

Conservation Assessments for 5 species of Lichens

Hypogymnia duplicata (Ach.) Rass.
Pilophorus nigricaulis Sato
Pseudocyphellaria rainierensis Imshaug
Sticta arctica Degel.
Tholurna dissimilis (Norman) Norman

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**Updated April 2013 by
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U.S.D.A. Forest Service Region 6 and U.S.D.I Bureau of Land Management
Interagency Special Status and Sensitive Species Program

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Preface

Converting Survey and Manage Management Recommendations into Conservation Assessments
January 2005: Much of the content in this document was included in previously transmitted Management Recommendations developed for use with Survey and Manage Standards and Guidelines. With the removal of those Standards and Guidelines, the Management Recommendations have been reconfigured into Conservation Assessments to fit Special Status/Sensitive Species Program (SSSSP) objectives and language. Changes include: the removal of terminology specific to Survey and Manage Standards and Guidelines, addition of Oregon Natural Heritage Information Center (ORNHIC), Washington Natural Heritage Program (WNHP) ranks for the species, and the addition of USDA Forest Service (FS) and USDI Bureau of Land Management (BLM) Sensitive Species (SS) status and policy. Where possible, habitat, range, taxonomic and site information have also been updated to be current with data gathered since the Management Recommendations were initially issued. The framework of the original documents has been maintained in order to expedite getting this information to field units. For this reason these documents do not entirely conform to recently adopted standards for the Forest Service and BLM for Conservation Assessment development in Oregon and Washington.

September 2012: Species biology, habitat, taxonomy, range, and site information were updated with new information gathered since 2005. Site information, including vouchers, were often tracked down and verified as well. Of the 5 species included in this document, 3 currently have status under the Survey and Manage Standards and Guidelines (HYDU, PSRA, and THDI). In addition, 2 of the 5 species are listed by Oregon/Washington BLM (OR/WA BLM) and Region 6 Forest Service (R6 FS) as Sensitive in Oregon (PINI, THDI). One species (STAR) is neither Sensitive nor Survey and Manage, but is listed as Strategic for Oregon.

Site Management and Management Considerations

Within each of the following Conservation Assessments, under the “Managing in Species Habitat Areas” section, there is a discussion on “Management Considerations” for each species. “Management Considerations” are actions and mitigations that the deciding official can utilize as a means of providing for the continued persistence of the species’ site. Under Sensitive and Special Status Species policy, these considerations are not required and are intended as general information that field level personnel could utilize and apply to site-specific situations. However, to meet Survey and Manage Standards and Guidelines, site management for the 3 Survey and Manage species must be implemented, and the considerations listed herein should be followed for those species. Additional information, including species specific maps, is available on the Interagency Special Status Species website.

Conservation Assessment
for
Hypogymnia duplicata (Ach.) Rass.

Originally issued
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March, 2000
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SUMMARY

Preface: Since the Conservation Assessment in 2005, new sites have been reported and additional information has been collected regarding the habitat of *Hypogymnia duplicata* and is presented herein.

Species: *Hypogymnia duplicata* (Ach.) Rass.

Taxonomic Group: Lichens

Other Management Status: Forest Service Region 6 and Bureau of Land Management (BLM) Strategic Species for Oregon. It is a Category C species under the Survey and Manage Standards and Guidelines. From NatureServe the species is ranked with a Global Heritage Rank of G4, described as apparently secure, uncommon but not rare; some cause for long-term concern due to declines or other factors. The species is not on the Washington State Heritage list, but it has a State rank of S2 in Oregon, described as imperiled because of rarity due to a very restricted range, very few populations, steep declines or other factors making it vulnerable to extirpation in the State. The Oregon Biodiversity Information Center (ORBIC) ranks the species Heritage List 3, considered taxa for which more information is needed before status can be determined but which may be threatened or endangered in Oregon.

Range: Global distribution is restricted to northwest North America and is primarily from Prince William Sound, Alaska south to northwestern Oregon. There are a few sites in the Oregon Coast and Cascade Ranges, but most of the US Pacific Northwest known sites occur in the Washington Cascades. On federal land in Washington, it is known to occur on the Mt. Baker-Snoqualmie and Olympic National Forests, and Olympic National Park. In Oregon, it is known to occur on the Mt. Hood National Forest, Columbia River Gorge National Scenic Area, Siuslaw National Forest and Salem District BLM. There is an unverified report from the Willamette National Forest.

Specific Habitat: *Hypogymnia duplicata* has a fairly narrow ecological amplitude. It grows as an epiphyte on mountain hemlock, western hemlock, Pacific silver fir, Douglas-fir and subalpine fir in old-growth forests of the western Cascades, Olympics and Coast Range, primarily between 330 and 1660 m (1100-5450 ft) elevation. In the western North Cascades, *H. duplicata* is found in high precipitation areas in old-growth mountain hemlock/Pacific silver fir forests in the moist to mesic Alaska huckleberry plant associations. Habitat for Oregon populations is noted mostly as moist hemlock stands and true fir forests. Rare habitat types include moss-covered basalt outcrops and snags in a bog.

