Management Recommendations for

Pseudocyphellaria rainierensis Imshaug

version 2.0

CONTENTS

SUMMARY

Species: *Pseudocyphellaria rainierensis* Imshaug
Taxonomic Group: Lichens (Rare Nitrogen-Fixing)
ROD Components: 1,2,3

Other Management Status: Oregon Natural Heritage Program List 3 (more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range); Natural Heritage Network Ranks: Oregon State Rank S2 (imperiled because of rarity or because other factors demonstrably make it very vulnerable to extirpation, typically with 6-20 occurrences), Global Rank G3 (Rare, uncommon or threatened, but not immediately imperiled, typically with 21-100 occurrences) (Oregon Natural Heritage Program 1998). BLM Bureau Tracking Status in Oregon (USDI, BLM 1998).

Range: *Pseudocyphellaria rainierensis* is endemic to the Pacific Northwest. It is found from southeastern Alaska, south to British Columbia, Washington, and Oregon. In the range of the northern spotted owl, it is reported from more than 40 sites, mostly on federal lands. It is reported in the Washington Cascades and Olympics, and the Oregon Cascades and Coast Range. It appears to reach the southern limit of its range in Douglas County on the Roseburg BLM District.

Specific Habitat: *Pseudocyphellaria rainierensis* is an epiphyte primarily on conifer trees in cool, humid, old-growth to climax forests in the Western Hemlock or lower Pacific Silver Fir zones. The elevational range of known sites is between 100 m and 1220 m (330-4000 ft). This species is rare in the range of the northern spotted owl. When present, *P. rainierensis* is generally not abundant, and occupies only a portion of what appears to be suitable habitat, suggesting strong dispersal limitations, and possibly specific habitat preferences.

Threats: The main threat to *P. rainierensis* is loss of populations resulting from activities that affect the habitat or the population, including changes in microclimate and removal of colonized substrate. As a nitrogen-fixing species, *P. rainierensis* may be sensitive to air pollution, as has been documented for other nitrogen-fixing lichens. *Pseudocyphellaria rainierensis* appears to be restricted to old forests. The limited distribution and abundance of these older age-classes in the landscape limit potentially suitable habitat, as well as contributing to the isolation of populations.

Management Recommendations:
- Manage populations at known sites by maintaining the ecological conditions associated with *Pseudocyphellaria rainierensis*, including old-growth forest structure, occupied and potentially suitable substrate and a cool, humid, interior forest microclimate. Restrict thinning or other stand treatments that will alter stand microclimate.
- Restrict collection of specimens where the species is rare or of limited abundance.

Information Needs: Determine the distribution of populations, species abundance, and ecological requirements of *P. rainierensis* in the area of the Northwest Forest Plan. Verify the current status of known populations.

Management Recommendations for *Pseudocyphellaria rainierensis*

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Pseudocyphellaria rainierensis Imshaug was first found in Mount Rainier National Park in 1948, and was described by Henry Imshaug in 1950 (Imshaug 1950). It is in the order Lecanorales, suborder Peltigerineae, family Lobariaceae (Tehler 1996).

B. Species Description

1. Morphology and Chemistry

Pseudocyphellaria rainierensis is a large, blue-gray foliose lichen, with thallus lobes typically longer than wide. It bears a superficial resemblance to *Lobaria oregana*, but the bluish-gray color of *P. rainierensis* and presence of pseudocyphellae (white spots) on the lower surface are distinctive features. *Pseudocyphellaria rainierensis* produces abundant lobules and/or isidia along the thallus margin, similar to those found in *Lobaria oregana* (Figure 1).

