid richness at five localities across the southern third of the province, from Vancouver Island to Glacier National Park. A few years later Willa Noble initiated an intensive study of lichen floristics in the Coastal Douglas-fir Zone on southeastern Vancouver Island. This study yielded a total of 5500 specimens, including 12 calicioid species (Noble 1982). Irwin Brodo began studying the lichen flora of the Queen Charlotte Islands (Haida Gwaii) in 1967, and subsequently has amassed approximately 5000 collections from all portions of the archipelago, resulting in a report of nine calicioid species (Brodo, unpublished checklist). Brodo's investigations were supplemented by Tor Toensberg and Trevor Goward in 2003, though with no increase in the calicioid flora. In 1995 Steve Selva collected about 500 calicioid specimens from the Robson Valley of east-central British Columbia. More recently Trevor Goward has undertaken surveys of calicioid diversity at 21 localities in the southern half of the province, resulting in approximately 1500 calicioid collections out of a total sample size of about 6000 specimens.

All of the localities above are mapped in Figure 4 (see also Appendix 1). Though the localities themselves are small, collectively they represent a fairly thorough inventory of calicioid richness in the southern half of British Columbia. Moreover, as calicioid diversity appears to decrease northwards (Tibell 1994), it seems unlikely that the northern portions of the province will contribute additional species. Farther south, in the American Pacific Northwest, Eric Peterson (2000) and Jouko Rikkinen (2003) have collected 1500 and 2100 calicioid specimens respectively, with an emphasis on southwest Washington and northwest Oregon.

Additional search effort for calicioid lichens in the American Pacific Northwest was undertaken by the USDA Forest Service (J Harpel, pers comm 2005; USDA Forest Service, 2003). In two pilot studies, some 750 plots (Figure 5) were searched for a target set of bryophyte and lichen species that were closely associated with old-growth. Calicioid lichens were included on the list of target species. Some 20,000 bryophyte and lichen collections resulted from this study and *Sclerophora peronella* was not found.

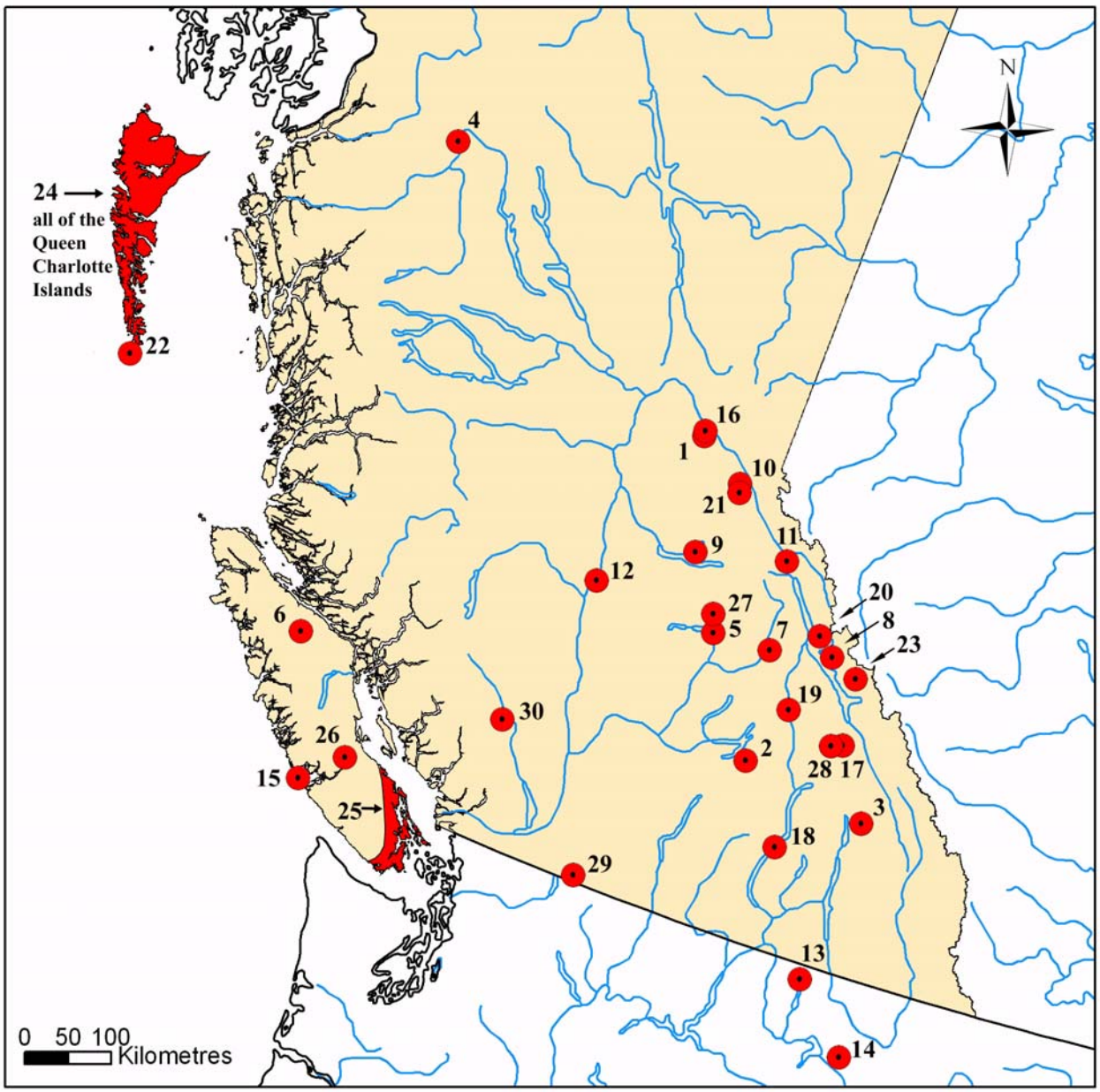


Figure 4. Major collection localities for calicioid lichens in British Columbia and the adjacent U.S.A. Numbers correspond to localities in Appendix 1. Location #4 is the single known locality of *Sclerophora peronella* in British Columbia.