Threats: The main threat to *Hypogymnia duplicata* is loss of populations due to activities that affect the habitat or the population, including removal of colonized substrate and alteration of microclimate. Declining air quality may be a threat to populations if it is determined that *H. duplicata* is sensitive to air pollution. A warming climate may stress populations at the limits of this species' range, and could result in a decline in vigor and a more restricted distribution of *H. duplicata*.

Management Considerations:

- Restrict thinning or other stand treatments that will alter stand microclimate.
- Utilize or prevent fire in the habitat areas with emphasis on fire suppression.

Data and Information Gaps:

- Verify current status of known populations; determine the distribution of populations, species abundance and ecological requirements of *Hypogymnia duplicata* in Oregon and Washington.
- Determine the air pollution sensitivity of *Hypogymnia duplicata*.

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Hypogymnia duplicata (Ach.) Rass was originally described (as *Parmelia*) by Acharius. This species is in the order Lecanorales, suborder Lecanorineae, family Parmeliaceae (Tehler 1996).

Synonym: *Hypogymnia elongata* (*vide* Goward).

B. Species Description

1. Morphology and Chemistry

Hypogymnia duplicata is a medium-sized foliose lichen with hollow, narrow lobes. The thallus is pendulous and its branches form a cascade of curved lobes. The lobes are narrow, typically uniform in width, 1-2 mm wide, and characteristically turn up at the lobe tips (Figure 1). The upper surface is grayish-white, lower surface is black and without rhizines (root-like holdfasts); lobe interior usually white; apothecia uncommon.

Technical description: thallus foliose, medium-sized to large (mostly 4-20 [30] cm), whitish-gray to greenish-gray above; lobes nodulose, hollow, about 1 mm wide, cascading in arcs, somewhat turned up at the lobe tips; lobe interiors usually white, or with a dark floor and white ceiling; lower cortex surface black; apothecia uncommon; soredia and isidia lacking; cortex K+ yellow; medulla K-, KC-, PD+ red, (Goward *et al.* 1994, McCune and Geiser 1997). Contains atranorin, diffractaic, physodalic, and protocetraric acids (Goward *et al.* 1994)

There are similar species of *Hypogymnia* that may be confused with *H. duplicata*.

- *Hypogymnia inactiva* typically has erect, broader and shorter thallus lobes, with dichotomous branching, and a pale to dark but never white medulla. Chemistry: cortex K+ yellow, medulla PD-, KC+ red.
- *Hypogymnia imshaugii* also has shorter thallus lobes which are typically stiff and erect, not cascading as in *H. duplicata*; the medulla in *H. imshaugii* is white as in *H. duplicata*. Chemistry: cortex K+ yellow, medulla KC+ red, PD+ red (or PD-).
- *Hypogymnia apinnata* and *H. enteromorpha* may have drooping thallus lobes, although they are typically broad (2-5 mm) and irregular in width, sometimes nodulose, compared with the consistently narrow (1 mm) lobes in *H. duplicata*; the medulla in *H. apinnata* and *H. enteromorpha* are pale to dark but never white. Chemistry: *H. apinnata*-- all chemical tests for the medulla are negative, cortex is K+ yellow; *H. enteromorpha*-- cortex is K+ yellow, medulla is PD+ orange or red, KC+ red.



Figure 1. Line drawing of *Hypogymnia duplicata* by Alexander Mikulin.

2. Reproductive Biology

Apothecia are uncommon in *Hypogymnia duplicata*; soredia and isidia are lacking. This species may also reproduce vegetatively by fragmentation.

3. Ecological Roles

Little is known specifically about the ecological roles of *Hypogymnia duplicata*. Various ecological functions of this species may be inferred by noting in general the ecosystem functions of lichens, which include their role as primary producers, their contributions to nutrient cycling by way of accumulating nutrients in their thalli which are then released by decomposition or consumption. Lichen litterfall contributes organic material to the soil. This species may contribute to the food web by providing forage for various organisms, possibly including invertebrates, small mammals, and ungulates. Invertebrates may also use the lichen thalli for shelter and possible nesting sites, as has been observed in some *Hypogymnia* species, *e.g.*, *H. enteromorpha*.