Technical Description: Thallus foliose, large, loosely appressed to pendulous, 1-2 dm across, brittle when dry; lobes 0.5-3 cm broad; upper surface gray or pale bluish-gray, smooth or irregularly wrinkled; lower surface whitish to light brown, tomentose, with scattered conspicuous pseudocyphellae, 0.2-0.6 mm in size; primary photobiont a green alga, with internal cephalodia containing the cyanobacterium photobiont; lobules and coralloid isidia present; apothecia rare, reddish-brown, with thalline margin; medulla white to gray; cortex K+ yellow; medulla K- or brownish, all other spot tests negative (Imshaug 1950, McCune and Geiser 1997).

2. Reproductive Biology

Pseudocyphellaria rainierensis apparently reproduces primarily by producing asexual lobules and isidia, which break off the thallus and become established nearby. Because of the size of the lobules (0.5-3 mm), dispersal distances are probably typically short, limiting this species' dispersal capabilities. Only one fertile population is known (Sillett 1997, Sillett and Goward 1998), suggesting that apothecia are very rare and sexual reproduction is uncommon. The patchy distribution of *P. rainierensis*, even in suitable habitat, suggests there are factors limiting its dispersal and establishment (Sillett 1997, Sillett and Goward 1998, Goward 1994).

3. Ecological Roles

Pseudocyphellaria rainierensis is a nitrogen-fixing lichen. Nitrogen-fixing lichen species play an important ecological role by contributing nitrogen to ecosystems. Although *P. rainierensis* is generally restricted in its ecological distribution and generally not abundant when present, it provides a source of nitrogen in ecosystems where this nutrient is often limiting.