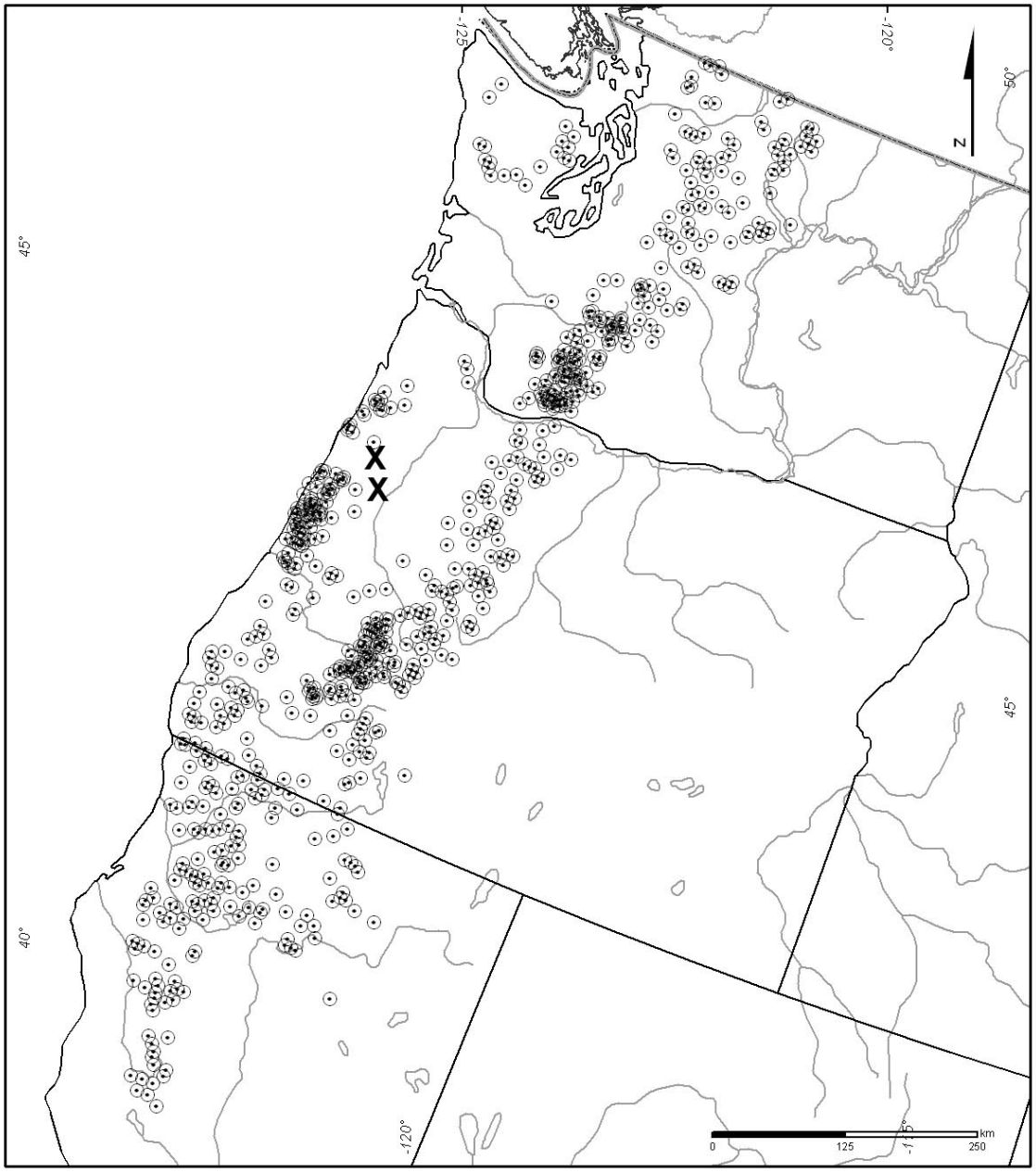


Figure 5. Distribution of 750 sampling plots for bryophytes and lichens for pilot studies conducted by the U.S. Dept. of Interior Bureau of Land Management from 2000 to 2003. Calicioid lichens were included among the target species. The two locations marked with an "X" show where earlier collections of *Sclerophora peronella* were made by Eric Peterson in Willamette Valley in 1997 and 1998 (collections EBP#2746 and EBP#2663).

Collecting for calicioid lichens in northeastern North America has, likewise, been both extensive and intensive over the past two decades (Figure 6). By far the greatest part of this work has been carried out by Steve Selva, who in the process has become the principal North American authority on the taxonomy and habitat ecology of the calicioid lichens and fungi. Formal and detailed surveys, typically requiring six to eight

hours of fieldwork per site, have been completed by Selva in 77 northern hardwoods, spruce-fir, eastern hemlock, and eastern white cedar (*Thuja occidentalis*) forests throughout the Maritime Provinces, in upstate New York, and the northern New England States (Selva 2003). An indication of the intensity of these efforts is that 12 or more calicioid species per stand have been found at 33 different sites in the northeast. The two stands in Nova Scotia where *S. peronella* were found had the richest overall diversity of calicioids (21 and 20 species, respectively) of all investigated hardwood forests in eastern North America. The total number of calicioid specimens collected by Selva and other lichenologists in the region is >3,000.

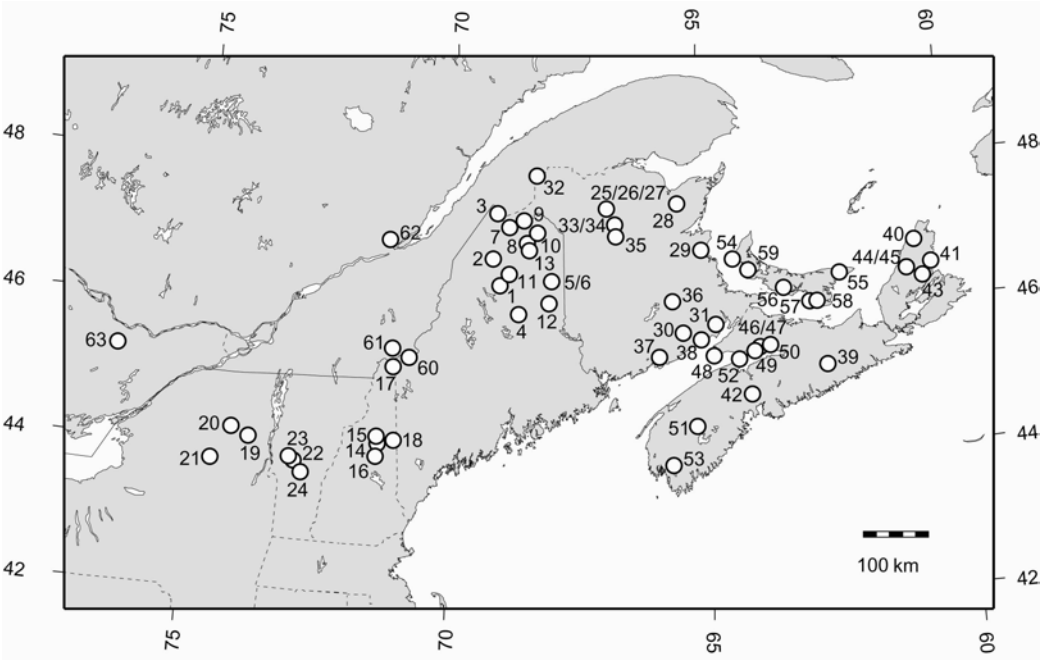


Figure 6. Major collecting localities for calicioid lichens in eastern Canada and the northeastern United States, 1985-2004. Locality numbers correspond to those given in Appendix 2. The only eastern North American records of *Sclerophora peronella* are at localities 44 and 45, not mapped separately because of their close proximity to each other.

