COSEWIC
Assessment and Status Report

on the

Oldgrowth Specklebelly
Pseudocyphellaria rainierensis

in Canada

SPECIAL CONCERN
2010

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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Oldgrowth Specklebelly — Photo courtesy of Margaret Symon ©2009.

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COSEWIC
Assessment Summary

Assessment Summary – April 2010

Common name
Oldgrowth Specklebelly

Scientific name
Pseudocyphellaria rainierensis

Status
Special Concern

Reason for designation
This foliose, tree-inhabiting lichen is endemic to old-growth rainforests of western North America. In Canada, it is limited to coastal or near-coastal areas of southern British Columbia. Recent discoveries of additional records have only slightly expanded the known range of occurrence, and the lichen remains threatened by ongoing loss of old growth forests through clear-cut logging. The low dispersal ability of its heavy propagules contributes to its rarity, as does its restriction to nutrient hotspots, such as dripzones under old Yellow-cedars, toe slope positions, and sheltered seaside forests. It tends to occur discontinuously and on very few trees in the stands where it is established.

Occurrence
British Columbia

Status history
Designated Special Concern in April 1996. Status re-examined and confirmed in April 2010.

COSEWIC
Executive Summary

Oldgrowth Specklebelly
Pseudocyphellaria rainierensis

Species information

The Oldgrowth Specklebelly lichen (*Pseudocyphellaria rainierensis* Imsh.) is a distinctive macrolichen characterized by large, draping, curtain-like lobes, a pale greenish-blue upper surface, a green algal photobiont (accompanied by a cyanobacterial photobiont in the form of internal cephalodia), ragged, lobulate to isidiate lobe margins, and a pale lower surface bearing scattered small white spots (pseudocyphellae).

Distribution

Oldgrowth Specklebelly is endemic to western North America, where it grows in humid coastal regions from southeast Alaska (58°N) to Oregon (43°N). In the northern portions of its range, it is restricted to within a few kilometres of the ocean, though in southern Canada it extends somewhat farther inland. In Washington and Oregon it is mostly absent from the immediate coast, occurring instead along the windward slopes of the Cascades.

Habitat

In Canada, Oldgrowth Specklebelly colonizes the branches and trunks of conifers in ecologically stable lowland to mid-elevation oldgrowth forests, especially in localized nutrient hotspots. Nutrient hotspots tend to develop in three situations: (1) within the drip zones of large old Yellow-cedar trees, usually on hillsides; (2) in the (nutrient receiving) toe-slope position at the base of hillsides, particularly in localities underlain by calcareous bedrock; and (3) in well ventilated seaside trees in coves sheltered from storm winds. The first habitat type appears to be of greater importance in the northern portion of the range, where climatic conditions suitable to Oldgrowth Specklebelly overlap with the highly acidic Coastal Crystalline Belt. Farther south, in southern British Columbia and adjacent portions of the U.S. northwest, toe-position localities assume greater importance. Here large old Yellow-cedar trees carry soil nutrients into the forest canopy, and so create the elevated nutrient conditions required for successful establishment by Oldgrowth Specklebelly.

Biology

Oldgrowth Specklebelly is an asexual species in which reproduction depends on the propagation and dissemination of thallus fragments, largely in the form of marginal lobules – probably an adaptation for rapid colonization of nutrient-enriched conifer branches prone to heavy overgrowth by mosses. Because marginal lobules are relatively heavy, they can be expected to disperse over only short distances from the host lichen. Presumably this helps to explain this species' highly discontinuous occurrence, which is further enforced by its specific requirement for nutrient-enriched microsites. Rates of dispersal to new host trees are thus very slow in Oldgrowth Specklebelly, apparently operating at a time scale of hundreds of years even within a single stand. Deep shade is detrimental to this species, as is exposure to full sunlight; only in open, humid, stable forest ecosystems does Oldgrowth Specklebelly encounter environmental conditions suitable both for establishment and growth. Oldgrowth stands are thus critical to the long-term persistence of this species.

Population sizes and trends

Oldgrowth Specklebelly has been documented in Canada from 51 localities. At least five of these localities, however, no longer support this species, while its status at another six localities is unknown. Recent thallus counts across the remaining 41 localities yielded 2277 thalli. At a majority of these localities, moreover, Oldgrowth Specklebelly colonizes only one or a few host trees. Its absence from apparently suitable old growth forests elsewhere is presumably owing to inefficient dispersal. This is especially the case in northern portions of the range, where it is restricted mostly to the dripzones of Yellow-cedar. South of about 51° N, it seems to be somewhat more broadly distributed, relying both on Yellow-cedar and on old growth forests occurring in nutrient-receiving toe-position sites. Both habitat types are in rapid decline owing to resource extraction.

Limiting factors and threats

Oldgrowth Specklebelly is confined in Canada to coastal temperate rainforests older than about 200 to 300 years. Here it is further restricted to the branches and trunks of conifers growing in nutrient hotspots, especially nutrient-receiving toe-positions and the dripzones of large old Yellow-cedar trees. Because such habitats types are necessarily restricted to very old forest ecosystems, it is clear that oldgrowth is critical to the long-term survival of Oldgrowth Specklebelly. Hence any human activity or natural process that results in a loss or significant reduction in oldgrowth constitutes a major threat to this species. On northern Vancouver Island, nearly half of the original oldgrowth forest land base within the horizontal and elevational range of Oldgrowth Specklebelly has been harvested, most of it within the past 25 years. In a rainforest region where wildfire is rare, industrial-scale forestry thus stands as by far the most important cause of decline in Oldgrowth Specklebelly – both as a result of habitat loss *per se*, and, in the long term, of ongoing fragmentation of the remaining oldgrowth islands.

Special significance of the species

Oldgrowth Specklebelly is an indicator of long-term environmental continuity in the oldest coastal temperate rainforests of western North America.

Existing protection

Five of the 51 Canadian localities from which Oldgrowth Specklebelly has been documented to date are situated in permanently designated protected areas (National or Provincial Parks). This species has recently been confirmed as extant at only two of these five localities since 2003. Eighteen additional localities receive partial, unlegislated protection within Wildlife Tree Retention Areas, Oldgrowth Management Areas, and Riparian Reserve Zones. Four localities (and a possible fifth locality) are known to have been extirpated by forest harvest, and the remaining 24 localities are on public lands that are potentially available for forest harvest.

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 entities (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 science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2010)

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 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 category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' 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. Definition of the (DD) category revised in 2006.

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

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SPECIES INFORMATION

Name and classification

Pseudocyphellaria rainierensis Imshaug, 1950

Phylum Ascomycota
Subphylum Pezizomycotina
Class Lecanoromycetes
Subclass Lecanoromycetidae
Order Peltigerales
Family Lobariaceae

The Oldgrowth Specklebelly lichen is currently placed in *Pseudocyphellaria* mostly owing to its production of tiny scattered pseudocyphellae over the lower surface. (Pseudocyphellae are cortical openings that permit gas exchange with the thallus interior.) In fact it now appears this species may not actually belong in *Pseudocyphellaria*, as recent molecular work has indicated a closer alliance with various species currently placed in *Lobaria* (Miadlikowska & Lutzoni 2004). In the absence of mature apothecia, the only features shared between Oldgrowth Specklebelly and *Pseudocyphellaria* include the large leafy lobes, the presence of a cyanobacterial photobiont (here taking the form of cephalodia), and the minutely hairy lower surface bearing scattered pseudocyphellae. *Pseudocyphellaria* in the strict sense contains yellow pigments in the medulla, whereas in Oldgrowth Specklebelly the medulla is white.

The earliest known collection of Oldgrowth Specklebelly was made at the type locality on Mount Rainier in 1948; hence the specific epithet (Imshaug 1950). *The English name refers to its association with oldgrowth forests and, like other species of Pseudocyphellaria, the presence of white spots (pseudocyphellae) on the lower surface of the lobes.*

Morphological description

Oldgrowth Specklebelly (Figure 1) is a loosely attached foliose lichen up to about 5-12 (-20) cm across. The lobes are 1.5-3 cm wide and vary from short to elongate. The upper surface is dull, naked, and pale greenish blue, except turning creamy brownish in the herbarium. It is also usually weakly “dimpled,” the dimples being separated by a low network of broad ridges. The lobe margins bear small brittle lobules or, rarely, cylindrical or coral-like isidia. Isidia are also sometimes present over the upper surface, especially along stress cracks. The medulla is white. The lower surface is dull, whitish to pale brownish, minutely hairy, and bears numerous white "breathing pores" (pseudocyphellae). Two kinds of photobionts are present: a green alga forming a more or less continuous layer; and a cyanobacterium (*Nostoc*) confined to localized swellings termed cephalodia. Cephalodia in this species are usually internal (and then visible from above as small, low swellings), though in some specimens they erupt through the upper cortex as small whitish “warts”.

Figure 1. *Pseudocyphellaria rainierensis*: Habit (courtesy of Margaret Symon ©2009).

Pycnidia are occasionally present over the upper surface, appearing as tiny black dots. Apothecia, though rare, also occur over the upper surface. At maturity they measure 1.0 - 1.5 mm across and arise on short "stalks". The apothecial rim is weakly isidiate. Efforts to find mature spores have been unsuccessful.

Chemistry: Cortex K+ yellow, C-, KC-, PD-, I-, UV-; medulla K-, C-, KC-, PD-, I+ blue, UV+ white to blue or UV-. The secondary lichen substances responsible for the positive spot tests are at present unknown, and may be undescribed.

Of particular interest in this species is the occurrence of a specialized isidia-bearing platform analogous to a soralium. This platform (an "isidalium") arises where the upper cortex gathers upward in a tiny, usually circular pedestal roughly 0.8 - 1.5 mm wide by approximately 0.3 - 0.5 mm high. The cortical surface of the isidalium eventually cracks, and a dense cluster of (usually granular) isidia develops along the resulting cortical margin. Such structures can perhaps more typically be interpreted as a highly evolved form of stress crack.