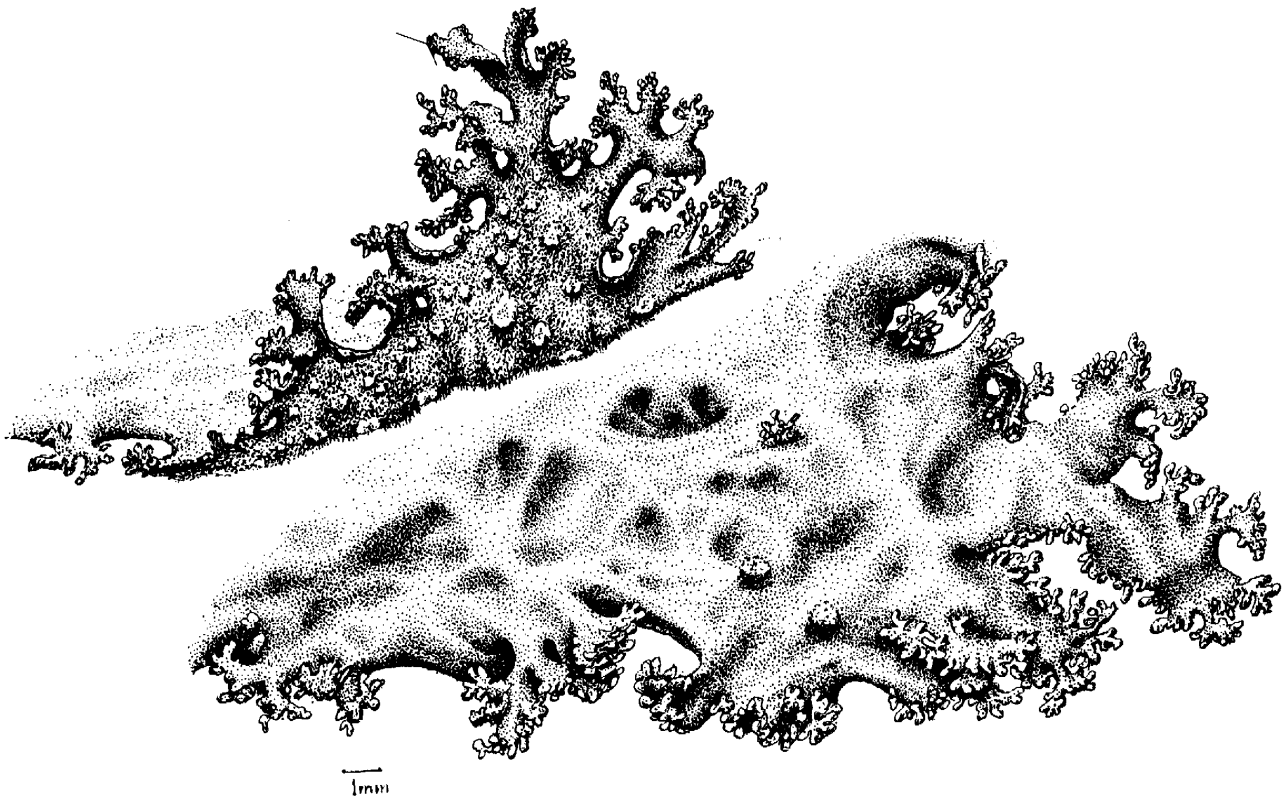

Figure 1. Line drawing of *Pseudocyphellaria rainierensis* by Alexander Mikulin.

C. Range and Known Sites

Pseudocyphellaria rainierensis is endemic to the Pacific Northwest. It is found from southeastern Alaska south to British Columbia, Washington, and Oregon. It is only known west of the Cascade crest. In the range of the northern spotted owl it is reported from more than 40 sites, mostly on federal lands. It is reported from Washington in Whatcom, Snohomish, King, Pierce, Lewis, Skamania, Clallam, and Jefferson counties. In Oregon, it is reported from Clackamas, Marion, Linn, Lane, Lincoln, Polk, and Douglas counties. It appears to reach the southern limit of its range in Douglas County, Oregon.

Pseudocyphellaria rainierensis is documented from nine disjunct sites on the Mt. Baker-Snoqualmie National Forest (Whatcom, Snohomish, and King counties), from the Nooksack River valley south to the Alpine Lakes Wilderness. Populations are reported from Mount Rainier National Park (Pierce County), including the type locality (Imshaug 1950). It is reported from four sites on the Olympic Peninsula in Clallam, Jefferson, and Grays Harbor counties; these sites need to be verified. It is known from multiple sites on the Gifford Pinchot National Forest (Lewis and Skamania Counties), from the Cowlitz Valley Ranger District, and Mount St. Helens National Volcanic Monument south to the Mount Adams Ranger District.

In Oregon, it is known from the upper Sandy River, Estacada Ranger District, Mt. Hood and Bull of the Woods Wilderness areas on the Mt. Hood National Forest (Clackamas County); Salem District BLM in the Coast Range (Polk County), and Cascades (Linn County); and on the Willamette National Forest from the North Fork Santiam River area (Marion and Linn counties), south to the H.J. Andrews Experimental Forest (Lane County). It is also known from the Oregon Coast at Cape Perpetua in Lincoln County (Sillett 1995). Based on current information, the southern limit of its range is on the Roseburg District BLM (Douglas County).

D. Habitat Characteristics and Species Abundance

Pseudocyphellaria rainierensis is a rare species throughout the range of the northern spotted owl. It appears there are factors that limit the dispersal and establishment of this lichen, as it is often absent from sites that appear to be suitable habitat. When present, *P. rainierensis* is not abundant; within stands it typically has a patchy distribution and is absent on apparently suitable substrate. *Pseudocyphellaria rainierensis* is very limited in distribution and appears to be restricted to old-growth and climax forests.

Pseudocyphellaria rainierensis is an epiphyte primarily on conifer trees in old-growth forests in the Western Hemlock or lower Pacific Silver Fir zones. It has been reported as an epiphyte on Pacific silver fir (*Abies amabilis*), Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), subalpine fir (*Abies lasiocarpa*), Pacific yew (*Taxus brevifolia*), Sitka spruce (*Picea sitchensis*), and western redcedar (*Thuja plicata*), as well as bigleaf maple (*Acer macrophyllum*), vine maple (*Acer circinatum*), red alder (*Alnus rubra*), cascara (*Rhamnus purshiana*), chinquapin (*Chrysolepis chrysophylla*), black cottonwood (*Populus trichocarpa*), and Pacific rhododendron (*Rhododendron macrophyllum*). The elevational range of known sites is from 100 m to 1220 m (330-4000 ft). The common feature of the habitats at known sites appears to be old-growth forest structure with cool, humid microclimate.