HABITAT

Habitat requirements

Sclerophora peronella has been found on bark and lignum of old deciduous trees such as *Acer, Fagus, Fraxinus, Quercus, Sorbus, Tilia* and *Ulmus* in humid and rather shaded situations, and more rarely on lignum of *Alnus, Betula, Fagus, Populus,* and *Malus* (Tibell 1999). Tibell also notes (pers. comm.) that “it usually occurs on wood of hardwoods—usually on decorticated parts in hollows of living trunks and more rarely on bark. It is often associated with old-growth forests, but also occurs in parklands and on the margins of old deciduous forests.”

According to Eric Peterson (pers. comm.), *S. peronella* "mainly grows on large trunks of old *Quercus garryana* in open savannas. One collection is from a large old *Acer macrophyllum*, and another is from a very odd habitat; a somewhat young *Abies grandis* (approximately 100 years old) within an old growth Douglas fir forest". Describing the 14 collections he has made, Jouko Rikkinen (pers. comm.) says the species is "relatively common only on aged hardwoods in the Willamette Valley (Oregon). In other types of forests I only found a few small populations, mostly in riparian old-growth stands". It should be noted that the region in Canada most similar in climate and vegetation to the Willamette Valley is the Puget Sound area of southeast Vancouver Island where *Sclerophora peronella* has not yet been found despite the earlier intensive collecting efforts of Noble (1982).

The specimen from British Columbia was corticolous (on bark) at the base of a large black cottonwood (*Populus trichocarpa*) in a rich, rather shady cottonwood stand. Both of the specimens from Nova Scotia were lignicolous on the exposed heartwood of living *Acer rubrum* growing in old-growth northern hardwood stands.

Sclerophora peronella is likely to be confined to maritime areas in Canada, owing to the frost sensitivity of its trentepohlian algal partner.

Trends

The availability of the habitat, environmentally stable older forests in coastal regions, is declining. For example in the Acadian Forest Region where it is currently known in Nova Scotia, little intact habitat remains, with logging cited as the main cause of habitat loss (World Wildlife Fund 2000).

British Columbia fares much better in this regard, as large tracts of older forest still remain. Although *S. peronella* may be known today from only one collection in a black poplar stand, the available data suggests that older coniferous and deciduous forests may both be considered suitable habitat for this species. However, because of the low numbers of specimens collected in Canada over the last 30 years, survival trends cannot be determined.

Protection/ownership

Both NS sites that presently have the lichen, the Sugarloaf Mountain and Margaree River sites, are Crown Land Wilderness Areas that are afforded official protected status by the province of Nova Scotia under the Wilderness Areas Act.

The site in BC that has the lichen, Kitsumkalum Lake site, is best described as a provincial forest service Recreational Reserve with a portion set aside as a demonstration forest for small scale logging, e.g., horse logging (K. Kriese, pers. comm.). There is nothing in the currently established objectives for this stand that protects the *S. peronella* site.

BIOLOGY

General

This species is found exclusively on the wood and bark of older trees. The Canadian occurrences of *S. peronella* have all been with apothecia bearing mature spores. Based on the available habitat descriptions, the species seems to have a preference for old-growth forests with stable humidity and small temperature fluctuations.

Reproduction

The thallus of *S. peronella* is imbedded in the substrate, and has not been observed to produce vegetative propagules**.** All thalli of *S. peronella* at Canadian sites have apothecia containing mature spores. As a result**,** it is the sexual spores housed in the capitulum of the stalked apothecia that must be distributed to new locations. This is thought to take place via wind, rain and, to a lesser degree, by invertebrates. These sexual spores must land and germinate in close proximity to a compatible green algal partner before lichenization can occur. The world's leading authority on the calicioid lichens and fungi, Leif Tibell, has indicated (pers. comm.) that longevity of thalli, age at sexual maturity, and generation time, remain unanswered questions within this group of species. According to Canters *et al*. (1991), the distribution of lichens "is governed by microclimatic factors that influence higher plants in different ways or not at all." Therefore microclimatic factors of the wood substrate such as pH, water holding capacity, or chemistry, may influence longevity of thalli, age at sexual maturity, and generation time.

Survival

It is generally assumed that the establishment of this and other lichen species is determined by such factors as age, texture, pH, moisture-holding capacity and nutrient status of the substrate, as well as degree of illumination and humidity of the microenvironment, inclination of surfaces, aspect, air pollution and stand continuity (e.g., Barkman 1958, Brodo 1973, James, Hawksworth and Rose 1977). However, specific microclimatic and physiological requirements for *S. peronella* have yet to be determined. According to Mattson and Middelborg (2000), microclimatic humidity is, perhaps, the most important ecological factor for explaining the distribution of calicioid species: the microclimatic humidity is primarily a product of topography and vegetation, not of precipitation.

Movements/dispersal

It is difficult to know whether the populations in British Columbia, Nova Scotia, and at isolated locations in the United States, Europe and Russia, are remnant populations from a previously continuous range, or if each is the consequence of a long distance dispersal event. Although the thalli at each of the disparate sites are of very limited size, they are healthy and capable of reproducing. However, given the species' apparent

preference for old forest habitat, the destruction and/or unavailability of such habitat is a reason for concern. Dispersal by sexual spores means that the fungal spore must land close to a compatible alga and on the appropriate substrate before another lichen can grow. If vegetative propagules were produced, the propagule containing both fungal and algal partners would only have to land on suitable substrate since both partners are already present. However, the lack of vegetative propagules, and the production of sexual spores only, presents an additional challenge for survival of the lichen.

Nutrition and interspecific interactions

Sclerophora peronella, as a lichenized fungus, satisfies its need for carbon by growing symbiotically with a photosynthetic algal partner. It receives water and other nutrients from the atmosphere. Because of the efficient adaptation for absorption from the atmosphere (as in most lichens and bryophytes), any pollutants soluble in the atmospheric moisture will also be efficiently absorbed by the lichen. The species does not seem to be impacted by interactions with other organisms based on the Selva's field observations and literature searches.