C. Range and Sites

Hypogymnia duplicata is endemic to the Pacific Northwest, ranging from Prince William Sound in Alaska south to northwest Oregon. Most of the known sites are on federal land with the majority (71%) occurring on the Mt. Baker-Snoqualmie National Forest. In Washington, this species is reported from Whatcom, Skagit, Snohomish, King, Lewis, Clallam, Mason, and Grays Harbor counties, and in Oregon from Clackamas, Multnomah, Hood River, Clatsop, Lincoln, Polk, Tillamook, Yamhill, and Lane counties.

Federal land sites reported for Washington *H. duplicata* include Mt. Baker, Sulphur Creek Lava Flow Finney Block, Boulder River Wilderness, Suiattle River valley, upper Sauk River, Goodman Creek, Barlow Pass, South Fork Stillaguamish River, Mt. Pilchuck area, Canyon Creek near Verlot, Silverton area, Barclay Lake, Martin Creek in the Tye watershed, Miller River, Mt. Persis, Alpine Lakes Wilderness, Snoqualmie River drainage, Snoqualmie Pass area, and the Cedar River watershed, all on the Mt. Baker-Snoqualmie National Forest. On the Olympic National Forest, it has been reported from the Snyder Peak area, near Brandeberry Creek, the South Fork Solduc River watershed, Salmon River area, Matheny Ridge, Cook Creek, near Gibson Peak, Colonel Bob Wilderness, Ziegler Creek drainage, Colonel Bob Wilderness, Chester Creek drainage, near Quinault Ridge, Humptulips Ridge, West Fork Humptulips River drainage, North Fork West Branch Wynoochee River drainage, near Wynoochee Lake, and the Skokomish River drainage. On the Olympic National Park it has been reported from the Solduc River Valley and Staircase area. This lichen has not been found on the southern end of the Washington Cascade range. It has been found in Oregon. Federal land sites reported for Oregon include Zigzag, Clackamas River, and Hood River Ranger Districts on the Mt. Hood National Forest; Columbia River Gorge National Scenic Area; Salem District BLM Lost Prairie Area of Critical Environmental Concern (ACEC), North Fork Siletz River near Valley of the Giants, Saddlebag (Saddleback) Mountain ACEC and Bald Mountain east of Tillamook; Hebo Ranger District (Yamhill and Tillamook counties) and Mt Hebo on the Siuslaw National Forest. Known sites on nonfederal land include Mt. Pilchuck area (Washington State Department of Natural Resources, Snohomish County), Forest Health Monitoring Plot (private land, Lewis County), and Twin Harbors State Park (Grays Harbor County) in Washington; Saddle Mountain State Park (Clatsop County), and Neahkanie Mountain (Tillamook County) in Oregon.

Selected herbarium specimens:

WASHINGTON. Mt. Baker-Snoqualmie NF: Mt. Baker, Sulphur Creek Lava Flow *Ryan 6320* (WTU); Decline Creek *Ward Feb-40* (WTU); Goat Lake, Henry Jackson Wilderness *Ward Feb 31* (WTU); Suiattle River drainage *Kovach 7* (WTU); Dingford Creek drainage, Alpine Lakes Wilderness, *Kovach 14-Jan* (WTU); South Fork Canyon Creek area *Nemens 8* (WTU); Rocky Creek drainage west of Lookout Mtn *Nemens 080201DGN06* (WTU); Money Creek *Burnett L4003* (WTU); Dorothy Lake Trail, Alpine Lakes Wilderness *Burnett L2658* (WTU); Skykomish River *Burnett L4098* (WTU); Barclay Lake trail *Burnett L278* (WTU); Independence Lake Trail *Joneson 3819* (WTU); Baker Lake area *Price AR18M* (WTU); near Keechelus Lake *Worthington SN4* (WTU); Big 4 Ice Caves Trail *Risvold AR17D* (WTU). Olympic NF: Quillayute River

Watershed *Hutten* 6803 (WTU); Eastfork Humptulips River Watershed *Hutten* 6283 (WTU); Quinault Ridge *Hutten* 6299 (WTU). Non-Federal Land: Cedar River Watershed *Hutten* 11525 (WTU). OREGON. Columbia River Gorge National Scenic Area: Bell Creek trail *McCune* 27746 (herb. McCune). Mt. Hood NF: Bull Run Watershed, *Horvath SNI* (OSC). Salem BLM: Lost Prairie ACEC *Ruchty* 94204 (OSC); Bald Mtn, Yamhill Co., *DiGiacomo BL-090999-01* (OSC); Fanno Ridge *Powell* 236 (OSC).