In the North Cascades of Washington on the Mt. Baker-Snoqualmie National Forest, the typical habitat of *P. rainierensis* is mesic to moist, old-growth Pacific Silver Fir/Alaska Huckleberry (*Vaccinium alaskaense*) forests more than 500 years old. Generally, these sites are in wet climatic areas with high precipitation, and the forests are characterized by high humidity and cool temperatures. In these areas, *P. rainierensis* is an epiphyte on the lower boles of Pacific silver fir. Other habitats where this species has been documented in northern Washington include an old-growth Douglas-fir/western hemlock forest, and an unusual low elevation stand of dead or dying subalpine fir on the Sulphur Creek lava flow (Rhoades 1981).

In the southern Washington Cascades on the Gifford Pinchot National Forest, *P. rainierensis* grows in old-growth Douglas-fir/western hemlock forests, with western redcedar and Pacific yew sometimes present. In this area, it has been recorded as an epiphyte on Douglas-fir, western hemlock, Pacific silver fir, bigleaf maple, and vine maple.

In Oregon, the majority of known sites are in old-growth conifer forests. Typical habitat for *P. rainierensis* is old-growth Douglas-fir/western hemlock forests from 490 m to 900 m (1600-2950 ft) elevation. It has been recorded as an epiphyte on Douglas-fir, western hemlock, Pacific silver fir, Pacific yew, western redcedar, Sitka spruce, red alder, chinquapin, and in canopy litterfall. In Oregon, it may not be restricted entirely to interior forest; it has persisted on an old-growth Douglas-fir at the edge of a 20-year-old clear-cut (Sillett 1995), and was found on an open grown western hemlock on a talus slope in an old-growth Douglas-fir/western hemlock forest. This lichen species has also been found on the moss-covered branches of Pacific yew in partially open conditions under the shelter of an old-growth forest canopy.

Pseudocyphellaria rainierensis appears to be one of the last lichens to reach the upper canopy during forest development (McCune 1993, Sillett 1995, Sillett and Neitlich 1996). In the 700-year-old Douglas-fir trees it was limited to the middle and lower crown (Sillett 1995), with a distribution pattern similar to the moss, *Antitrichia curtipendula*. These moss mats may provide an important function in regulating moisture regimes in the forest canopy (Norris, pers. comm., Sillett 1995), and may contribute to providing suitable habitat and microclimatic conditions for *P. rainierensis*.

Several reports of *P. rainierensis* are from stands younger than 200 years (Sillett 1995, Messinger pers. comm.). These sites are in the western Oregon Cascades and described as mature forests, late-successional forests, and a 140-year-old riparian forest of Douglas-fir and western hemlock.

II. CURRENT SPECIES SITUATION

A. Why Species is Listed Under the Survey and Manage Standard and Guideline

Pseudocyphellaria rainierensis was considered at risk under the Northwest Forest Plan because of its rarity and limited distribution in the range of the northern spotted owl (USDA and USDI 1994a, 1994b). At the time of the lichen viability panel, it was known from 16 sites in the range

of the northern spotted owl (USDA and USDI 1994a, 1994b). This species is endemic to the Pacific Northwest and reaches its southern limit in Oregon. Based on current information, it is closely associated with old-growth forests. In addition, it is assumed to be sensitive to air pollution, as inferred from the known sensitivity of other nitrogen-fixing lichen species (Rose 1988). Because of its rarity, its close association with old-growth forests, and its presumed dispersal limitation, *P. rainierensis* is potentially vulnerable to land management activities, and there was a high level of concern for species persistence. Because of these concerns, *Pseudocyphellaria rainierensis* was listed under the Survey and Manage strategies 1,2 and 3 to manage known sites, to locate additional populations on federal lands, and to identify high priority sites for management (USDA and USDI 1994c).