Behaviour/adaptability

As perhaps our most sensitive biomonitors of forest ecosystem health, the calicioid lichens and fungi, including *S. peronella*, remain one of the forest's most elusive and poorly known inhabitants. The habitat data suggests that this species prefers the stable environment of established forests—particularly those associated with older stands. Like other calicioid lichens, it appears to be intolerant of disturbance and, considering the limited number of records available, its global range is perhaps directly linked to the worldwide decline of suitable old-forest habitat.

POPULATION SIZES AND TRENDS

The entire known area of coverage for *S. peronella,* in the three known Canadian locations, is probably no more than one square metre. At each locality, the species was found only once, in spite of repetitive collecting within the localities. Each collection record is interpreted as representing a single contiguous thallus with each bearing several apothecia. Approximately 75% of the apothecia appeared to be mature. It is not known whether these populations are increasing, remaining stable, or are declining in size. The three Canadian occurrences are as follows:

1) British Columbia, Skeena River Basin, Kitsumkalum Lake, Goward 1991-1139. Trevor Goward (pers. comm.) describes the location as a rather shady cottonwood stand at the south end of Kitsumkalum Lake.

2) Nova Scotia, Cape Breton Island, Inverness County. Sugarloaf Mountain Wilderness Area, 1998, Selva 7628. Described by the Nova Scotia Department of Natural Resources as an immature old-growth stand and by Selva (1999) as

an old-growth stand, this protected northern hardwoods forest is located at the northeast end of Sugarloaf Mountain above East Big Intervale Road.

3) Nova Scotia, Cape Breton Island, Inverness County, Margaree River Wilderness Area, 1998, Selva 7852. This is another protected northern hardwoods forest described by the Nova Scotia Department of Natural Resources as an immature old-growth stand and by Selva (1999) as an old-growth stand. It was surveyed in its southwestern section, along the north-facing slopes above First Brook Pool.

Estimating "population" size is difficult since field identification has to be verified by microscope studies. In the research that S. Selva has been engaged in over the past 15 years, an assessment of environmental continuity in forested ecosystems is predicated on the compilation of as complete an inventory of the species in the survey area as possible. Since many of these species are rare, even at ancient forest sites, the Relevé Analysis for Classification approach to sampling (Mueller-Dombois and Ellenberg 1974), a form of "intelligent meander", is preferred. While mindful of the disadvantages of preferential sampling—that of "being biased by subjectivity and of not allowing statistical inferences from the data", the advantage of "allowing the highest sampling intensity" with "less likelihood of missing localized rich areas" (Nimis 1991) makes this the sampling option of choice. Numerous replicates increase the chances that rarer species would be captured (Selva 1994, 1996). As a result of such intensive collecting, if only a single record is reported for a site—as it has for *S. peronella* at each of the populations in Nova Scotia, for example, S. Selva is confident in describing the species as extremely rare. To date, the continuity of 76 forests in northeastern North America has been assessed by the S. Selva using the methods described above. In spite of this concerted search effort, *S. peronella* has been found only twice. Detailed accounts of search effort throughout the species' range are presented in the section Canadian range, and in Figures 4-6.

LIMITING FACTORS AND THREATS

Sclerophora peronella seems to have a preference for the environmental stability associated with older established forests. Therefore habitat destruction from logging of old forests is a potential threat. Given the sensitivity of this and other calicioid species to disturbance—including acid rain and other atmospheric pollutants that affect lichens generally, the ultimate fate of this species depends in large part on the protection and management of the type of forest ecosystems in which it tends to occur. *Sclerophora peronella* is also probably confined to coastal or near-coastal regions, owing to the known frost sensitivity of its alga partner, *Trentepohlia*.

SPECIAL SIGNIFICANCE OF THE SPECIES

Sclerophora peronella is considered rare to extremely rare throughout its range and is red listed in Austria (Hafellner 2000), Denmark, Sweden and Finland (Tibell 1999) and is declining in Italy (Nimis 2000). The species has an important ecological significance.

The lichen is an old-growth forest indicator species, recognized by Selva (1994, 1996) who considered the calicioid lichens and fungi our most sensitive biomonitors of forest ecosystem health. Small changes in the microenvironment, resulting from changes in the forest ecosystem, will influence the survival of the lichen, in turn reflecting the health of the forest.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Of the three known localities of *S. peronella* in Canada, the two from Nova Scotia are afforded provincial protective status as Crown Lands Wilderness Areas under the Wilderness Areas Act. The site in British Columbia, however, does not currently provide official protective status.

On an international level, the species is red listed in Austria, Denmark, Sweden and Finland but is not listed or proposed for listing under the United States Endangered Species Act or by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The species is not the subject of any international agreements, nor is it covered by any international conventions. The Nature Conservancy has not given *S. peronella* a global rank or a Canadian national rank, nor does it have any state rank. It has not been assigned any provincial rank by the Conservation Data Centres or Natural Heritage Information Centres. *Sclerophora peronella* is not protected by any federal laws or any provincial/territorial wildlife acts or endangered species acts.

SUMMARY OF STATUS REPORT

Sclerophora peronella is known from fewer than 20 collections for all of North America, including one in British Columbia and two in Nova Scotia. The remainder are collections from western Oregon. It is possible, however, that due to its minute size and only relatively recent discovery in North America, further fieldwork in Canada will result in the finding of additional localities. To date, S. Selva has searched a total of 76 forested sites in northeastern North America with an emphasis on Maine, New Brunswick, Nova Scotia, Prince Edward Island, southeastern Ontario and southwestern Quebec. No new sites were found beyond the original discoveries. New localities for other calicioid lichens were found, however, during recent targeted searches for *S. peronella*. Current indications are that *S. peronella* appears to be a very rare species in Canada and North America.

For the world as a whole, the species is considered rare to extremely rare throughout its range and is red listed in Austria (Hafellner 2000), Denmark, Sweden and Finland (Tibell 1999). It is declining in Italy (Nimis 2000), and is known from only single records or from only a few collections in Russia and several other European countries.

Each of the Nova Scotia collections was examined and determined to have apothecia that were in good condition, containing spores that appeared to be viable; the apothecia also did not demonstrate any of the negative symptoms associated with air pollution or attack by parasites. Given the sensitivity of this and other calicioid species to disturbance, it was clear that *S. peronella* was healthy at the two sites. Likewise, the species at the collection site reported by Trevor Goward for British Columbia was also healthy. However, the health of such disparate populations is difficult to judge when the species is so small that it cannot be positively identified in the field, appears to be rare to extremely rare throughout its range, and has been encountered only once in each of two forest ecosystems.

Given the available data, *S. peronella* seems to prefer the ecological stability associated with mature and old-growth forests. Unfortunately, according to a report from the World Wildlife Fund (2000) on the status of the Acadian forest in northeastern North America—within which it resides in Nova Scotia, little intact habitat remains in this ecoregion, with only about 3-5 percent of this forest in presettlement condition. British Columbia fares much better in this regard, as large tracts of older forests still remain and undoubtedly harbour more populations of this rare species.