Generic description

Pseudocyphellaria is an essentially southern hemisphere genus of foliose lichens consisting of about 115 species worldwide. Only seven species have been reported from North America (Esslinger 2009), as compared, for example, to 48 species from New Zealand alone (Galloway 2007). The genus is composed mainly of species with medium to broad, ascending lobes, and most particularly, with conspicuous pseudocyphellae on the lower surface of the thallus. Recent molecular studies suggest that *Pseudocyphellaria* is in fact a "form genus" comprised of at least three phylogenetic entities (Miadlikowska & Lutzoni 2004).

Similar species

Oldgrowth Specklebelly is a distinctive lichen, easily recognized in the field by its large, pendent, curtain-like lobes and pale greenish blue colouration. In North America, no other broad-lobed, tree-dwelling lichen combines a pale greenish blue upper surface, a green algal photobiont, and a pale, distinctly spotted (pseudocyphellate) lower surface, a white medulla, and lacerate/isidiate lobe margins.

DISTRIBUTION

Global range

Oldgrowth Specklebelly is endemic to western North America, where it occurs in cool, humid coastal regions from southeast Alaska at 58°N to northern Oregon at 43°N (Figure 2). In southeast Alaska and adjacent portions of coastal British Columbia, it is restricted to within a few kilometres of the ocean, though farther south, in southern British Columbia and Oregon and Washington, it is essentially absent along the outer coast, occurring instead along the windward slopes of the Cascades.

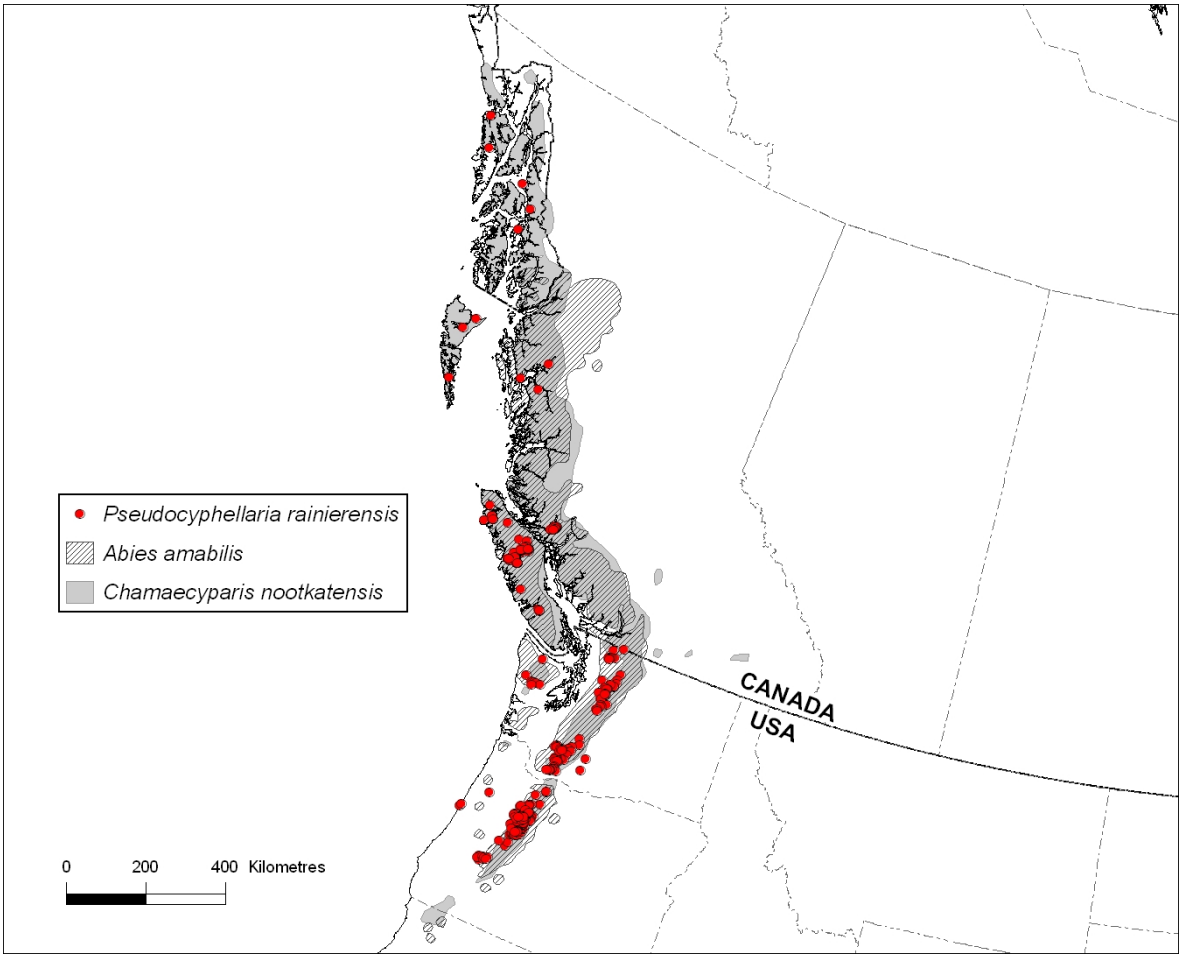

Figure 2. Global distribution of *Pseudocyphellaria rainierensis*. The global ranges of Amabilis Fir (*Abies amabilis*) and Yellow-cedar (*Chamaecyparis nootkatensis*) are included for comparison.

Canadian range

The first known Canadian collection of Oldgrowth Specklebelly was made near Fourth Nanaimo Lake in 1950, the year the species was described. Since then it has been documented in Canada from an additional 51 localities, all in coastal British Columbia (Figure 3; Table 1). Biogeoclimatically, all of these localities are located within the five wettest, coolest subzones of the Coastal Western Hemlock Zone (Meidinger & Pojar 1991).

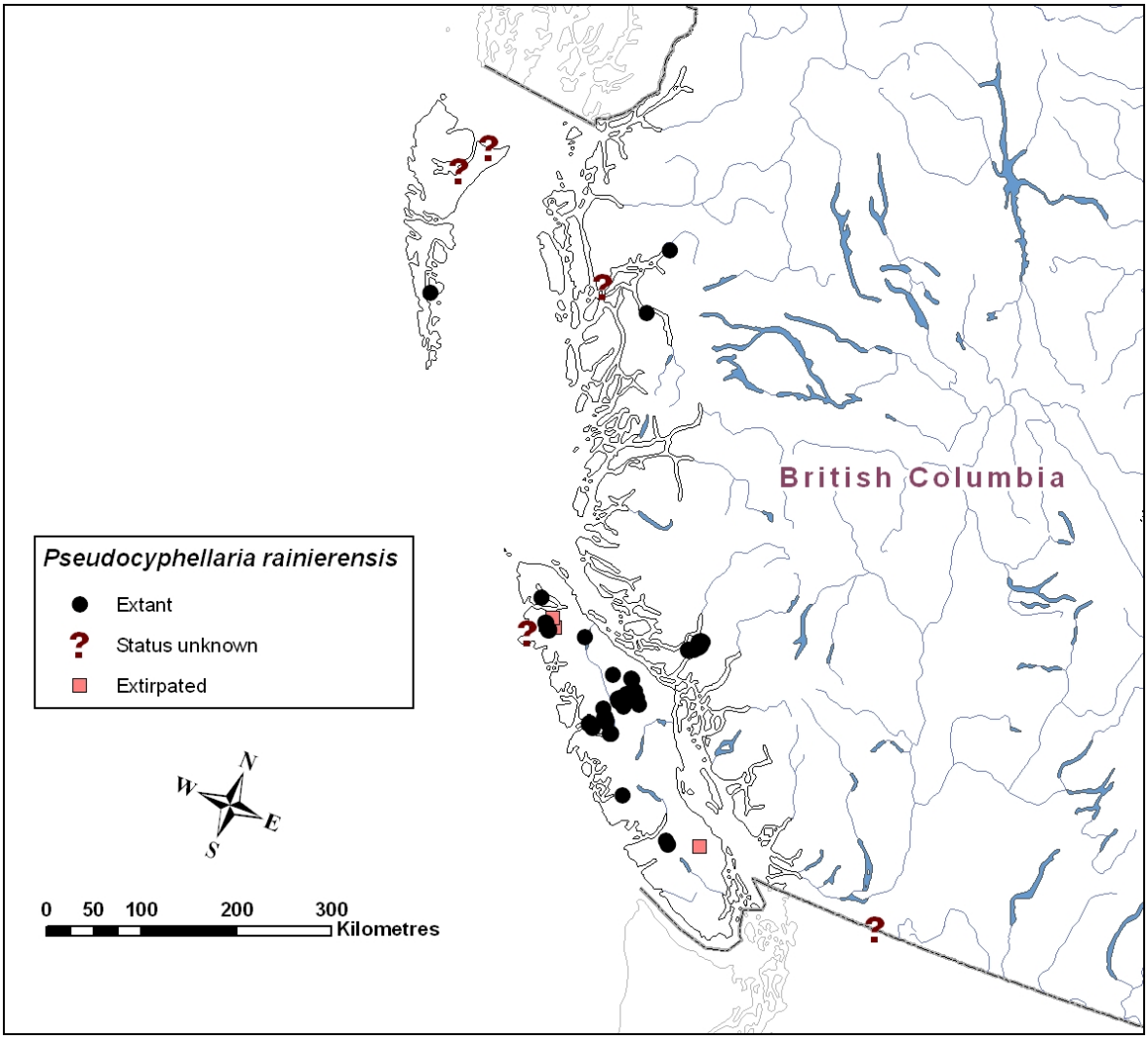

Figure 3. *Pseudocyphellaria rainierensis*: Known distribution in Canada.

Table 1. Summary of the localities of Canadian populations of *Pseudocyphellaria rainierensis* and their historical and current status. All localities are in British Columbia. Localities designated as "Beese 2008" and "Beese 2009" are described at greater length in the on-line reports listed in the Reference section.