B. Major Habitat and Viability Considerations

The close association of *P. rainierensis* with old forests in certain climatic regimes in the Pacific Northwest is an important factor determining this species' distribution. This association indicates specific ecological requirements, and may reflect the inability of this species to become established or maintain viable populations in younger forests. The limited extent of older age-classes across the landscape, particularly in certain geographical areas, suggests that potential suitable habitat may be limited for this species. This contributes to the isolation of populations and the vulnerability of populations to disturbance. The major viability consideration for *P. rainierensis* is loss of populations resulting from management activities that affect populations or their habitat.

It appears there are factors that limit the dispersal and establishment of this lichen. *Pseudocyphellaria rainierensis* is often absent from sites that appear to be suitable habitat. Even when this species occurs, it is patchy in its distribution and is absent on apparently suitable substrate.

A warming climate may stress populations at the limits of a species' range, and could result in a decline in vigor and a more restricted distribution of *P. rainierensis.*

C. Threats to the Species

Threats to *P. rainierensis* are those actions that disrupt stand conditions necessary for its survival, including treatments that may directly or indirectly affect populations, such as removing colonized or potential substrate, stand treatments that result in changes in forest structure or changes in microclimate (such as temperature, humidity, radiation). Significant deterioration in air quality is also a potential threat to this species.

D. Distribution Relative to Land Allocations

The distribution of known sites of *P. rainierensis* relative to land allocations needs to be determined. Each administrative unit should evaluate the land allocations for known sites on lands within its jurisdiction, and share this information at the regional level.

III. MANAGEMENT GOAL AND OBJECTIVES

A. Management Goal for the Species

The goal for managing *Pseudocyphellaria rainierensis* is to assist in maintaining species viability.

B. Objectives

Manage known sites on federal lands by maintaining habitat, forest structure, occupied and potential suitable substrate, and microclimatic conditions associated with *P. rainierensis*.

IV. HABITAT MANAGEMENT

A. Lessons From History

Lichen species with specific ecological requirements may experience population declines in response to land management activities that affect habitat or decrease potential or occupied habitats. Loss of species richness has been documented in areas of Europe in response to land management practices (Rose 1988, Olsen and Gauslaa 1991, Esseen *et al*. 1992). There has been little documentation of *P. rainierensis* in response to management treatments or other disturbance in the Pacific Northwest. It was probably more abundant in the past, since some of its probable habitat and substrate has been removed through timber harvest activities.

The thalli of *P. rainierensis* may need time to become acclimatized to edge conditions when populations are isolated by harvesting (Sillett 1994). Sillett conducted transplant studies of *P. rainierensis* thalli that originated from edge and old-growth interior forest sites. His results showed that edge lichens transplanted back to a 20-year-old regeneration clear-cut edge environment grew well, but interior lichens from a 700-year-old stand transplanted to the clear-cut edge lost weight (Sillett 1994). This study suggests that maintaining interior forest habitat conditions around *P. rainierensis* populations adjacent to timber harvest or road building activities may be important.

Many lichen species are known to be sensitive to air pollution, and lichen population declines attributed to air pollution have been documented in Europe and North America (Rao and LeBlanc 1967, Skye and Hallberg 1969, Hawksworth 1971, Ferry *et al.* 1973, Hawksworth and Rose 1976, Case 1980, Sigal and Nash 1983, Gilbert 1992). Many nitrogen-fixing lichen species are especially sensitive to air pollution, particularly sulfur dioxide (Wetmore 1983). The air pollution sensitivity of *P. rainierensis* is unknown, but it is likely to be sensitive to pollution, based on the known sensitivity of other nitrogen-fixing lichen species.