D. Habitat Characteristics and Species Abundance

Hypogymnia duplicata occurs as an epiphyte on mountain hemlock (*Tsuga mertensiana*), western hemlock (*T. heterophylla*), Pacific silver fir (*Abies amabilis*), subalpine fir (*A. lasiocarpa*), and Douglas-fir (*Pseudotsuga menziesii*) in old-growth forests of the western Cascades, Olympics, and Oregon Coast Range between 330 m and 1660 m (1100-5450 ft) elevation. This lichen is primarily found in maritime, high precipitation (100 – 110 in/yr) old-growth conifer forests west of the Cascade crest in Washington; it is also found in mountain hemlock/Pacific silver fir forests in the mesic to moist Alaska Huckleberry (*Vaccinium alaskaense*) plant associations (Leshner 2005). These areas in Washington are on the western Olympic peninsula and the northern half of the west-side Cascades (USDA 2012; USDI 2012)

Hypogymnia duplicata is less common in Oregon, where it is mostly known from the northern Coast Range and Mount Hood. Habitat descriptions in Oregon include mid-elevation moist western hemlock stands, old-growth Douglas-fir, mature western hemlock/Douglas-fir forest, moist Pacific silver fir or noble fir (*Abies procera*) forests, Sitka spruce (*Picea sitchensis*), riparian forest and late-successional forests along ridgetops in the Oregon Coast Range. On the Mt. Hood National Forest, sites are in the areas of highest precipitation, generally 250 cm (100 in) and greater. Very small populations are reported from known sites in the Oregon Coast Range (Mikulín and DiGiacomo pers. comm.).

Occasionally, atypical habitat conditions are documented for this species. These habitats are described as forests on a lava flow and a lahar in northwestern Washington, on a snag in a bog in the Oregon Coast Range, and on moss-covered basalt outcrops on a windswept ridge of Saddle Mountain in Oregon.

II. CURRENT SPECIES SITUATION

A. Status History

Hypogymnia duplicata was considered at risk under the Northwest Forest Plan because of its presumed 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 four sites in the region and was placed in Survey and Manage (S&M) strategy 1, 2 and 3 (USDA and USDI 1994a, 1994b). With the completion of the 2000 SEIS, it was assigned to Management Category A (USDA and USDI 2001). After a S&M hiatus, the Standards and Guidelines were reinstated in 2011, following the 2001 Record of Decision Standards and Guidelines; *H. duplicata* is assigned to Management Category C on this list (USDA-USDI 2001; USDA-USDI 2011a). In 2004, *H. duplicata* was designated a Sensitive species for Forest Service Region 6 in

Oregon and a Bureau Tracking species for the Bureau of Land Management in Washington and Oregon. Due to an increased number of new sites, this lichen has been moved from the Sensitive to the Strategic list for Oregon and removed from Washington list (USDA-USDI 2011b).

In 2004, *H. duplicata* had a Global Heritage Rank of G4, described as apparently secure, uncommon but not rare; some cause for long-term concern due to declines or other factors; it had a State Heritage Rank of S2 for Oregon, considered imperiled because of rarity due to a very restricted range, very few populations, steep declines or other factors making it vulnerable to extirpation in the State, and S3 in Washington, described as vulnerable in the State due to a restricted range, relatively few populations, recent and widespread declines, or other factors making it vulnerable to extirpation (ORNHIC 2004). The species was also on the ORNHIC List 3, described as taxa for which more information is needed before status can be determined but which may be threatened or endangered in Oregon. As of 2010, *H. duplicata* was removed from the Washington Natural Heritage Program due to new information indicating it is no longer rare in the state (WNHP 2012).

B. Major Habitat and Viability Considerations

The major viability consideration for *Hypogymnia duplicata* is loss of populations resulting from management activities that affect the populations or their habitat. The species' distribution along the western edge of the North Cascades may make it vulnerable to air pollution effects, if this species is determined to be sensitive to air pollutants. A warming climate may stress populations at the limits of this species' range, which could result in a decline in vigor and a more restricted distribution for *H. duplicata*.

C. Threats to the Species

One of the greatest threats to *Hypogymnia duplicata* is climate change. Although populations are stable in parts of its range, climate parameters are major factors for this lichen, and alterations in precipitation and air temperature may shrink its habitat (Leshner 2005). Other threats are those actions that disrupt stand conditions necessary for its survival, which include treatments that may affect populations such as removing colonized substrate, stand treatments that change the microclimate or forest structure, and possibly a significant deterioration in air quality. The habitat of this lichen has been well studied and has been found to be significantly associated with old-growth and late-seral forests (Lebo *et al.* 2004; Leshner 2005). Management activities within old growth forest habitats in the range of the species may pose a threat.

D. Distribution Relative to Land Allocations

Most of the sites known for *Hypogymnia duplicata*, and its habitat, are on Congressionally reserved allocations or Late-Successional Reserves (Leshner 2005; USDA 2002; USDA 2012; USDI 2012).

III. MANAGEMENT GOALS AND OBJECTIVES

Management for *Hypogymnia duplicata* follows the Survey and Manage 2001 Record of Decision Standards and Guidelines (USDA-USDI 2001; USDA-USDI 2011).