	Area	Years Reported	Original population size (no. of thalli)	Population size (2003-2009) (no. of thalli)	Population trend (Population threat)	Ownership
1	Haida Gwaii (Queen Charlotte Islands), Graham Island: Naikoon Provincial Park, Tow Hill area (in original report of Goward 1996)	1971	Unknown	Unknown	Not revisited; location intact (Google Earth, 2009) (Climate Change: major winter storms)	Naikoon Provincial Park
2	Haida Gwaii (Queen Charlotte Islands), Graham Island: near Port Clements; Kumdis Bay	2000	Unknown	Unknown	N/A: visited only once; location intact (Google Earth, 2009) (Climate Change: major winter storms; clearcut logging)	Unknown
3	Haida Gwaii (Queen Charlotte Islands): Gwaii Haanas National Park Reserve; Bischoff Islet	2003	15 thalli	15 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Climate change: major winter storms)	Gwaii Haanas National Park Reserve
4	Kitimat area; Robinson Lake trail (in original report of Goward 1996) and near Volunteer Creek	1970, 2006	13 thalli	13 thalli	Searched for but not found N/A; Volunteer creek visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Unknown but probably unprotected
5	Kitimat area; Europa Creek	2007	6 thalli	6 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Hydro-electric development; Climate change: severe winter storms)	Crown land, no protected status
6	Chilliwack Lake Provincial Park; South of S end of Chilliwack Lake (in original report of Goward 1996)	1992, 2006* *Terry McIntosh, Curtis Bjork and others	3 thalli: litterfall	Unknown	Searched for but not found (Climate change)	Chilliwack Lake Provincial Park
7	(Beese 2008) Vancouver Island; Holberg area: Western Forest Products TFL 6-K560 525R	2008* *Bill Beese and others (Plot 3839)	20 thalli	20 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products, TFL 6 No protected status
8	(Beese 2008) Vancouver Island; Jeune Lake area: Western Forest Products TFL 6-K1100	2008* *Bill Beese and others (Plot 3871, 3876)	45 thalli	45 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products, TFL 6 No protected status
9	Vancouver Island; Port Alice area: outside Western Forest Products TFL 33-511	2005*, 2006 *Derek Woods	82 thalli	80 thalli	N/A: visited only once Not revisited, but location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products, TFL33 No protected status
10	(Beese 2008) Vancouver Island; Jeune Lake area: Western Forest Products TFL 6-Cayuse ML	2008* *Bill Beese and others (Plot 3887, 3872, 3873)	515 thalli	515 thalli	N/A: visited only once; location probably intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products, TFL6 One plot in Wildlife Tree Retention Area, but no legislated protected status
11	Vancouver Island: Brooks Peninsula Provincial Park (in original report of Goward 1996)	1977	Unknown	Unknown	N/A: visited only once; location intact (Google Earth, 2009) (Climate change: severe winter storms)	Brooks Peninsula Provincial Park

	Area	Years Reported	Original population size (no. of thalli)	Population size (2003-2009) (no. of thalli)	Population trend (Population threat)	Ownership
12	(Beese 2010) Vancouver Island; Englewood, Karmutzen Cr. Area	2010 S.Muir (OGS 10-01)	Present in 2010, but no counts made	Unknown	Unknown (visual sighting) (Unknown)	Western Forest Products TFL-37 No protected status
13	(Beese 2008) Vancouver Island; Gold River area	2008* *Bill Beese and others (Plot 3817, 3826)	5 thalli	5 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 19 Wildlife Tree Retention Area but no legislated protected status
14	(Beese 2008) Vancouver Island; Gold River area	2008* *Bill Beese and others (Plot 3824)	30 thalli	30 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 19 No protected status
15	(Beese 2008) Vancouver Island; Gold River area	2008* *Bill Beese and others (Plot 3807, 3808, 3809, 3812, 3813)	13 thalli	13 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 19 3 plots in Wildlife Tree Retention Area but no legislated protected status
16	(Beese 2008) Vancouver Island; Gold River area	2008* *Bill Beese and others (Plot 3804, 3806, 3811)	23 thalli	23 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 19 No protected status
17	(Beese 2008) Vancouver Island; Gold River area	2008* *Bill Beese and others (Plot 3801, 3802)	12 thalli	12 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 19 Riparian Reserve Zone but no legislated protected status
18	(Beese 2008) Vancouver Island; Gold River area	2008* *Bill Beese and others (Plot 3833, 3829, 3832, 3835)	45 thalli	45 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 19 1 plot in Wildlife Tree Retention Area but no legislated protected status 1 plot in Riparian Reserve Zone but no legislated status
19	(Beese 2009) Vancouver Island; Gold River area, Muchalat Valley	2009 Bill Beese	Unknown	No counts, but lichen present in 2009	unknown (Unknown)	Western Forest Products TFL 19 Unknown
20	British Columbia, Vancouver Island; Mt Cain, 14km NW Schoen Lk: West of branch MC400 TFL37, adjacent to cutblock DA102	2006	30 thalli	30 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products, TFL37 No protected status
21	(Beese 2009) Vancouver Island; Sayward area	2009* *Bill Beese and others (Plot 3733)	15 thalli	15 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 39 No protected status
22	(Beese 2009) Vancouver Island; Sayward area	2009* *Bill Beese and others (Plot 3734)	6 thalli	6 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 39 Oldgrowth Management Area but no legislated status
23	(Beese 2009) Vancouver Island; Sayward area	2009* *Bill Beese and others (Plot 3740)	12 thalli	12 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 39 Riparian Reserve Zone but no legislated status

	Area	Years Reported	Original population size (no. of thalli)	Population size (2003-2009) (no. of thalli)	Population trend (Population threat)	Ownership
24	(Beese 2009) Vancouver Island; Sayward area	2009* *Bill Beese and others (Plot 3738)	40 thalli	40 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Unknown)	White River Provincial Park; Plot 3738 is Western Forest Products TFL 39 No protected status
25	(Beese 2009) Vancouver Island; Sayward area	2009* *Bill Beese and others (Plot 3889)	10 thalli	10 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 39 Oldgrowth Management Area but no legislated status
26	(Beese 2009) Vancouver Island; Sayward area	2009* *Bill Beese and others (Plot 3726)	30 thalli	50 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 39 Oldgrowth Management Area but no legislated status
27	(Beese 2009) Vancouver Island; Sayward area	2009* *Bill Beese and others (Plot 3888)	12 thalli	12 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 39 Oldgrowth Management Area but no legislated status
28	(Beese 2009) Vancouver Island; Sayward area	2009* *Bill Beese and others (Plot 3727)	50 thalli	50 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 39 No protected status
29	(Beese 2009) Vancouver Island; Sayward area	2009* *Bill Beese and others (Plot 3751)	40 thalli	40 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 39 Riparian Reserve Zone but no legislated status
30	(Beese 2009) Vancouver Island; Sayward area	2009* *Bill Beese and others (Plot 3735, 3736)	524 thalli (500 in 3736; 24 in 3735)	524 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 3 1 plot in Riparian Reserve Zone but no legislated status – this plot preserves only 24 thalli (3735)
31	(Beese 2009) Vancouver Island; Sayward area	2009* *Bill Beese and others (Plot 3737)	27 thalli	27 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 39 Oldgrowth Management Area but no legislated status
32	(Beese 2009) Vancouver Island; Sayward area	2009* *Bill Beese and others (Plot 3739)	16 thalli	16 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 39 Wildlife Tree Retention Area but no legislated status
33	Vancouver Island; N. of Twaddle Lake and 6km SW of Victoria Peak, Block No: N104, Road: W-79-D1	2007* *Bill Beese, Nels Nielsen	10 thalli	10 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging, windthrow due to edge effect))	Western Forest Products, TFL 19 Wildlife Tree Patch (long-term reserve) but no legislated status
34	(Beese 2008) Vancouver Island; Gold River area	2008* *Bill Beese and others (Plot 3815, 3814, 3816, 3821, 3822, 3823, 3830)	41 thalli	41 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 19 3 plots in Oldgrowth Management Area but no legislated status 1 plot in Wildlife Tree Retention Area but no legislated status
35	Vancouver Island; W. of Elbow Creek and 9km SE of Victoria Peak, Block No: Z17, Road: EB-8	2007* *Bill Beese, Nels Nielsen	10 thalli	10 thalli	N/A: visited only once; location intact (Google Earth, 2009) (Clearcut logging)	Western Forest Products TFL 19 No protected status

	Area	Years Reported	Original population size (no. of thalli)	Population size (2003-2009) (no. of thalli)	Population trend (Population threat)	Ownership
36	Vancouver Island, Clayoquot River	1996 Bill Beese (temporary plot OGS1996)	Unknown	unknown	Unknown. (visual sighting) (unknown)	Unknown tenure Unknown status
37	(Beese 2009) Mainland, SW Coast, White River	2009* Margaret Symon and others (plot 3850)	20 thalli	20 thalli	N/A: visited only once (clearcut logging)	Western Forest Products TFL 44 No protected status
38	(Beese 2009) Vancouver Island, Port Alberni	2009* Margaret Symon and others (plot 3865, 3894)	105 thalli	105 thalli	N/A: visited only once (clearcut logging)	Western Forest Products TFL 44 No protected status
39	(Beese 2009) Mainland, SW Coast; Stafford Valley	2009* Bill Beese (Plot 3741, 3742)	172 thalli	172 thalli	N/A: visited only once (clearcut logging)	Western Forest Products TFL25 No protected status
40	(Beese 2009) Mainland, SW Coast; Stafford Valley	2009* Bill Beese and others (Plot 3754)	10 thalli	10 thalli	N/A: visited only once (clearcut logging)	Western Forest Products TFL 25 No protected status
41	(Beese 2009) Mainland, SW Coast; Stafford Valley	2009* Bill Beese (Plot 3753)	6 thalli	6 thalli	N/A: visited only once (clearcut logging)	Western Forest Products TFL 25 No protected status
42	(Beese 2009) Mainland, SW Coast; Stafford Valley	2009* Bill Beese, J. Sandford (Plot 3743, 3744, 3745, 3746	32 thalli	32 thalli	N/A: visited only once (clearcut logging)	Western Forest Products TFL 25 No protected status
43	(Beese 2009) Mainland, SW Coast; Stafford Valley	2009* Bill Beese (Plot 3750)	50 thalli	50 thalli	N/A: visited only once (clearcut logging)	Western Forest Products TFL25 Riparian Reserve Zone but no legislated status
44	(Beese 2009) Southwest Coast; Stafford Valley	2009* Jeff Sandford (Plot 3749)	40 thalli	40 thalli	N/A: visited only once (clearcut logging)	Western Forest Products TFL 25 No protected status
45	(Beese 2009) Mainland, SW Coast	2009* Bill Beese (Plot 3747, 3748)	59 thalli	59 thalli	N/A: visited only once (clearcut logging)	Western Forest Products TFL25 1 plot in Riparian Reserve Zone but no legislated status (plot 3747); 1 plot with no protected status (plot 3748)
46	Vancouver Island; Port Alice area	2005* *Derek Woods	50 thalli	50 thalli "Probably intact" D. Woods pers. comm.	N/A: visited only once (Clearcut logging)	Western Forest Products TFL 33
47	Vancouver Island; Port Alice area:	2005* *Derek Woods	25 thalli	0 thalli "in road right-of-way" D. Woods, pers. comm.	N/A; Visited only once (Extirpated)	Western Forest Products TFL 33
48	Vancouver Island; near Fourth Nanaimo Lake (in original report of Goward 1996)	1950	Unknown	Probably 0 thalli	Probably extirpated by clearcut logging (Google Earth, 2009) (Presumed Extirpated)	Unknown