TECHNICAL SUMMARY

Sclerophora peronella
Frosted glass-whiskers
(British Columbia population)
Occurrence: British Columbia

sclérophore givré
(population de la Colombie-Britannique)

Extent and Area information	
• *extent of occurrence (EO)(km²)*	<1 km^2
• *specify trend (decline, stable, increasing, unknown)*	Not known
• *are there extreme fluctuations in EO (>1 order of magnitude)?*	Unlikely
• *area of occupancy (AO) (km²)*	<1 m^2
• *specify trend (decline, stable, increasing, unknown)*	Unknown
• *are there extreme fluctuations in AO (>1 order magnitude)?*	Unknown
• *number of extant locations*	3
• *specify trend in # locations (decline, stable, increasing, unknown)*	Stable
• *are there extreme fluctuations in # locations (>1 order of magnitude)?*	No
• *habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat*	Unknown
Population information	
• *generation time (average age of parents in the population) (indicate years, months, days, etc.)*	Unknown
• *number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)*	Approx. 75% of apothecia were mature
• *total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals*	Unknown
• *if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)*	
• *are there extreme fluctuations in number of mature individuals (>1 order of magnitude)?*	Unknown
• *is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤1 successful migrant / year)?*	Total worldwide population is severely fragmented
• *list each population and the number of mature individuals in each*	British Columbia, Skeena River Basin 1) Kitsumkalum Lake
• *specify trend in number of populations (decline, stable, increasing, unknown)*	Unknown
• *are there extreme fluctuations in number of populations (>1 order of magnitude)?*	Unlikely
Threats (actual or imminent threats to populations or habitats	
- Given the available data, *Sclerophora peronella* seems to prefer the ecological stability associated with mature and old-growth forests. These ecosystems are under threat worldwide from habitat loss and degradation. No specific threats in this regard were noted for the collection localities. - Like certain other groups of lichens, this species is sensitive to acid rain and other atmospheric pollutants that affect lichens generally.	

Rescue Effect (immigration from an outside source)	Unlikely.
• *does species exist elsewhere (in Canada or outside)?*	Several small populations exist in Oregon and others in Europe.
• *status of the outside population(s)?*	Unknown.
• *is immigration known or possible?*	Immigration is possible but unlikely.
• *would immigrants be adapted to survive here?*	Possibly.
• *is there sufficient habitat for immigrants here?*	Yes, but it is declining.
Quantitative Analysis	Not applicable

Status and Reasons for Designation

Status: Data Deficient	**Alpha-numeric code**: Not applicable

Reasons for Designation:
This tiny cryptic stubble lichen is very rare or threatened over much of its global range. The species is known from only one site in the north-central part of the province where it was found once on a large cottonwood. Although search effort for stubble lichens has been extensive in regions farther south within the province, search effort in the northern region where the species was found was inadequate.

Applicability of Criteria

Criterion A (Declining Total Population): Population decline not documented.

Criterion B (Small Distribution, and Decline or Fluctuation): Not applicable.

Criterion C (Small Total Population Size and Decline): Not applicable since the number of individuals is not known.

Criterion D (Very Small Population or Restricted Distribution): Not applicable.

Criterion E (Quantitative Analysis): Not applicable.

TECHNICAL SUMMARY

Sclerophora peronella
Frosted glass-whiskers
(Nova Scotia population)
Occurrence: Nova Scotia

sclérophore givré
(population de la Nouvelle-Écosse)

Extent and Area information	
• *extent of occurrence (EO)(km²)*	Estimated to be <100 km^2
• *specify trend (decline, stable, increasing, unknown)*	Historical decline of mature and old-growth forests in Canada has occurred
• *are there extreme fluctuations in EO (>1 order of magnitude)?*	Unlikely
• *area of occupancy (AO) (km²)*	about 3 km^2 of habitat available where species was found but actual area occupied was <1 m^2
• *specify trend (decline, stable, increasing, unknown)*	Unknown
• *are there extreme fluctuations in AO (>1 order magnitude)?*	Unknown
• *number of extant locations*	2
• *specify trend in # locations (decline, stable, increasing, unknown)*	Stable
• *are there extreme fluctuations in # locations (>1 order of magnitude)?*	No
• *habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat*	Extent of potential habitat declining
Population information	
• *generation time (average age of parents in the population) (indicate years, months, days, etc.)*	Unknown
• *number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)*	Approx. 75% of apothecia at each of the 2 sites were mature
• *total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals*	Unknown
• *if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)*	
• *are there extreme fluctuations in number of mature individuals (>1 order of magnitude)?*	Unknown
• *is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤1 successful migrant / year)?*	Total worldwide population is severely fragmented
• *list each population and the number of mature individuals in each*	Nova Scotia, Cape Breton Island, Inverness County 1) Sugarloaf Mountain Wilderness Area 2) Margaree River Wilderness Area
• *specify trend in number of populations (decline, stable, increasing, unknown)*	Unknown
• *are there extreme fluctuations in number of populations (>1 order of magnitude)?*	Unlikely

Threats (actual or imminent threats to populations or habitats	
- Given the available data, *Sclerophora peronella* seems to prefer the ecological stability associated with mature and old-growth forests. These ecosystems are under threat worldwide from habitat loss and degradation. No specific threats in this regard were noted for the collection localities. - Like certain other groups of lichens, this species is sensitive to acid rain and other atmospheric pollutants that affect lichens generally.	
Rescue Effect (immigration from an outside source)	Unlikely
• *does species exist elsewhere (in Canada or outside)?*	Several small populations exist in Oregon and others in Europe
• *status of the outside population(s)?*	Unknown
• *is immigration known or possible?*	Immigration is possible but unlikely
• *would immigrants be adapted to survive here?*	Possibly
• *is there sufficient habitat for immigrants here?*	Yes, but it is declining
Quantitative Analysis	Not applicable

Status and Reasons for Designation

Status: Special Concern	**Alpha-numeric code**: Not applicable

Reasons for Designation:
This tiny cryptic stubble lichen is very rare or threatened over much of its global range. Two of the three known locations of this species in Canada are in Nova Scotia. Despite considerable efforts to locate this and other rare calicioid lichens in the province, this lichen is known only from the exposed heartwood of red maple trees in mature/old-growth hardwood forest. Threats include potential habitat loss and degradation associated with the decline of old-growth forest ecosystems. However, in Nova Scotia of the two populations appear healthy and are situated within large protected areas on Cape Breton Island.

Applicability of Criteria

Criterion A (Declining Total Population): Population decline not documented.