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 lichen 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). The association of *Hypogymnia duplicata* with old-growth forests in the Pacific Northwest indicates specific ecological requirements, and may reflect the inability of this species to become established or maintain populations in younger forests.

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). However, the pollution sensitivity of *Hypogymnia duplicata* is unknown.

B. Identifying Species Habitat Areas for Management

All sites of *Hypogymnia duplicata* on federal lands administered by the Forest Service Region 6 and/or OR/WA BLM are identified as areas where the information presented in this Conservation Assessment could be applied. A species habitat area is defined as the suitable habitat occupied by a known population, plus the surrounding habitat needed to support the site

C. Managing In Species Habitat Areas

The objective of a Species Habitat Area is to maintain habitat conditions such that species viability will be maintained at an appropriate scale, in accordance with agency policies. Specific management considerations include:

- Determine the extent of the local population and species habitat area with a field visit.
- Include an area large enough to maintain the ecological conditions associated with *Hypogymnia duplicata*, including forest structure and microclimatic conditions.
- Maintain occupied substrate and provide for a distribution of appropriate substrate in habitat areas.
- Restrict thinning and other stand treatments which could alter the stand microclimate.
- Utilize or prevent fire in species habitat areas, with emphasis on fire suppression.
- Restrict collecting specimens where this species is rare or of limited abundance.

V. RESEARCH, INVENTORY, AND MONITORING OPPORTUNITIES

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 and Information Gaps

- Revisit sites to verify the status of known populations of *Hypogymnia duplicata*, determine their extent and abundance, and characterize ecological conditions.
- Determine the distribution of *Hypogymnia duplicata* in areas identified as potential suitable habitat.
- Report documented sites to ORBIC and Washington Natural Heritage Programs and enter data into agency regional databases.
- Report changes in documented and suspected status as quickly as possible to the interagency (OR/WA BLM and Forest Service Region 6) Special Status/Sensitive Species Specialist in the State and Regional Office.
- Report sitings and survey work in the appropriate agency database.

B. Research Questions

- What habitat characteristics and ecological conditions are necessary for establishment of *Hypogymnia duplicata* propagules and survival of established thalli?
- Is *Hypogymnia duplicata* sensitive to air pollution?
- At what point in stand development (stand age, successional stage) does *Hypogymnia duplicata* enter the stand?
- What are the reproductive and dispersal mechanisms, and dispersal distances for *Hypogymnia duplicata*?
- What are the rates of growth and reproduction for *Hypogymnia duplicata*?
- What limits dispersal and establishment of propagules and colonization in suitable habitat?
- What is the genetic diversity of this species within its local populations and across the region?

C. Monitoring Opportunities and Recommendations

- If management activities are planned near sites, monitor the population to determine response to treatment and effects on the local population.
- Consider establishment of air quality monitoring plots near selected known populations.

REFERENCES

- Case, J.W. 1980. The influence of three sour gas processing plants on the ecological distribution of epiphytic lichens in the vicinity of Fox Creek and Whitecourt, Alberta, Canada. *Water, Air and Soil Pollution* 14:45-68.
- Dijiacomo, S. 1999. Personal communication. Salem District BLM., OR.
- Esseen, P.-A., B. Ehnstrom, L. Ericson, and K. Sjoberg. 1992. Boreal forests - the focal habitats of Fennoscandia. pp. 252-325. *In: Hansson, L. (ed.). Ecological Principles of Nature Conservation. Applications in Temperate and Boreal Environments.* Elsevier Applied Science, London.
- Ferry, B.W., M.S. Baddeley, and D.L. Hawksworth (eds.). 1973. *Air Pollution and Lichens.* Athlone Press, University of London, London.
- Goward, T. 1988. *Hypogymnia oceanica*, a new lichen (Ascomycotina) from the Pacific Northwest of North America. *The Bryologist* 91:229-232.
- Goward, T., B. McCune, and D. Meidinger. 1994. *The Lichens of British Columbia. Part 1. Foliose and Squamulose Species.* British Columbia Ministry of Forests. Crown Publications, Inc., Victoria, BC. 181 p.
- Gilbert, O.L. 1992. Lichen reinvasion with declining pollution. pp. 159-177. *In: Bates, J.W. and A.M. Farmer (eds.). Bryophytes and Lichens in a Changing Environment.* Clarendon Press, Oxford.
- Hawksworth, D.L. 1971. Lichens as a litmus for air pollution: a historical review. *International Journal of Environmental Studies* 1:281-296.
- Hawksworth, D.L. and F. Rose. 1976. Lichens as pollution monitors. *The Institute of Biology's Studies in Biology* no. 66. Edward Arnold, London.
- Henderson, J.A. 1998. Potential Natural Vegetation Model. Mt. Baker-Snoqualmie National Forest, Mountlake Terrace, WA.
- ISMS. 2004. Interagency Species Management System database. Ad hoc query, Sept. 2004.
- Lebo, D., J. Ponzetti and M. Turley. 2004. Random Grid Surveys of Lichens in the Pacific Northwest. Unpublished draft report. USDA Forest Service and USDI Bureau of Land Management. Portland, OR.
- Leshner, R. D. 2005. An environmental gradient model predicts the spatial distribution of potential habitat for *Hypogymnia duplicata* in the Cascade Mountains of northwestern Washington. PhD dissertation, University of Washington. Seattle, WA. 85 p.