	Area	Years Reported	Original population size (no. of thalli)	Population size (2003-2009) (no. of thalli)	Population trend (Population threat)	Ownership
49	Vancouver Island; Port Alice area: Western Forest Products TFL 43-431	2005* *Derek Woods	1 thallus: litterfall	0 thalli	N/A: visited only once, but extirpated by clearcut logging (Google Earth, 2009) (Extirpated)	Western Forest Products, TFL 43 No protected status
50	Kitimat area; west end of Douglas Channel (in original report of Goward 1996)	1970	Unknown	Unknown	Not revisited, but probably extirpated by logging (Google Earth, 2009). (Extirpation uncertain)	Unknown but probably unprotected
51	Vancouver Island; Port Alice area	2005* *Derek Woods	150 thalli	0 thalli	Extirpated by clearcut logging (Extirpated)	Western Forest Products TFL 33

The asterisk in the "Years Reported" column indicates that the lichen was reported by a collector other than Trevor Goward. That collector(s) is listed immediately below the year.

In contrast to its comparatively frequent occurrence in the U.S. Cascades (Figure 2), Oldgrowth Specklebelly has a highly discontinuous range in Canada, with the exception of northern Vancouver Island (Figure 3). While it could be tempting to dismiss this discrepancy as reflecting a more sustained search effort in the U.S. – where Oldgrowth Specklebelly is a targeted species (Lesher *et al.* 2003) – in fact Canadian lichenologists have paid considerable attention to lichen occurrence and distribution in coastal British Columbia (Figure 4; see also Search Effort). Haida Gwaii (the Queen Charlotte Islands), for example, has been intensively inventoried for lichens over a period spanning several decades, yet has yielded only three localities for this species. More likely this discrepancy reflects a much higher incidence of potential habitat in the south than in the north owing in part to a higher incidence of nutrient-enriched trees coupled with relaxed competition from tree-dwelling bryophytes. The exceptionally heavy winter rains characteristic of British Columbia's north coast can be expected to leach soluble cations from the bark of trees (Farmer *et al.* 1991), presumably contributing further to the sparse occurrence of Oldgrowth Specklebelly. Interestingly, this species is relatively most common in those portions of its range where Amabilis Fir (*Abies amabilis*) grows in sympatry with Yellow-cedar (*Chamaecyparis nootkatensis*, Figure 2); see below.

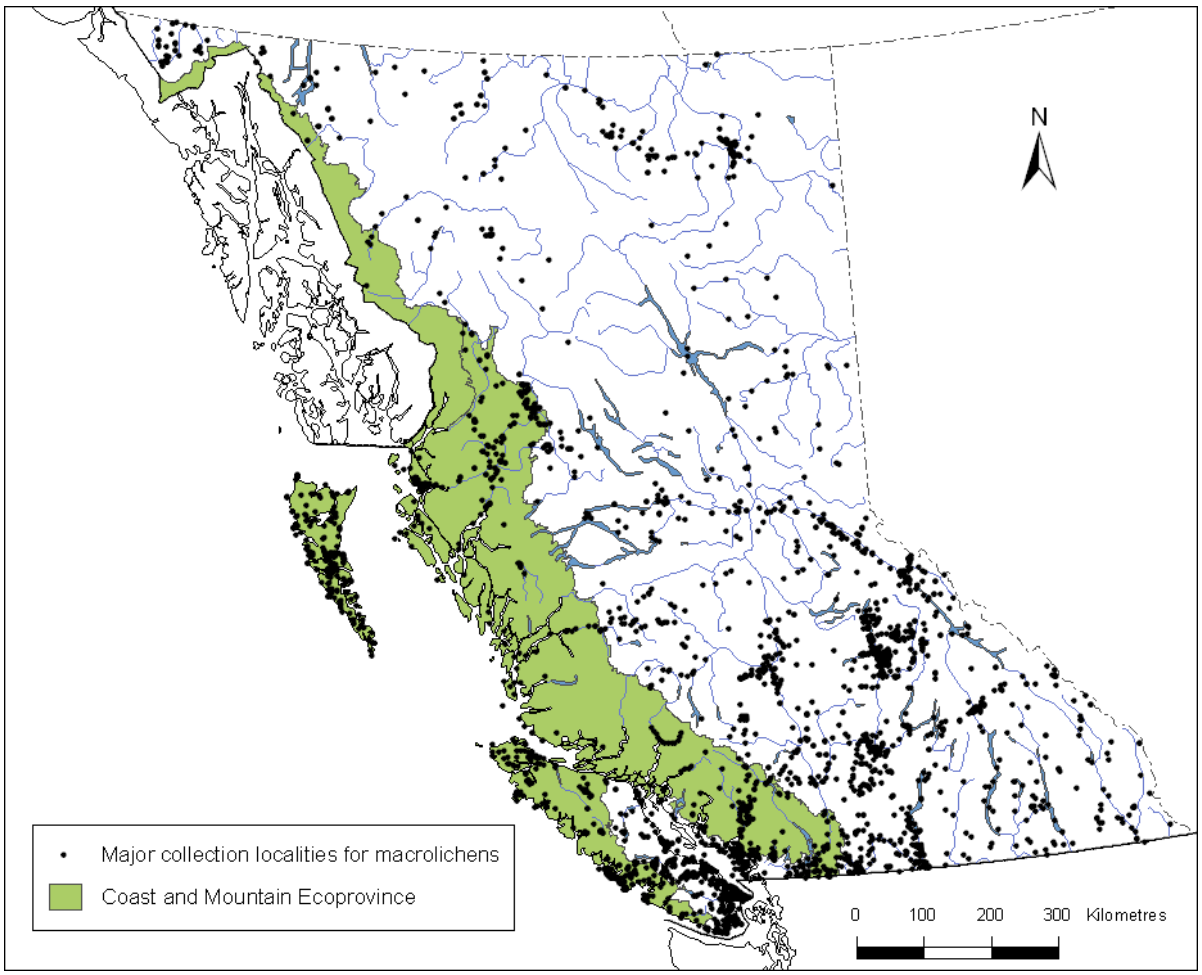

Figure 4. Major general collection localities of macrolichens in British Columbia.

Note: “Locations” are defined as a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon under consideration (IUCN 2001). For convenience, “localities” are reported here as opposed to “locations”. “Localities” in this report are defined as populations separated by at least 1 km. Since the major threat to Oldgrowth Specklebelly is forest harvesting, which operates at scales less than 1 km, and the sizes of the cutblocks are not known, it becomes difficult to estimate the exact number of locations. However, it is likely that the number of locations exceeds the number of localities.

HABITAT

Habitat requirements

Oldgrowth Specklebelly is a tree-dwelling (epiphytic) lichen known almost exclusively from the branches and trunks of conifers in very old conifer forests with long environmental continuity. In Canada it colonizes a narrow range of trees and shrubs, namely Amabilis Fir, Subalpine Fir, Sitka Spruce, Douglas-fir, Yellow-cedar, Western Red-cedar, Western Hemlock, Mountain Hemlock and Western Yew. Many additional trees and shrubs are known to support this species in the U.S. northwest (Sillett 1997).

In common with other tree-dwelling lichens bearing cyanobacterial photobionts – here in the form of cephalodia – Oldgrowth Specklebelly can be characterized as nutrient-demanding (e.g. Gauslaa 1995). It is likely to establish only on trees with a bark pH of greater than 5.0; bark with a pH lower than this is prohibitive to nitrogenase activity, hence fails to promote colonization. Because conifers in the Pinaceae tend to have acid bark (Barkman 1958), their ability to support cyanolichens depends upon nutrient enrichment from extraneous sources. Nutrient enrichment is a rather localized phenomenon within the winter-wet rainforests colonized by Oldgrowth Specklebelly, owing to the tendency of heavy rains to remove nutrients from the system (see previous section). Only in a small number of nutrient-retentive hotspots do nutrients routinely accumulate to levels likely to promote the establishment of tree-dwelling cyanolichens. Such hotspots tend to arise in one or both of two ways, that is, either from the interception of marine aerosols, or from the uptake of nutrients from nutrient-rich soil or bedrock. Both mechanisms operate according to the dripzone phenomenon described by Goward & Arsenault (2000).

An instance of the first mechanism occurs in the case of conifers growing within the dripzone of large old Yellow-cedar trees. The branches of Yellow-cedar consist of large, pendent sprays which presumably enable efficient interception of marine aerosols. Once captured from the air, these aerosols are eventually released as throughfall into the lower canopy, where they are captured in turn by the branches of understory conifers. The resulting improved nutrient status of the understory trees promotes establishment by Oldgrowth Specklebelly and other tree-dwelling cyanolichens. Though Yellow-cedar itself only rarely supports Oldgrowth Specklebelly, old trees of this species are of critical importance to the lichen's long-term persistence over much of its Canadian range by facilitating its establishment on trees, especially Amabilis Fir, growing within the cedar's dripzone. The fact that this lichen is most frequent in those portions of its range where Yellow-cedar and Amabilis Fir overlap (Figure 2) would suggest some sort of synergistic response (Goward, pers. comm.. 2010).).