Criterion B (Small Distribution, and Decline or Fluctuation): May meet criterion for Endangered B1+2 (AO <500 km²), a (2 of the 3 locations, Canadian population is severely fragmented), b(iii) (inferred decline habitat based loss of old growth forest).

Criterion C (Small Total Population Size and Decline): Not applicable since we do not know the number of individuals.

Criterion D (Very Small Population or Restricted Distribution): May meet criterion for Threatened D2, based on small AO and small number of locations (2). However both Nova Scotia populations are within large protected areas where potential threats are mitigated.

Criterion E (Quantitative Analysis): Not applicable.

ACKNOWLEDGEMENTS AND AUTHORITIES CONTACTED

Acknowledgements

All individuals identified in the "Authorities contacted" section of this report have assisted, in one way or another, in the preparation of this report and I wish to thank all for their contributions.

Among the individuals I offer special thanks to are those who assisted me in the field and in arranging herbarium visits. At the head of that list are Stephen Clayden and Ernie Brodo, who assisted me in both regards while visiting New Brunswick and Ontario, respectively, and their wives Barbara Clayden and Fenja Brodo for their hospitality during these visits. Special thanks also to Alex Wilson, Ruth Newell, Donna Crossland, Anna Koffman, Rob Lee, Albert Dugal, and Alain Caissie.

Authorities contacted

Alvo, R. September 2001. Conservation Biologist, Ecological Integrity Branch, Parks Canada.

Amirault, D.L. September 2001. Wildlife Biologist – Species at Risk, Canadian Wildlife Service, Environment Canada, Sackville, N.B.

Bowman, I. September 2001. Senior Biologist, Rare, Threatened and Endangered Species, Ministry of Natural Resources, Peterborough, ON

Brodo, I.M. May 2001. Research Scientist, retired, Canadian Museum of Nature, Ottawa, ON.

Breuss, O. January 2001. Research Scientist, Naturhistorisches Museum Wien, Botanische Abteilung, Wien, Austria.

Caissie, A. June 2001. Conservation Officer, Fundy National Park, Alma, NB.

Carroll, H. June 2001. Director, Parks and Recreation Division, Nova Scotia Department of Environment, Belmont, NS.

Clayden, S. May 2001. Research Scientist, The New Brunswick Museum, Saint John, NB.

Crossland, D. July 2001. Ecologist, Kouchibouguac National Park, NB.

Curley, R. September 2001. Program Manager, Habitat and Biodiversity Conservation, Fish and Wildlife Division, PEI Department of Fisheries, Aquaculture and Environment, Charlottetown, PE.

Donovan, M. September 2001. Biological Information Coordinator, BC Conservation Data Centre, Ministry of Sustainable Resources Management, Victoria, BC.

Dugal, A. June 2001. Naturalist, the Ottawa Region, Greely, ON.

Elderkin, M.F. September 2001. Species at Risk Biologist, Wildlife Division, Nova Scotia Department of Natural Resources, Kentville, NS.

Fowler, B.T. September 2001. Scientific Authority, Species Assessment, Canadian Wildlife Service, Environment Canada, Ottawa, ON.

Gerriets, S. September 2001. Data Manager, Atlantic Canada Conservation Data Centre, Sackville, NB.

Goulet, S. September 2001. Coordinator, Aboriginal Traditional Knowledge, COSEWIC Secretariat, Ottawa, ON.

Goward, T. March 2001. Ecologist, Enlichened Consulting, Ltd., Clearwater, BC.
Hafellner, J. March 2001. Professor of Botany, Institut fur Botanik, Karl-Franzens Universitat, Austria.
Koffman, A. June 2001. Ecologist, County Board in Gavlegorg, Nature Conservation Department, Sweden.
Lavoie, G. September 2001. Ministère de l'Environnement du Qubec, Direction du patrimoine écologique et du développement durable, Québec (Québec).
Laporte, P. September 2001. Biologiste principal, – Espèces en peril, Service canadien de la faune – Région du Québec, Environnement Canada, Sainte-Foy (Québec).
Lee, R.E. June 2001. Naturalist, the Ottawa Region, White Lake, ON.
Lynds, A. June 2001. Ecologist and Air Photo Interpreter, Nova Scotia Department of Environment, Protected Areas, Belmont, Colchester County, NS.
Newell, R. June 2001. E.C. Smith Herbarium, Biology Department, Acadia University, Wolfville, NS.
Oldham, M.J. September 2001. Botanist/Herpetologist, Ontario Natural Heritage Information Centre (NHIC), Ministry of Natural Resources, Peterborough, ON.
Peterson, E. November 2003. Nevada Natural Heritage Program, Carson City, Nevada, USA.
Rikkinen, J. November 2003. Department of Botany, University of Helsinki, Helsinki, Finland.
Tibell, L. March 2001. Professor of Botany, Department of Systematic Botany, Evolutionary Biology Centre, Uppsala University, Norbyvagen, Sweden.
Titov, A.N. March 2001. Research Scientist, Komarov Botanical Institute of the Russian Academy of Sciences, St. Petersburg, Russia.
Toner, M. September 2001. Species at Risk Biologist, Fish and Wildlife Branch, Department of Natural Resources and Energy, Fredericton, NB.
Wenting, R. September 2001. Canadian Wildlife Service (Ontario Region), Environment Canada, Nepean, ON.
Wilson, A. May 2001. Manager of Collections, Nova Scotia Museum of Natural Science, Halifax, NS.
Wissink, R. June 2001. Park Ecologist, Fundy National Park, Alma, NB.

INFORMATION SOURCES

Barkman, J.J. 1958. Phytosociology and Ecology of Cryptogamic Epiphytes, Van Gorcum & Company, Assen. Netherlands.
Brodo, I. M. 1973. "Substrate Ecology." In The Lichens, edited by V. Ahmadjian and M.E. Hale, 401-41. Academic Press, New York, NY
Canters, K.J., H. Scholler, S. Ott, and H.M. Jahns. 1991. "Microclimatic Influences on Lichen Distribution and Community Development." Lichenologist 23: 237-52.
Goward, T. and O. Breuss, B. Ryan, B. McCune, H. Sipman and C. Scheidegger. 1996. Notes on the lichens and allied fungi of British Columbia III. The Bryologist 99: 439-449.