- McCune, B. and L. Geiser. 1997. *Macrolichens of the Pacific Northwest*. Oregon State University Press, Corvallis, OR. 386 p.
- Mikulin, A. 1998. Personal communication. Siuslaw National Forest, OR.
- Olsen, S.R. and Y. Gauslaa. 1991. *Usnea longissima*, a lichen of ancient forest, threatened in Nordmarka, SE Norway. *Svensk Bot. Tidskr.* 85:342-346.
- ORNHIC 2004. Oregon Natural Heritage Information Center. <http://orbic.pdx.edu>
- Rao, D.N. and F. LeBlanc. 1967. Influence of an iron-sintering plant on corticolous epiphytes in Wawa, Ontario. *The Bryologist* 70(2):141-157.
- Rose, F. 1988. Phytogeographical and ecological aspects of *Lobarian* communities in Europe. *Botanical Journal of the Linnaean Society* 96:69-79.
- Sigal, L.L. and T.H. Nash III. 1983. Lichen communities on conifers in southern California Mountains: an ecological survey relative to oxidant air pollution. *Ecology* 64(6):1343-1354.
- Skye, E. and I. Hallberg. 1969. Changes in the lichen flora following air pollution. *Oikos* 20:547-552.
- Tehler, A. 1996. Systematics, phylogeny and classification. pp: 217-239. *In*: Nash, T.H. III, (ed.). *Lichen Biology*. Cambridge University Press, Cambridge, UK.
- USDA. 2002. USDA Forest Service Region 6 Land Use Allocation corporate GIS data; Northwest Forest Plan GeoDatabase.
- USDA. 2012. USDA Forest Service Natural Resources Manager database.
- USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Portland, OR.
- USDA Forest Service and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl, Appendix J2: Results of Additional Species Analysis. Portland, OR. 476 p.
- USDA Forest Service and USDI Bureau of Land Management. 1994c. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents and Standards and Guidelines for Management of Habitat for Late-successional and Old-growth Forest Related Species within the Range of the Northern Spotted Owl. Portland, OR.

USDA Forest Service and USDI Bureau of Land Management. 2001. Record of Decision for Amendments to the Survey and Manage Protection Buffer, and other Mitigation Measures Standards and Guidelines. Portland, OR.

USDA Forest Service and USDI Bureau of Land Management. 2004. Record of Decision to Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines in Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. Portland, OR.

USDA-USDI. 2011a. 2011 Settlement Agreement in Litigation over the Survey and Manage Mitigation Measure in *Conservation Northeast et al. v. Sherman et al.*, Case No. 08-1067-JCC (W.D. Wash.) Available on-line:
<http://www.blm.gov/or/plans/surveyandmanage/gg.htm>

USDA-USDI. 2011b. USDA Forest Service and USDI Bureau of Land Management Interagency Sensitive Species-Special Status Program 2011 list.
<http://www.fs.fed.us/r6/sfpnw/issssp/agency-policy/>

USDI. 2012. USDI Bureau of Land Management GeoBob database.

WNHP. 2012. Washington Natural Heritage Program.
http://www.dnr.wa.gov/researchscience/topics/naturalheritage/pages/amp_nh.aspx

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SUMMARY

Preface: Since the Conservation Assessment in 2005, new sites have been located for *Pilophorus nigricaulis* and that information is presented herein.

Species: *Pilophorus nigricaulis* Sato

Taxonomic Group: Lichen

Other Management Status: Forest Service and Bureau of Land Management Region 6 Sensitive Species in Oregon and Strategic Species in Washington. NatureServe ranks *P. nigricaulis* as Global Heritage Rank of G3 and a State Rank of S2 for Oregon; it is assigned to Oregon List 2 (ORBIC 2010). Rank 2 is described as imperiled, with fewer than 20 known sites, and very vulnerable to extirpation from the State. Rank 3 is described as rare, uncommon or threatened, but not immediately imperiled, typically with 21- 100 occurrences. List 2 includes species that are threatened and very rare.