The second mechanism operates most efficiently in nutrient-receiving sites, especially the toe-slope position at the base of hillsides (Goward & Pojar 1998), and above all in localities underlain by calcareous bedrock. Here soil nutrients apparently accumulate in localized "nutrient pockets", where they are absorbed by mycorrhizae and later transported into the upper canopy, especially, again, by large old Yellow-cedar, but also by large old Amabilis Fir trees. Eventually the nutrients are leached downward into the lower canopy, thereby creating a chemical environment favourable to Oldgrowth Specklebelly. As mentioned earlier, this phenomenon is more widespread in the U.S. portion of the range, but is nevertheless of considerable importance in southern British Columbia, including Vancouver Island.

Oldgrowth Specklebelly is widely regarded as an archetypal old growth-dependent lichen (Sillett & Goward 1998). Its extraordinarily high level of correlation with conifer stands older than about 200 to 300 years can perhaps be attributed to three attributes of old forests. First, oldgrowth forests are available for colonization over long periods – a fact of considerable importance in a species that, like Oldgrowth Specklebelly, is notoriously inefficient at long-range dispersal. Second, the spread of Oldgrowth Specklebelly within a particular oldgrowth forest is clearly favoured by the open, stable, multi-aged canopy structure characteristic of oldgrowth as a whole (Franklin *et al.* 1981) – though rates of spread, even so, are very slow (e.g., Sillett 1997). And third, the ability of conifers both to intercept marine aerosols and to uptake soil nutrients seems to increase with increasing tree age; presumably this reflects a concomitant increase in canopy area and a gradual accumulation of nutrient reserves over the life of the tree, respectively.

Habitat trends

As noted above, the occurrence of Oldgrowth Specklebelly in Canada is limited by a strict requirement for a complex set of environmental criteria. These appear to include: (1) relative proximity to the ocean; (2) a cool, wet climate; (3) stable environmental conditions; (4) elevations below 800-900 m; (5) pronounced nutrient enrichment; and (6) weak to moderate competition from tree-dwelling bryophytes. Only forest stands meeting all of these criteria are likely to provide microhabitats suitable for colonization by Oldgrowth Specklebelly – though even here this species can still be expected to be absent owing to an extremely low capacity for dispersal (see below).

Since the appearance of the first COSEWIC report on *Pseudocyphellaria rainierensis* in the mid-1990s (Goward 1996), 48 new localities have been documented in British Columbia (Table 1), bringing the total number of known localities to 51. Of these, however, four (and a possible fifth) have subsequently been clearcut, and hence no longer support this species, with one additional locality also possibly having been harvested. Although 18 localities are in Wildlife Tree Retention Areas, Oldgrowth Management Areas, and Riparian Reserve Zones, their protection in these areas is not legislated. Hence, “Although all of these reserves have legal requirements, it should be noted that they represent a range of potential ‘protection’ for OGS lichen, from presumably permanent (Parks) to areas subject to substitution with equivalent areas

(WTRAs) or changes in government regulations" (Beese 2010). Not including localities in parks and protected area, 21 localities are available for harvesting; the ownership of the remaining seven localities is unknown.

It is clear that many old growth forests supporting Oldgrowth Specklebelly are being lost to industrial forestry – even prior to being inventoried for this species. In a majority of the localities known to support this species since 2003, Oldgrowth Specklebelly persists in remnant patches more or less surrounded by a patchwork of recent clearcuts; as such it is highly vulnerable to edge effects (Figure 5). Only in a few protected areas do the original old growth forests remain intact (see below).

Figure 5. Aerial view of Locality 51. Locality 51 is here labelled at "Site 19". Note evidence of extensive clearcut logging. *Pseudocyphellaria rainierensis* is restricted to small "islands" of old growth in an "ocean" of clearcuts of different age. All known localities for this species on northern Vancouver Island are subject to similar levels of habitat loss.

Habitat protection/ownership

Of the 51 localities from which Oldgrowth Specklebelly has been documented in Canada, only five are located in areas permanently dedicated to protection from human activity (National or Provincial Parks, Table 1). Eighteen localities, or portions thereof are located on lands that receive protection from harvest, although this protection is not legislated (Wildlife Tree Retention Areas, Old growth Management Areas, and Riparian Reserve Zones).

BIOLOGY

Life cycle and reproduction

Oldgrowth Specklebelly is an asexual species in which reproduction occurs by means of the propagation and dissemination of thallus fragments. Generally these take the form of marginal lobules, though laminal isidia are also produced in some thalli, especially in Oregon and Washington (Sillett & Goward 1998). Reliance on large corticated thallus fragments may improve reproductive success during the establishment phase, e.g., both by circumventing the need for resynthesis and by "jumpstarting" the subsequent generation through the provision of thalline carbon reserves. In any event, Oldgrowth Specklebelly seems better adapted than most cyanolichens to colonizing epiphytic moss mats (Sillett & McCune 1998).

Herbivory

Evidence of cortical grazing by invertebrates has been noted in a few thalli of Oldgrowth Specklebelly. However, herbivory appears to be of little importance in the life history of this species.

Physiology

Research on the ecophysiology of Oldgrowth Specklebelly is still at an early stage. Simple transplant studies, however, suggest this species performs poorly both in shady microsites and in full sun, e.g., in clearcuts (Sillett & McCune 1998). In common with *Lobaria pulmonaria* and other secondary cyanolichens (i.e., species having a green alga as primary photobiont), Oldgrowth Specklebelly is presumably capable, at least in cool weather, of achieving positive net photosynthesis at humidity levels as low as about 80%.

Dispersal

Oldgrowth Specklebelly is an asexual species in which reproduction occurs exclusively via the production and dispersal of marginal lobules and, in some cases, coarse granular isidia. Because lobules and isidia are relatively heavy, they tend to disperse only short distances from the host lichen, resulting in a strongly discontinuous

pattern of distribution (Sillett & McCune 1998). Only on northern Vancouver Island does Oldgrowth Specklebelly occur with sufficient frequency (Beese 2008, 2009) to suggest the existence of a once rather continuous population structure; but any such spatial continuity has for the most part been profoundly disrupted by a long history of clearcut logging (Figure 5).

Even in the event that a lobule or isidium does successfully disperse to a new location, it must still land on and become affixed to a branch segment or trunk portion providing a suitable combination of light, exposure to wetting, ecological stability and (in the case of conifers) nutrient enrichment. The first three requirements are easily met in most oldgrowth forests, but the fourth – nutrient enrichment – is limiting for this species and must further account for its highly discontinuous distribution.

Yet successful long-distance dispersal clearly does occur in Oldgrowth Specklebelly from time to time, as it must have done, for example, at the close of the Fraser Glaciation when this species began to migrate northward into Canada from its glacial refugia in the U.S. northwest. In this connection it is interesting to contrast the relative frequency of this species on northern Vancouver Island (30 localities; see also Beese 2008, 2009) with its obvious rarity on Haida Gwaii (three localities). Possibly the relative rarity of Oldgrowth Specklebelly in the northern portions of its range – including Haida Gwaii – is related at least in part to the absence here of its primary host tree, Amabilis Fir (Figure 2), as well as to the comparatively recent arrival of its primary facilitator, Yellow-cedar; see below.

Interspecific interactions

Little is known about interspecific interactions in Oldgrowth Specklebelly, apart from its obvious dependence on Amabilis Fir, which serves as a primary host tree over most of its range. Also noteworthy is the obvious importance to this species of large old Yellow-cedar trees. Though Yellow-cedar rarely serves as a host tree for Oldgrowth Specklebelly, yet by enhancing the pH of other conifer species growing within its dripzone, it effectively facilitates this lichen's establishment in acidic regions that would otherwise be unavailable to it. In this connection it is interesting to observe the strong correspondence between the distribution area of Oldgrowth Specklebelly and those of Amabilis Fir and, especially, Yellow-cedar (Figure 2).

Adaptability

Poor dispersal ability coupled with a requirement for nutrient-enriched conifer trunks and branches enforces a strikingly narrow ecological niche for Oldgrowth Specklebelly. Indeed, few other old growth-dependent macrolichens are so exclusively tied to old forests throughout their range. In light of its pronounced inability to adapt to changing environmental conditions, Oldgrowth Specklebelly is extremely unlikely to establish in the plantation forests of the future, notwithstanding the report by Sillett & McCune (1998) of favourable growth rates in a young clear cut stand in Oregon. Here it is important to emphasize that short-term physiological compatibility need not translate

into long term persistence: an observation particularly pertinent to young regenerating conifer stands, in which microsite conditions are continuously being altered owing to rapid growth of the canopy layer. One-off claims concerning the putative ability of Oldgrowth Specklebelly to persist in young plantation stands must be reconciled against the virtual absence of this species in young natural forests throughout its range.

POPULATION SIZES AND TRENDS

Search effort

The first Canadian collection of Oldgrowth Specklebelly was made in 1950, near Fourth Nanaimo Lake on Vancouver Island (see Ohlsson 1973). Since then, coastal British Columbia has been the focus of considerable attention by lichenologists (Figure 4). Major inventories have been undertaken especially on Haida Gwaii (the Queen Charlotte Islands) (Brodo 1995), southeast Vancouver Island (Noble 1982), southwest Vancouver Island (Goward, unpublished collections), and Saltspring Island (Bird & Bird 1973). Karl Ohlsson spent several weeks collecting up and down the British Columbia coastline in about 1970 (Ohlsson 1973), while Trevor Goward in the early 90s made a concerted search for Oldgrowth Specklebelly – and other rare cyanolichens – in 145 rainforests located both in inland regions and along the coast (Goward 1994). Since then, Goward has conducted several additional lichenological surveys within the range of Oldgrowth Specklebelly, including southwest Vancouver Island, central Vancouver Island, northern Vancouver Island, the Terrace area, the Kispiox Valley and South Moresby (Figure 4). Other lichenologists in recent years have also sought this species in connection with other work: Curtis Bjork in the Homathko, Southgate and Toba Valleys, as well as in the Vancouver region, the lower Fraser Canyon, and the vicinity of Whistler; Terry McIntosh and Curtis Bjork in the upper Chilliwack Valley; Karen McKeown on Porcher, Pitt, Grief, Yeo, Cunningham and King Islands, as well as in the Prince Rupert and Bella Bella areas; Patrick Williston in the Tulsequah, Prince Rupert and Stewart areas as well as on Porcher Island; Derek Woods and especially Bill Beese (2008, 2009) on northern Vancouver Island and the mainland and adjacent mainland; and Kenneth G. Wright on various other portions of Vancouver Island. Notwithstanding these efforts, Oldgrowth Specklebelly had been observed at only six localities up to 1994 (Goward 1996), and since 2003 has been documented and/or reconfirmed at only 40 localities. It must be noted, moreover, that 30 of these localities have been brought to light as a result of several weeks of intense inventory on the part of Bill Beese and colleagues on northern Vancouver Island and adjacent mainland.