Hafellner, J. 2000. Red list of endangered lichens in Austria. Web site: http://www-ang.kfunigraz.ac.at/~hafell/redlist.htm [Accessed March 2001].
James, P. W., D.L. Hawksworth, and F. Rose. 1977. "Lichen Communities in the British Isles: A Preliminary Conspectus." In Lichen Ecology, edited by M.R.D. Seaward, 295-413. Academic Press New York.
Mattson J. and J. Middelborg. 2000. Keys to genera and species of Caliciales in Norway. http://www.toyen.uio.no/botanisk/lav/LichenKey/Current/Middelborg/keyes.htm [accessed Oct. 2004].
Mueller-Dombois, D. and H. Ellenberg. 1974. Aims and Methods of Vegetation Ecology, Wiley, New York, NY.
Nimis, P.L. 1991. Developments in lichen community studies. Lichenologist 23: 215-225.
Nimis, P.L. 2000. Lichen database of Italy 1.0. Web site: http://biobase.kfunigraz.ac.at/flechte/owa/askitalflo [Accessed March 2001].
Noble, W. 1982. The lichens of the coastal Douglas-fir Dry Subzone of British Columbia. Ph.D. thesis. University of British Columbia, Vancouver, British Columbia.
Peterson, E.B. 2000. Analysis and prediction of patterns in lichen communities over the western Oregon landscape. Ph.D. thesis. Oregon State University, Corvallis.
Rikkinen, J. 2003. Calicioid lichens and fungi in the forests and woodlands of western Oregon. Acta Botanica Fennica 175: 1-41.
Selva, S.B. 1994. "Lichen Diversity and Stand Continuity in the Northern Hardwoods and Spruce-Fir Forests of Northern New England and Western New Brunswick," The Bryologist 94: 424-28.
Selva, S.B. 1996. Using lichens to assess ecological continuity in northeastern forests, pp. 35-48. In M.B. Davis (ed.), Eastern Old-growth Forests. Island Press, Washington, D.C.
Selva, S.B. 1998a. The Caliciales of Nova Scotia and Prince Edward Island. An unpublished report prepared for the National Geographic Society, Washington, D.C.
Selva, S.B. 1999. Survey of epiphytic lichens of late successional northern hardwoods forests in northern Cape Breton Island. Unpubl. report prepared for Cape Breton Highlands National Park and Parks Canada.
Selva, S.B. 2003. Using calicioid lichens and fungi to assess ecological continuity in the Acadian Forest Ecoregion of the Canadian Maritimes. Forestry Chronicle 79: 550-558.
Selva, S.B. and L. Tibell. 1999. Lichenized and non-lichenized calicioid fungi from North America. The Bryologist 102: 377-397.
Tibell, L. 1975. The Caliciales of boreal North America. Symbolae Botanicae Upsalienses 21: 1-128.
Tibell, L. 1980. "The Lichen Genus *Chaenotheca* in the Northern Hemisphere," Symbolae Botanicae Upsaliensis 23: 1-65.
Tibell, L. 1994. Distribution patterns and dispersal strategies of Caliciales. Botanical Journal of the Linnean Society 116:159-202.
Tibell, L. 1999. “Calicioid lichens and fungi.” In Nordic Lichen Flora, Volume 1, edited by T. Ahti, P.M. Jorgensen, H. Kristinsson, R. Moberg, U. Sochting, and G. Thor. Naturcentrum AB, Uddevalla.

Titov, A.N. 1998. New and rare calicioid lichens and fungi from relict tertiary forests of Caucasus and the Crimea. Folia Cryptogamia Estonica 32: 127-133.
USDA Forest Service. 2003. A Bryophyte and Lichen Random Grid Study, unpublished data, USDA Forest Service, Pacific Northwest Region 6, and USDI Bureau of Interior, Oregon/Washington State Office, Portland, Oregon.
World Wildlife Fund. 2000. Scientific Reports on the New England Acadian Forest and the Gulf of St. Lawrence Lowland Forests. Web site: http://worldwildlife.org/wildworld/profiles/terrestrial/na/na0410_full.html [Accessed September 1, 2001].

BIOGRAPHICAL SUMMARY OF THE REPORT WRITER

Steve Selva is a Professor of Biology and Environmental Studies at the University of Maine at Fort Kent. Having grown up in California, he received his baccalaureate degree in biology and botany from Humboldt State University in 1972, then went on to Iowa State University where he earned both a master's and a PhD degree in systematic botany.

Since arriving in Maine in 1976, Dr. Selva has been engaged in research using lichens to assess the ecological continuity of northern hardwoods and coniferous forests in northern New England and Maritime Canada. These studies have shown that, not only do epiphytic lichen floras become richer over time—with older stands harbouring more rare species—but that the total number and presence of particular calicioid lichens and fungi collected at a site is, itself, an indicator of continuity. Given his familiarity with the calicioid lichens and fungi (Selva 1988, 1994, 1996, 1998b; Selva and Tibell 1999), and his familiarity with the literature and the works of colleagues studying the group in other parts of the world, Dr. Selva has brought these qualifications to bear during the preparation of this report.

COLLECTIONS EXAMINED

In addition to searching for *S. peronella* in the field, herbarium collections at the following institutions were also visited and searched for specimens by S. Selva in 2001:

The E.C. Smith Herbarium at Acadia University, Wolfville, NS B0P 1X0
The New Brunswick Museum, 277 Douglas Avenue, Saint John, NB E2K 1E5
The Nova Scotia Museum of Natural Science, 1747 Summer Street, Halifax, NS B3H 3A6
The National Herbarium of the Canadian Museum of Nature (Gatineau, Québec), P.O. Box 3443, Station D, Ottawa, ON K1P 6P4

Appendix 1. Major collection localities for calicioid lichens in British Columbia and the adjacent U.S. Site numbers correspond to the map in Figure 4.

Site*	Location	Month	Year	Number of specimens / search effort	Collector
1	Robson Valley	Jun	1995	450 calicioid specimens collected from vicinity	S. Selva
2	Sicamous Creek	Aug	1995	200 calicioid specimens collected from vicinity	T. Goward
3	Tenise Creek	Sep	1995	75 calicioid specimens collected from vicinity	T. Goward
4	Kitsumkalum Lake	Jun	1996	20 calicioid specimens collected from vicinity	T. Goward
5	Wells Gray	Aug	1996	650 calicioid specimens collected from vicinity	T. Goward
6	Mount Cain	Sep	1996	35 calicioid specimens collected from vicinity	T. Goward
7	Adams River	Sep	1996	50 calicioid specimens collected from vicinity	T. Goward
8	Cummins Valley	Jul	1997	50 calicioid specimens collected from vicinity	T. Goward
9	Quesnel Lake	Aug	1999	15 calicioid specimens collected from vicinity	T. Goward
10	Robson Valley	Aug	1999	12 calicioid specimens collected from vicinity	T. Goward
11	Valemount	Jun	2000	1 calicioid specimen collected from vicinity	T. Goward
12	Williams Lake	Sept	2000	0 calicioid specimens collected from vicinity	T. Goward
13	Priest Lake	Apr	2001	15 calicioid specimens collected from vicinity	T. Goward
14	Ross Creek	Apr	2001	20 calicioid specimens collected from vicinity	T. Goward
15	Pacific Rim	Jul	2001	10 calicioid specimens collected from vicinity	T. Goward
16	Robson Valley	Jul	2001	80 calicioid specimens collected from vicinity	T. Goward
17	Beaver Valley	Jul	2002	50 calicioid specimens collected from vicinity	T. Goward
18	Mount Revelstoke	Jul	2002	20 calicioid specimens collected from vicinity	T. Goward
19	Mica Dam	Jul	2002	45 calicioid specimens collected from vicinity	T. Goward
20	Wood River	Jul	2002	20 calicioid specimens collected from vicinity	T. Goward
21	Robson Valley	Oct	2002	45 calicioid specimens collected from vicinity	T. Goward
22	Gwaii Haanas	Jul	2003	5 calicioid specimens collected from vicinity	T. Goward
23	Incomappleux Valley	Oct	2003	50 calicioid specimens collected from vicinity	A. Arsenault