B. Identifying Habitat Areas for Management

All known sites of *Pseudocyphellaria rainierensis* on federal lands administered by the Forest Service and BLM in the range of the northern spotted owl are identified as habitat areas where

these management recommendations apply. A habitat area for management is defined as suitable habitat occupied by or adjacent to a known population.

C. Managing in Habitat Areas

- Determine the extent of the local population and habitat area with a field visit.
- Habitat areas should be managed to include an area large enough to maintain the ecological conditions associated with *P. rainierensis*, including undisturbed forest structure and interior forest microclimatic conditions.
- At all locations, current habitat conditions should be maintained, and allowed to develop naturally. The size of the area necessary to maintain populations and interior forest conditions should be determined by a field visit.
- Maintain occupied substrate and manage a habitat area large enough to provide for a distribution of appropriate substrate within the habitat area.
- Restrict thinning or other stand treatments that will alter stand microclimate.
- Prevent fire in habitat areas with emphasis on fire suppression.
- Restrict collection of specimens in areas where this species is rare or of limited abundance.

D. Other Management Issues and Considerations

- Providing a well-distributed network of older forests in the range of *Pseudocyphellaria rainierensis* will provide stands to replace those lost to fire, blowdown, or other natural disturbance events.
- Target the older stands in watersheds to meet the Standard and Guideline for 15% retention of old-growth in watersheds where little remains. Maintaining the older age classes across the landscape is important for *Pseudocyphellaria rainierensis* as this lichen typically does not occur in younger-aged late-successional forests.
- *Pseudocyphellaria rainierensis* should be evaluated for its sensitivity to air pollutants. As a nitrogen-fixing lichen, it is thought to be very sensitive to air pollution.

V. RESEARCH, INVENTORY AND MONITORING NEEDS

The objective of this section is to identify opportunities to acquire additional information which could contribute to more effective species management. The content of this section has not been prioritized or reviewed as to how important the particular items are for species management. The inventory, research, and monitoring identified below are not required. These recommendations should be addressed by a regional coordinating body.

A. Data Gaps and Information Needs

- Revisit known sites to verify the status of known populations, determine the extent of populations and abundance, and characterize ecological conditions.
- Request additional information from S. Sillett, K. Glew and G. McHenry-Teller to incorporate their reported sites of *P. rainierensis* into the regional interagency species database.

- Locate and determine the status of reported populations on the Olympic Peninsula.
- Prioritize Strategy 3 surveys in areas where projects are scheduled or proposed.
- Determine the distribution of *P. rainierensis* in areas identified as potential suitable habitat. Potential suitable habitat is characterized as old-growth to climax forests in high precipitation areas of the Western Hemlock and Pacific Silver Fir zones, with cool humid microclimate.
- Determine the air pollution sensitivity of *P. rainierensis.*
- Revisit the 140-year-old riparian site in the Blue River basin, and other sites in stands less than 200 years old on the Willamette National Forest, and characterize habitat conditions and forest structure to compare with the ecological conditions at other sites.

B. Research Questions

- What habitat characteristics and ecological conditions are necessary for establishment of *P. rainierensis* propagules and survival of established thalli?
- What are the dispersal mechanisms and dispersal distances of *P. rainierensis* propagules?
- What limits dispersal and establishment of propagules and colonization of suitable habitat?
- What are the rates of growth and reproduction for this species?
- What is the genetic diversity of this species within its local populations and across the region?
- Can other locations be found where populations of *P. rainierensis* have persisted after harvest treatments, as reported by Sillett (1994, 1995)?
- Is *P. rainierensis* sensitive to air pollution?

C. Monitoring Needs and Recommendations

- If management activities occur near known sites, monitor the population to determine its response to treatment and the effects on the population.
- Establish monitoring plots in the population of *P. rainierensis* in the recent blowdown area of the Sauk river on the Mt. Baker-Snoqualmie National Forest to document population trends of *P. rainierensis* in response to this disturbance.
- Consider establishing air quality monitoring plots near selected known populations.

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