As already noted, Yellow-cedar appears to facilitate establishment by Oldgrowth Specklebelly, a relationship partly responsible for the considerable overlap in their respective ranges (Figure 2). A comparison of their distribution areas with lichen search effort in British Columbia (Figure 4) reveals a major gap in our knowledge of lichen occurrence along the north coast of the province, thus raising the question whether Oldgrowth Specklebelly might eventually be found to be relatively common here. Actually this seems highly unlikely: first because the British Columbia north coast is

largely underlain by the Coastal Crystalline Belt, a region of highly siliceous bedrock elsewhere not known to support this nutrient-demanding lichen; and second because heavy winter rains in this region can be expected to acidify the bark of trees (Farmer *et al.* 1991) – an observation applicable also to the western coast of Haida Gwaii (the Queen Charlotte Islands) where Oldgrowth Specklebelly appears to be absent. Its obvious rarity on the drier, eastern coast of Haida Gwaii (documented from only three localities) appears to be correlated with the absence here of Amabilis Fir; see above.

Abundance

Throughout most of its Canadian range, Oldgrowth Specklebelly exhibits a strongly discontinuous distribution – a pattern no less true regionally than at stand scale. At many localities it is known from only one or a few host trees. Putting aside Localities 10 and 29, which support it in relatively high abundance – 515 thalli and 524 thalli respectively – most populations of Oldgrowth Specklebelly consist of between 10 and 30 thalli. Elsewhere, in shady forests, this lichen can sometimes occur exclusively in the mid-canopy; and here its presence is detectable only as a consequence of litterfall. Three of the 16 localities recorded in this report – Localities 7, 9 and 49 – belong in this category, though at none of these has Oldgrowth Specklebelly been documented in recent years.

Considering only the 41 Canadian localities from which it has been confirmed since 2003, Oldgrowth Specklebelly has a total thallus count in Canada of more than 2277 thalli, as summarized in Table 1. Such modest numbers put into high relief the recent loss to clearcut logging of Locality 51 which supported at least 150 thalli. Thus at least 6% of the total Canadian thallus count since 2003 has subsequently been lost to resource extraction in that one event alone. Of concern is that the logging company in question was alerted to the presence of this remarkable colony at the time of block layout (Derek Woods, pers. comm. 2009). What is more, only 40 thalli of all thalli documented since 2003 are situated on lands available ultimately for logging (including reserve zones, tree retention areas, and management areas).

It is remarkable that a large majority of the Canadian localities currently known to support Oldgrowth Specklebelly are situated on northwest Vancouver Island. In large part this anomaly can be credited to the efforts of Derek Woods and especially Bill Beese (2008, 2009), who have clearly demonstrated that Oldgrowth Specklebelly is less rare on northern Vancouver Island than once believed.

Oldgrowth Specklebelly may once have been relatively widespread over western Vancouver Island as a whole – as evidenced by its former presence in the Nanaimo Lakes region (49°N). If so, then its absence (or apparent absence) south of about 50°N can probably be attributed to habitat loss as a result of large-scale logging. A similar process of exploitation is now well under way on northern Vancouver Island north of Campbell River. According to available figures, nearly half (156,000 of 328,000 ha) of the original old growth forest land base within the horizontal and elevational range of Oldgrowth Specklebelly has now been harvested (Dave Leversee, pers. comm. 2009).

A majority of the remaining high index sites particularly conducive to this nutrient-demanding species are scheduled to be cut in the years ahead. It is worth noting in this connection that most of the cutting on northern Vancouver Island has taken place within the past 25 years (Figure 5).

Fluctuations and trends

This study has documented the loss, within the past decade, of four localities known formerly to support Oldgrowth Specklebelly – including one of the largest known Canadian populations. Projecting ahead, the ongoing loss of old growth conifer forests in coastal British Columbia is certain to result in increasing population fragmentation. Of much greater concern than the actual number of remnant populations is their size and, even more, their increasing isolation from one another. Owing to the essentially exclusive requirement of Oldgrowth Specklebelly for oldgrowth forests – even in the U.S. northwest it has never been found in forests younger than about 140 years (Sillett & Goward 1998) – and since these forests are projected to be logged at 100-120 year rotations, the loss of suitable habitat to logging essentially limits the likelihood of successful recolonization onto trees of the required ages.

Rescue effect

That Oldgrowth Specklebelly is poorly adapted to long-distance dispersal is now well established, e.g., by Sillett & McCune (1998). Thus the loss of this species from any significant portion of its Canadian range, e.g., as a result of forest removal, is unlikely soon to be rectified by natural recruitment from more viable populations elsewhere. Even assuming that the young plantation stands of today were permitted eventually to attain old growth status, the likelihood that Oldgrowth Specklebelly will find its way into these ecosystems is exceedingly low, at least in the absence of more or less continuous dispersal corridors. It can be noted here that this species in the U.S. is confined to the Cascades, and hence longitudinally discontinuous with areas of suitable climatic conditions in Canada.

LIMITING FACTORS AND THREATS

To the best of our knowledge, Oldgrowth Specklebelly occurs on only one or a few host trees at each of the 41 Canadian localities from which it has recently been documented. This, together with an extremely low thallus count of only 2293 thalli, underscores the considerable importance of these localities for its long-term maintenance in Canada. Again, only two Canadian populations of Oldgrowth Specklebelly are situated in a protected area, the rest being located on Crown land currently available for resource extraction. To date this species has disappeared (or is presumed to have disappeared) at six of the 51 Canadian localities from which it has been documented – as a direct result of forest harvest.

Since Oldgrowth Specklebelly occurs exclusively in the canopies of oldgrowth forests, there can be little question of its extreme vulnerability to human activity, especially logging. Also, because Oldgrowth Specklebelly has an extremely low capacity for even medium-range dispersal, there is little reason to hope that localities now being lost as a result of resource extraction will be offset by the rapid colonization of new localities.

Oldgrowth Specklebelly is also likely to be adversely affected by global climate change, especially in the form of an increased incidence in and severity of windstorms, wildfire, insect outbreaks, and other dynamic factors that disrupt ecological continuity at stand scale. In effect this species' ability to maintain itself over time will be seriously compromised by the progressive loss of source populations from which dispersal to other suitable localities can proceed. Clearly these expected trends will be exacerbated by the current ongoing erosion of suitable habitat as a result of clearcut logging.

In summary, industrial-scale forestry poses by far the largest single threat to Oldgrowth Specklebelly in Canada. According to Lesher *et al.* (2003), even stand thinning as a result of selective logging is likely to place this species at risk. In valley situations, the continued existence of Oldgrowth Specklebelly will increasingly depend on management strategies that favour the maintenance of rich, toe-position oldgrowth stands, whereas on sloping ground it will require the retention of undisturbed oldgrowth stands centred on large old Yellow-cedar trees. On a more local scale, increasing mining activity in coastal British Columbia, especially for aggregate, poses an additional threat, as does the construction of infrastructure in support of micro-hydro developments, e.g., at Locality 5 (Table 1; Patrick Williston, pers. 2009.); see also Goward & Bjork (2009).

SPECIAL SIGNIFICANCE OF THE SPECIES

Recent research suggests that the fungal partner in Oldgrowth Specklebelly is phylogenetically isolated, apparently the sole member of an ancient fungal lineage more closely related to *Lobaria* than to *Pseudocyphellaria*. Oldgrowth Specklebelly is also a hallmark of the oldest stands within western North America's coastal temperate rainforests. The production in this species of a highly specialized, and possibly unique, isidial platform (= isidalium) makes it of considerable interest to lichen morphologists. The presence of nitrogen-fixing blue-green cephalodia raises the possibility that it may contribute, albeit marginally, to the nitrogen cycle in the ecosystems in which it at least some oldgrowth ecosystems.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Of the 51 localities formerly or currently known to support Oldgrowth Specklebelly, only five are in protected areas. One of these localities occurs on federal lands, i.e., Gwaii Haanas National Park Reserve, while the remaining four are located in provincial parks, i.e., Chilliwack Lake Provincial Park, White River Provincial Park, Brooks Peninsula Provincial Park, and Naikoon Provincial Park. It must be noted, however, that only White River and Gwaii Haanas populations have recently (as of 2003) been confirmed as extant. The Chilliwack Lake population was searched for in 2007, but was not relocated. Owing to difficulties of access, the status of the remaining two populations remains unknown. Eighteen additional localities on northern Vancouver Island receive partial, unlegislated protection within Wildlife Tree Retention Areas (7), Oldgrowth Management Areas (6), and Riparian Reserve Zones (5). Thus, of the 41 localities recently confirmed to support Oldgrowth Specklebelly in Canada, all but two are on public lands potentially subject to resource extraction.

Oldgrowth Specklebelly has been assigned S1 status in British Columbia (Goward *et al.* 1998). In Canada it is designated as *Special Concern* (COSEWIC). In Oregon, where the greatest number of localities have been documented (e.g., Derr *et al.* 2003), it has received an S3 status by the Oregon Natural Heritage Program. No status summary for lichens is currently available from either the Washington or the Alaska Natural Heritage Program. NatureServe currently accords it a global ranking of G3/G4 which is, however, clearly out of keeping with its actual level of rarity.

TECHNICAL SUMMARY

Pseudocyphellaria rainierensis
Oldgrowth Specklebelly pseudocyphellie des forêts surannées
Range of occurrence in Canada: BC

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines(2008) is being used)	Unknown
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Unknown
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Unknown
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased?	No
Are there extreme fluctuations in number of mature individuals?	Unlikely. Establishment varies considerably from year to year, depending on weather conditions, so it is likely that fluctuations in number of mature thalli also exist, though to what extent is unknown.