Range: *Pilophorus nigricaulis* is rare throughout its range, known only from Japan and the west coast of North America, from Alaska south to Washington and Oregon, primarily west of the Cascade crest. It is reported from 23 sites in the Pacific Northwest. Most sites are on federal lands and include the Mt. Baker-Snoqualmie, Gifford Pinchot, Willamette, and Wenatchee National Forests; Columbia River Gorge National Scenic Area; and Salem District BLM.

Specific Habitat: *Pilophorus nigricaulis* grows on rock substrates from 40-1430 m (130-4700 ft) elevation, it is primarily found in non-forest communities on talus slopes, cliffs, rock outcrops, and large boulders; it may also occur on these substrates within a forest setting. Volcanic rock is the predominant substrate reported. Adjacent vegetation has been noted as old-growth forests, vine maple communities, sub-alpine parkland, and moss- and lichen-dominated communities.

Threats: The major threat to *Pilophorus nigricaulis* is loss of populations resulting from activities that affect the population or its habitat, including effects on or removing colonized substrate, altering microclimatic conditions, and collecting specimens where the species is rare. As a nitrogen-fixing species, *P. nigricaulis* may be sensitive to air pollution.

Management Considerations:

- Restrict collection of specimens where the species is rare or of limited abundance.
- Minimize effects to substrate occupied by *Pilophorus nigricaulis*.

Data and Information Gaps:

- Determine distribution of populations, species abundance, and ecological requirements of *Pilophorus nigricaulis* in Washington and Oregon.

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Pilophorus nigricaulis Sato was described in 1940 (Journ. Jap. Bot. 16:173). It is in the order Lecanorales, suborder Cladoniineae, family Stereocaulaceae (Tehler 1996). There are no known synonyms.

B. Species Description

1. Morphology

Pilophorus nigricaulis is a distinctive, but relatively inconspicuous, rock-dwelling lichen (Figure 1). It has very short stalks arising from a white crustose primary thallus; stalks are simple with a blackish core and scattered to continuous white warts or areoles, < 5 mm tall, about 1 mm diameter. Some stalks may have terminal roundish black apothecia (McCune and Geiser 1997). It can be seen from a distance as a bright white, crustose-appearing thallus growing directly over rock, contrasting with the surrounding darker lichens and bryophytes; on closer inspection, the stalks can be seen (McCune and Geiser 1997). The basal cephalodia fix atmospheric nitrogen.

Technical Description: Horizontal thallus persistent, white or light gray, granular. Granules about 2 mm high and 1 mm broad, subglobose, aggregated or scattered on the substrate. Most granules slightly peltate. Pseudopodetia pin-like, 1-6 mm high, 1 mm in diameter. Internally, the stalks are compact, composed of strongly gelatinized hyphae, colored black by the deposition of dark pigment granules. The pseudopodetia are covered by subglobose granules of the same color, morphology, and structure as the granules of the horizontal thallus. In some specimens, a few stalks are branched. Pycnidia apical on short pseudopodetia or sessile on the horizontal thallus. Conidiophores long, slightly branched with terminal sickle-shaped conidia. Apothecia terminal on mature pseudopodetia or sometimes sessile on the horizontal thallus, 1.0-2.5 mm in diameter. Apothecial margin downturned as far as the point of attachment to the stalk. Apothecia subglobose or slightly conical. No columella is present. Apothecium and pseudopodetium separated by a broad boundary texture. No pigment boundary is present. Hymenium about 180 μm high, subhymenium 120 μm . Excipulum absent. Asci eight-spored. Spores rounded when young, becoming spindle-shaped when mature, about 18 x 7 μm . Photobiont green, *Pleurococcus* type. Cephalodia on the horizontal thallus, thick, brown to black, with wrinkled surface, about 0.5 mm in diameter, containing the cyanobacterium *Stigonema* (Jahns 1981).

2. Reproductive Biology

Pilophorus nigricaulis reproduces sexually by producing ascospores in apothecia.