Site*	Location	Month	Year	Number of specimens / search effort	Collector
24	Haida Gwaii (all of Queen Charlotte Islands)		1969-2004	Intensive investigation. 9 calicioid species collected.	I.M. Brodo
25	Southeastern Vancouver Island (north to Courtenay)		1974-1981	Intensive investigation. 12 calicioid species collected.	W.J. Noble
26	Southern Vancouver Island		1972	Thorough investigation	L. Tibell
27	Southern Wells Gray Provincial Park		1972	Thorough investigation	L.Tibell
28	Glacier National Park		1972	Thorough investigation	L. Tibell
29	Manning Provincial Park		1972	Thorough investigation	L. Tibell
30	Pemberton		1972	Thorough investigation	L. Tibell

*Site numbers correspond to the map in Figure 4 only.

Appendix 2. Major collecting localities for calicioid lichens in northeastern North America, 1985-2004, and names of collectors. In some cases (Tuckerman Workshops, American Bryological and Lichenological Society [ABLS] excursion), groups of several or more knowledgeable lichenologists surveyed the localities noted. Site numbers correspond to the map in Figure 6.

Site*	Province or state	Locality	Collector, workshop, or excursion
United States:			
1	ME	Big Reed Preserve	S. Selva
2	ME	Musquacook	S. Selva
3	ME	Yankeetuladi	S. Selva
4	ME	Lunksoos Mountain	S. Selva
5	ME	Number Nine Mountain	S. Selva
6	ME	Hedgehog Mountain	S. Selva
7	ME	Morrison Mountain	S. Selva
8	ME	Pennington Pond	S. Selva
9	ME	Charette Hill and other localities near Fort Kent	S. Selva
10	ME	Cross Lake	S. Selva
11	ME	Bartlett Stream	S. Selva
12	ME	Timoney Mountain	S. Selva
13	ME	Nixon Siding	S. Selva
14	NH	Nancy Brook RNA	S. Selva
15	NH	Gibbs Brook Research Natural Area	S. Selva
16	NH	The Bowl Research Natural Area	S. Selva
17	NH	Norton Pool Natural Area	S. Selva
18	NH	Mountain Pond Candidate RNA	S. Selva
19	NY	Adirondack Mountain Reserve	S. Selva
20	NY	Ampersand Mountain	S. Selva
21	NY	Forked Lake Forest Preserve	S. Selva
22	VT	The Cape RNA	S. Selva
23	VT	Chandler Ridge Candidate RNA	S. Selva
24	VT	Gifford Woods Natural Area	S. Selva
Canada:			
25	NB	Mt Carleton Prov. Park, Mount Bailey	S. Selva
26	NB	Mt Carleton Prov. Park, Big Brook	S. Selva
27	NB	Mt Carleton Prov. Park, Sagamook Mountain	S. Selva, S. Clayden
28	NB	Bass River, near Allardville	S. Clayden
29	NB	Kouchibouguac National Park	K. Egger, A. Koffman, S. Selva, S. Clayden
30	NB	Rockville (The Bluffs)	S. Selva, S. Clayden
31	NB	Crooked Creek Protected Area	S. Clayden
32	NB	Miller Lake	S. Clayden
33	NB	Nalaisk Mountain	S. Clayden
34	NB	Half Moon Lake, Northumberland Co.	S. Clayden
35	NB	Gover Mountain Protected Area	S. Clayden
36	NB	Cranberry Lake Protected Area	S. Selva, S. Clayden
37	NB	Ben Lomond, Saint John	S. Clayden
38	NB	Fundy National Park, numerous localities	S. Gowan, S. Selva, S. Clayden

Site*	Province or state	Locality	Collector, workshop, or excursion
39	NS	Abrahams Lake	S. Selva
40	NS	Cape Breton Highlands NP	S. Selva, S. Clayden
41	NS	French River Wilderness Area, NS	S. Selva
42	NS	Panuke Lake Nature Reserve, Panuke Lake	S. Selva
43	NS	North River Wilderness Area	S. Selva
44	NS	Sugarloaf Mountain Wilderness Area	S. Selva
45	NS	Margaree River Wilderness Area	S. Selva
46	NS	Economy River Wilderness Area, Economy Falls	Tuckerman Workshop 2004
47	NS	Economy River Wilderness Area, Simpson Lake	Tuckerman Workshop 2004
48	NS	Cape Chignecto Provincial Park	S. Clayden, Tuckerman Workshop 2004
49	NS	Five Islands Provincial Park	Tuckerman Workshop 2004
50	NS	Portapique River Wilderness Area	Tuckerman Workshop 2004
51	NS	Kejimkujik National Park	Tuckerman Workshop 1999
52	NS	Blomidon Provincial Park	S. Clayden, S. Selva
53	NS	Quinan Lake	S. Selva
54	PE	Municipality of O'Leary, Wood Woodlot	S. Selva
55	PE	Municipality of Souris, Townshend Woodlot	S. Selva
56	PE	Municipality of Bonshaw, Loo Woodlot	S. Selva
57	PE	Municipality of Eldon, Pinette Hemlocks	S. Selva
58	PE	Municipality of Lewes, MacLean Woodlot	S. Selva
59	PE	St. Chrysostome Cedar Natural Area	S. Selva
60	QC	ZEC Louise Gosford	S. Clayden
61	QC	Parc du Mont-Mégantic	S. Clayden
62	QC	Laurentian Mountains N of Quebec City, localities near Lac Beauport and in Forêt Montmorency	I. Brodo, ABLS excursion 1997
63	ON	several localities in Ottawa region including old-growth Thuja and Fraxinus stands, Lanark and Ottawa-Carleton Counties	I. Brodo, S. Selva, P.Y. Wong

*Site numbers correspond to the map in Figure 6 only.