Extent and Occupancy Information

Estimated extent of occurrence	183000 km^2
Index of area of occupancy (IAO)	216 km^2
Is the total population severely fragmented?	Not likely. It is not known if habitat between localities is unsuitable and unpopulated. The lichen has poor dispersal capability.
Number of “locations”	47 localities (does not include extirpated localities (4)
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence?	Possibly declining, owing mostly to progressive loss of oldgrowth forests, but probably also as a result of climate change.
Is there an [observed, inferred, or projected] continuing decline in ind ex of area of occupancy?	Possibly declining, owing to loss of habitat as a result of industrial logging.

Is there an [observed, **inferred**, or projected] continuing decline in number of populations?	Possibly. Number of mature individuals in decline, owing to loss of host trees and the old growth forest ecosystems that support.
Is there an [observed, inferred, or projected] continuing decline in number of locations?	Possibly. Six localities have been lost since 2003, but many new localities have been found since 2008.
Is there an [**observed**, **inferred**, or projected] continuing decline in [area, extent and/or quality] of habitat?	Unknown, but presumed declining, due to the loss to logging of oldgrowth forest ecosystems
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations?	Unknown
Are there extreme fluctuations in extent of occurrence?	Unknown
Are there extreme fluctuations in index of area of occupancy?	Unknown

Number of Mature Individuals (in each population)

Population	At least 2277 mature thalli
See Table 1	
Total	

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	Data not available for PVA

Threats (actual or imminent, to populations or habitats)

1) Loss of oldgrowth forest as a result of clearcut logging.
2) Climate change: warmer, drier conditions adversely affect establishment.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)?	S3 (Oregon
Is immigration known or possible?	No known, and unlikely
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes, but decreasing, and unlikely to be accessible to establishment via long-range dispersal
Is rescue from outside populations likely?	Not likely

Current Status

COSEWIC: Special Concern (1996, 2010)

Additional Sources of Information: N/A

Status and Reasons for Designation

Status: Special Concern
Final Criteria: not applicable
Status History: Designated Special Concern in April 1996. Status re-examined and confirmed in April 2010.
Reason for Designation: This foliose, tree-inhabiting lichen is endemic to old-growth rainforests of western North America. In Canada, it is limited to coastal or near-coastal areas of southern British Columbia. Recent discoveries of additional records have only slightly expanded the known range of occurrence, and the lichen remains threatened by ongoing loss of old growth forests through clear-cut logging. The low dispersal ability of its heavy propagules contributes to its rarity, as does its restriction to nutrient hotspots, such as dripzones under old Yellow-cedars, toe slope positions, and sheltered seaside forests. It tends to occur discontinuously and on very few trees in the stands where it is established.

Applicability of Criteria

Criterion A: Not applicable. Past declined observed and inferred decline suspected, but rate unknown because of recent discovery of new populations.
Criterion B: Does not meet criterion as the lichen is not severely fragmented (it is not known if the lichen exists in habitat between many localities, which may be suitable habitat and proximal to one another), and does not show extreme fluctuations in population numbers.
Criterion C: Not applicable. The success of recent inventories suggests that further inventory may result in the number of thalli exceeding 10,000 individuals.
Criterion D: Not applicable. Exceeds thresholds for population size (TH: actual mature individuals more than 2277) and IAO and number of locations exceed thresholds for TH D2 (actual IAO 216 km², and number of localities = 47).
Criterion E: Data not available for PVA.

ACKNOWLEDGEMENTS AND AUTHORITIES CONSULTED

Assistance with this report was received from many people. Field assistance during the 2003 - 2006 field seasons was received from Kenneth G. Wright, Andy MacKinnon, and Bill Beese. Derek Woods generously put his collections of Oldgrowth Specklebelly at the author's disposal, and provided critical information concerning its occurrence on northern Vancouver Island. Curtis Bjork, Irwin Brodo, Terry McIntosh, Karen McKeown, Toby Spribille, Patrick Williston and Kenneth G. Wright all kindly kept an eye out for Oldgrowth Specklebelly during recent field excursions in coastal British Columbia. Olivia Lee at UBC and Pak Yau Wong at the Canadian Museum of Nature graciously responded to requests concerning collections housed at their respective institutions. Jason Hollinger, Chris Roosenboom, and Patrick Williston generously read and commented on an earlier draft of this report. Jenny Wu and Alain Filion, of the COSEWIC Secretariat, produced the maps in Figures 2, 3 and 4. Margaret Symon generously provided the image appearing in Figure 1 and on the cover of the report. Special thanks to Chris Roosenboom for technical support during the early stages of report preparation. Thanks as well as to Dave Leversee of the Sierra Club of British Columbia, for providing figures on the progress of oldgrowth exploitation rates on northern Vancouver Island. Finally, the author extends thanks to members of the Mosses and Lichens Species Specialist Subcommittee of COSEWIC. Funding to offset the cost of field work and report preparation was received from Environment Canada.

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BIOGRAPHICAL SUMMARY OF REPORT WRITER

Trevor Goward began studying lichens in 1976, while completing an undergraduate degree in French and Latin at Mount Allison University, New Brunswick. Since then he has developed and maintained a broad interest in lichen taxonomy and distributional ecology, and has written or co-authored five books on lichens and published about 62 papers in refereed journals. Currently a consulting lichenologist based out of Clearwater, British Columbia, Trevor maintains a special interest in the lichens of oldgrowth forests as well as in the ecology of rare lichens. In 1989, he was appointed as curator of lichens at University of British Columbia, a position he has held ever since. Most of his 30,000+ lichen collections are on deposit with the UBC herbarium. Trevor has served on the lichen subcommittee of COSEWIC from 1995 until 2009.

COLLECTIONS EXAMINED

All known collections of Old growth Specklebelly on deposit at public institutions have been examined in connection with this study. Specimens are listed in Appendix 1.

Appendix 1. Known collections of the North American endemic macrolichen *Pseudocyphellaria rainierensis*. Additional material from nearby areas on northern Vancouver Island has been photodocumented by Beese (2008, 2009). Specimens collected from localities denoted "Beese 2009*" are currently in the possession of Bill Beese, of Western Forest Products.

Herbarium	Location Habitat Substrate	Collector Collecting# Date	Determined / Examined by
UBC	Canada, British Columbia, Chilliwack Lake area. Elev: 650m (verified in Google Earth, 2009) Habitat: Litterfall beneath Red-Cedar	Steve Sillett, 106 25 August 1992	Trevor Goward
Michigan State University, East Lansing	Canada, British Columbia, Vancouver Island, near Fourth Nanaimo Lake Elev: "900m" (Probably 760m, Google Earth, 2009). Habitat: unknown.	Vladimir Krajina, 283. 27 July 1950	Trevor Goward
Western Forest Products, also photographs on file (See Authorities Consulted)	Canada, British Columbia, Vancouver Island: W. of Elbow Creek and 9km SE of Victoria Peak Elev: 750m Habitat: on trunk of old Amabilis Fir under Yellow-cedar in oldgrowth forest	Bill Beese WJB-07-01, photos on file 5 June 2007	Bill Beese & Nels Nielsen
Western Forest Products, also photographs on file (See Authorities Consulted)	Canada, British Columbia, Vancouver Island: N. of Twaddle Lake and 6km SW of Victoria Peak Elev: 540m Habitat: trunk of old Amabilis Fir under Yellow-cedar in oldgrowth forest	Bill Beese WJB-07-02, photos on file 5 June 2007	Bill Beese & Nels Nielsen
UBC	Canada, British Columbia, Vancouver Island, Brooks Peninsula. Elev: near ocean (pers. comm.) Habitat: trunk of Sitka Spruce by shore	Jim Pojar, s. n. 25 June 1977	Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Mt. Cain, 14km NW Schoen Lk Alt: 810m Habitat: branches of Western Hemlock and Amabilis Fir, toe oldgrowth forest under Yellow-cedar	Trevor Goward, 06-xxx 12 October 2006	Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Mt. Cain, 14km NW Schoen Lk Elev: "710m" (860m: Google Earth, 2009) Habitat: branch young Western Hemlock under Yellow-cedar in oldgrowth forest.	Trevor Goward, 96-349 & 96-311, 06-xxx 11 September 1996, 12 October 2006	Trevor Goward

Herbarium	Location Habitat Substrate	Collector Collecting# Date	Determined / Examined by
UBC	Canada, British Columbia, Vancouver Island, Port Alice area Elev: 500m (Google Earth, 2009) Habitat: 2 m up on trunk of Amabilis Fir in oldgrowth conifer forest	Derek Woods, s.n. 2 August 2005	Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Gold River area Elev: 590m Habitat: trunk of Amabilis Fir, 1-5m above ground in oldgrowth forest with Western Hemlock and Yellow-cedar.	Bill Beese 08-18 5 September 2008	Bill Beese/ Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Gold River area Elev: 575m Habitat: trunk of Amabilis Fir, 0.7-2.2m above ground in oldgrowth forest with Western Hemlock, Yellow-cedar and Western Red-cedar.	Bill Beese 08-16 5 September 2008	Bill Beese/ Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Gold River area Elev: 620m Habitat: trunk of Amabilis Fir, 0.7-2.3m above ground in oldgrowth forest with Western Hemlock and some Yellow-cedar.	Bill Beese 08-17 5 September 2008	Bill Beese/ Trevor Goward
No collection made	Canada, British Columbia, Vancouver Island, Port Alice area Elev: 410m (Google Earth, 2009) Habitat: 4 m up on trunk of Amabilis Fir in oldgrowth conifer forest	Derek Woods, no collection made (road right-of-way: decaying thalli) 15 May 2005	Derek Woods
UBC	Canada, British Columbia, Vancouver Island, Port Alice area Elev: 690m Habitat: 2-18 m on trunks of three old Amabilis Firs in oldgrowth forests in gully	Trevor Goward, 06-xxx 10 October 2006	Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Port Alice area Elev: 650m Habitat: litterfall on forest floor with Yellow-cedar nearby	Derek Woods, s.n. 10 May 2005	Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Port Alice area Elev: 650m Habitat: trunk of Amabilis Fir, 2-5m above ground in oldgrowth forest with Western Hemlock and Yellow-cedar.	Derek Woods, s.n. 25 June 2005	Trevor Goward

Herbarium	Location Habitat Substrate	Collector Collecting# Date	Determined / Examined by
UBC	Canada, British Columbia, Vancouver Island, Port Alice area Elev: 710m Habitat: litterfall from forest floor and trunk of Amabilis Fir	Derek Woods, s.n. 19 July 2005	Trevor Goward
UBC	Canada, British Columbia, Haida Gwaii (Queen Charlotte Islands), Bischoff Islet. Elev: 5m Habitat: branch of Sitka Spruce, sheltered site at seashore	Trevor Goward, 03-324 29 July 2003	Trevor Goward
Herbarium of Patrick Williston	Canada, British Columbia, Kitimat Area, Europa Creek. Elev: 380m Habitat: on trunk of a sub-canopy Amabilis Fir in an oldgrowth forest with Yellow-cedar within the spray zone of a cascade.	Patrick Williston, 6131 30 August 2007	Patrick Williston
CANL	Canada, British Columbia, Kitimat area, west end of Douglas Channel. Elev: near sea level Habitat: unknown.	Karl Ohlsson, 2447 21 July 1970	Trevor Goward
UBC	Canada, British Columbia, Kitimat area, Robinson lake trail. Elev: "175 m". Habitat: "in an open swampy area".	Karl Ohlsson, 2437 20 July 1970	Trevor Goward
UBC	Canada, British Columbia, Kitimat area, Robinson lake trail. Elev: 380m (Google Earth, 2009) Habitat: on Amabilis Fir and Western Hemlock under Yellow-cedar in open hillside oldgrowth forest.	Trevor Goward, 06-xxx 11 September 2006	Trevor Goward
CANL	Canada, British Columbia, Haida Gwaii (Queen Charlotte Islands), Graham Island, Tow Hill area. Elev: near sea level. Habitat: Unknown.	Irwin Brodo, 18253 13 July 1971	Trevor Goward
CANL	Canada, British Columbia, Haida Gwaii (Queen Charlotte Islands), Graham Island, Kumdis Bay. Elev: near sea level. Habitat: on Picea snag at edge of wet meadow.	Irwin Brodo 30148, with Jack Miller, Rolf Bettner and Fenja Brodo 15 July 2000	Irwin Brodo

Herbarium	Location Habitat Substrate	Collector Collecting# Date	Determined / Examined by
UBC	Canada, British Columbia, Vancouver Island, Holberg area Elev: 650m Habitat: trunk of Amabilis Fir, 0.7-5m above ground in oldgrowth forest with Western Hemlock and Red-cedar.	Margaret Symon 08-11 3 September 2008	Bill Beese/ Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Jeune Lake area Elev: 650m Habitat: trunk of Amabilis Fir (snag), 3-3.5m above ground in oldgrowth forest with Western Hemlock and Yellow-cedar.	Bill Beese 08-15 4 September 2008	Bill Beese/ Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Jeune Lake area Elev: 648m Habitat: trunk of Amabilis Fir, 1-2.2m above ground in oldgrowth forest with Yellow-cedar and Western Hemlock.	Margaret Symon 08-02 4 September 2008	Bill Beese/ Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Gold River area Elev: 693m Habitat: trunk of Amabilis Fir, 6m above ground in oldgrowth forest with Yellow-cedar and Western Hemlock.	Margaret Symon 08-03 27 August 2008	Bill Beese/ Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Gold River area Elev: 854m Habitat: branch of Amabilis Fir, 4.8m above ground in oldgrowth forest with Western Hemlock and Yellow-cedar.	Margaret Symon 08-05 27 August 2008	Bill Beese/ Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Gold River area Elev: 548m Habitat: branch of Western Hemlock 3.5m above ground in oldgrowth forest with Amabilis Fir and Yellow-cedar.	Margaret Symon 08-06 27 August 2008	Bill Beese/ Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Gold River area Elev: 650m Habitat: trunk of Amabilis Fir, 3-6m above ground in oldgrowth forest with Mountain Hemlock and Yellow-cedar.	Margaret Symon 08-02 26 August 2008	Bill Beese/ Trevor Goward

Herbarium	Location Habitat Substrate	Collector Collecting# Date	Determined / Examined by
UBC	Canada, British Columbia, Vancouver Island, Gold River area Elev: 695m Habitat: branch of Mountain Hemlock, 5.7m above ground in oldgrowth forest with Yellow-cedar and Western Hemlock.	Bill Beese 08-06 26 August 2008	Bill Beese/ Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Gold River area Elev: 649m Habitat: branch of Mountain Hemlock, 3m above ground in oldgrowth forest with Yellow-cedar and Amabilis Fir.	Ian Ritchie 08-01 29 August 2008	Bill Beese/ Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Gold River area Elev: 720m Habitat: branch of Yellow-cedar, 3.7m above ground in oldgrowth forest with Amabilis Fir, Mountain Hemlock and Western Hemlock.	Bill Beese 08-02, 08-04 26 August 2008	Bill Beese/ Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Gold River area Elev: 550m Habitat: trunk of Amabilis Fir, 0.7-5m above ground in oldgrowth forest with Western Hemlock and Red-cedar	Margaret Symon 08-08 28 August 2008	Bill Beese/ Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Gold River area Elev: 635m Habitat: trunk of Amabilis Fir (snag), 3-7m above ground in oldgrowth forest with Yellow-cedar, Western Hemlock and Red-cedar.	Bill Beese 08-14 29 August 2008	Bill Beese/ Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Gold River area Elev: 715m Habitat: forest floor in oldgrowth forest with Western Hemlock, Yellow-cedar and Amabilis Fir.	Margaret Symon 08-09 28 August 2008	Bill Beese/ Trevor Goward
UBC	Canada, British Columbia, Vancouver Island, Gold River area Elev: 765m Habitat: trunk and branches of Amabilis Fir, 1-3m above ground in oldgrowth forest with Yellow-cedar, Western Hemlock and Mountain Hemlock.	Stephanie Major 08-12 29 August 2008	Bill Beese/ Trevor Goward

Herbarium	Location Habitat Substrate	Collector Collecting# Date	Determined / Examined by
UBC	Canada, British Columbia, Vancouver Island, Gold River area Elev: 726m Habitat: trunk of Amabilis Fir, 4.2m above ground in oldgrowth forest with Western Hemlock and Yellow-cedar.	Ian Ritchie 08-09 29 August 2008	Bill Beese/ Trevor Goward
Beese 2009*	Canada, British Columbia, Vancouver Island, Sayward area Elev: 921m Habitat: trunk of Amabilis Fir, 1.5m above ground in oldgrowth forest with Mountain Hemlock and Yellow-cedar.	Stephanie Major 09-03 14 July 2009	Bill Beese
Beese 2009*	Canada, British Columbia, Vancouver Island, Sayward area Elev: 625m Habitat: trunk and branches of Amabilis Fir, 1.5-15 m above ground in oldgrowth forest with Western Hemlock..	Bill Beese 09-07 5 August 2009	Bill Beese
Beese 2009*	Canada, British Columbia, Vancouver Island, Sayward area Elev: 490m Habitat: trunk of Amabilis Fir, 1-10m above ground in oldgrowth forests with Western Hemlock and Yellow-cedar.	Bill Beese 08-19 19 November 2008	Bill Beese
Beese 2009*	Canada, British Columbia, Vancouver Island, Sayward area Elev: 200m Habitat: trunk of Amabilis Fir, 5-15 m above ground in oldgrowth forests with Western Hemlock and Douglas-fir.	Bill Beese 09-08 6 July 2009	Bill Beese
Beese 2009*	Canada, British Columbia, Vancouver Island, Sayward area Elev: 696m Habitat: trunk of Yellow-cedar, 2.5m above ground in oldgrowth forest with Western Hemlock and Mountain Hemlock.	Stephanie Major 09-01 14 July 2009	Bill Beese
Beese 2009*	Canada, British Columbia, Vancouver Island, Sayward area Elev: 318m Habitat: trunk of x Amabilis Fir, 2.5m above ground in oldgrowth forest with Western Hemlock.	Bill Beese 09-03 17 July 2009	Bill Beese

Herbarium	Location Habitat Substrate	Collector Collecting# Date	Determined / Examined by
Beese 2009*	Canada, British Columbia, Vancouver Island, Sayward area Elev: 395m Habitat: trunk of Amabilis Fir, 0.2m above ground in oldgrowth forest with Western Red-Cedar and Western Hemlock.	Stephanie Major 09-05 17 July 2009	Bill Beese
Beese 2009*	Canada, British Columbia, Vancouver Island, Sayward area Elev: 550m Habitat: trunk of Amabilis Fir, 4-8m above ground in oldgrowth forest with Yellow-cedar.	Bill Beese 09-05 6 August 2009	Bill Beese
Beese 2009*	Canada, British Columbia, Vancouver Island, Sayward area Elev: 149m Habitat: trunk of Amabilis Fir, 5m above ground in oldgrowth forest with Western Hemlock and Western Red-cedar.	Bill Beese 09-06 6 August 2009	Bill Beese
Beese 2009*	Canada, British Columbia, Vancouver Island, Sayward area Elev: 675m Habitat: trunk of Amabilis Fir, 5m above ground in oldgrowth forest with Yellow-cedar and Western Hemlock.	Bill Beese 09-02 16 July 2009	Bill Beese
Beese 2009*	Canada, British Columbia, Vancouver Island, Sayward area Elev: 841m Habitat: branch of Amabilis Fir, 2.82m above ground in oldgrowth forest with Yellow-cedar and Mountain Hemlock.	Stephanie Major 09-04 16 July 2009	Bill Beese
Beese 2009*	Canada, British Columbia, Vancouver Island, Sayward area Elev: 880m Habitat: branch of Amabilis Fir, 2-4m above ground in oldgrowth forest with Yellow-cedar and Mountain Hemlock.	Bill Beese 09-01 14 July 2009	Bill Beese
Beese 2009*	Canada, British Columbia, Vancouver Island, Sayward area Elev:797m Habitat: trunk of Amabilis Fir, 4m above ground in oldgrowth forest with Yellow-cedar and Western Hemlock.	Stephanie Major 09-06 17 July 2009	Bill Beese