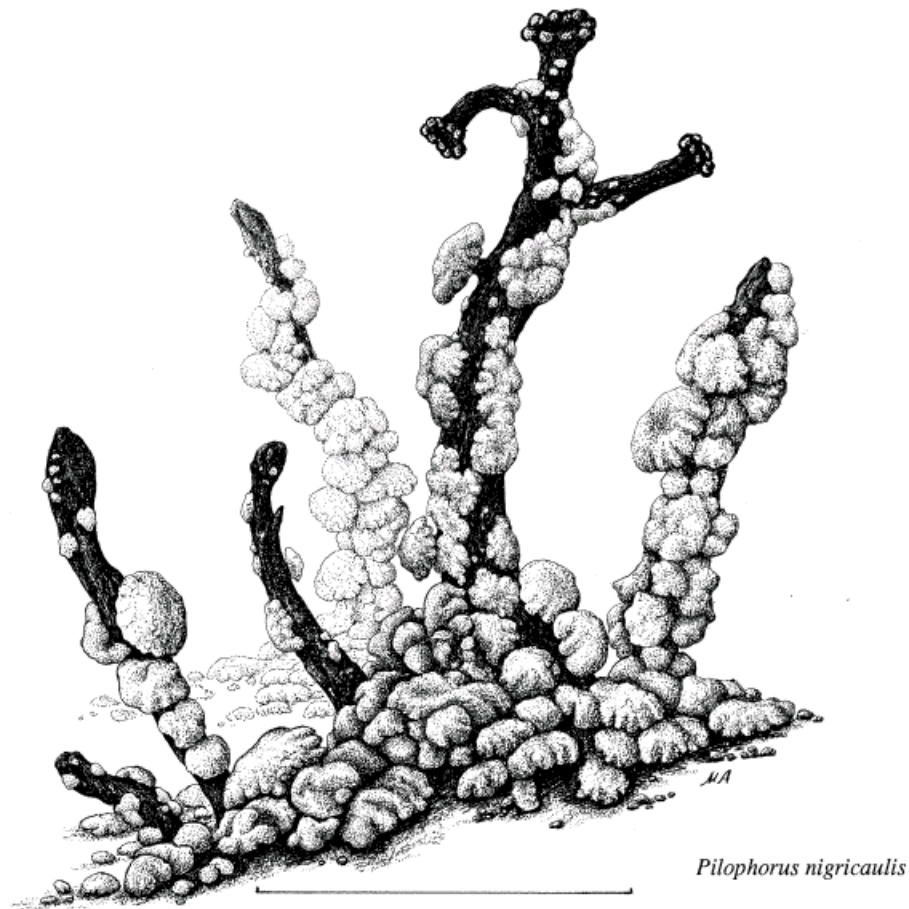


Figure 2. Line drawing of *Pilophorus nigricaulis* by Alexander Mikulin.

3. Ecological Roles

Very little is known about the ecological role of *Pilophorus nigricaulis*. This species contains cyanobacteria, so it is able to fix atmospheric nitrogen.

C. Range and Sites

Pilophorus nigricaulis occurs in Japan and on the west coast of North America, from Alaska south to British Columbia, Washington, and Oregon, west of the Cascade crest (Jahns 1981). In the Pacific Northwest, this species has been reported from 23 sites, 12 in Washington, and 11 in Oregon. All but two of the reported sites are on federal land. In Washington, the species has been reported from Whatcom, King, Lewis, and Skamania counties. Locations reported include the Snoqualmie Pass area, Mt. Shuksan, Gunn Mtn, Austin Pass, Sulphur Creek, and Mt. St. Helens. In Oregon, sites have been reported from Multnomah, Hood River, Marion, Linn, and Clatsop counties. This lichen mostly occurs in the Cascade Range, with reports from the

Columbia River Gorge south into the Willamette National Forest. There is also one confirmed site in the Oregon Coast Range. Selected herbarium specimens:

WASHINGTON. Mt. Baker-Snoqualmie NF: Old Silver Creek FS road *Burnett L3166* (WTU); Lake Serene trail *Burnett L2591* (WTU); Dock Butte trail *Burnett L1794* (WTU); Gunn Mtn trail *Burnett L1230* (WTU); Franklin Falls near Snoqualmie Pass *Rosentreter 8681* (SRP); and near Mt. Shuksan *Burnett L2013* (WTU). Gifford Pinchot NF: Butter Creek Research Natural Area *Riley 62* (WTU); Little Nisqually River basin *Riley 0197* (herb. Siuslaw); talus slope near Bluff Mountain *Berryman 3364* (herb Siuslaw). Non-Federal Land: Cultus Mountains *Burnett L2481* (WTU). OREGON. Columbia River Gorge National Scenic Area: Eagle Creek trail *Sherton 86773* (OSC); Nesmith Pt Trail *McCune 27756* (herb. McCune); and near Multnomah Falls *McCune 17803* (herb. McCune). Willamette NF: near Opal Creek *McCune 22076* (herb. McCune). Salem BLM: Carolyn's Crown/Shaffer Creek RNA *Rosentreter 7545* (SRP); Snow Peak area, *Fennell 990716-SP2* (OSC). Non-Federal Land: Onion Peak in Clatsop State Forest *McCune 26137* (herb. McCune).

D. Habitat Characteristics and Species Abundance

Pilophorus nigricaulis grows primarily on volcanic rock substrates (basalt and andesite). Habitats have been described as lava flows, cliffs, rock outcrops, talus slopes, and large boulders. Observations of known site habitats in the Columbia River Gorge report fairly stable substrate conditions. The elevation ranges from 40 m to 1430 m (130-4700 ft). This lichen grows on rock substrates in a variety of plant communities, including low- to mid-elevation old-growth conifer forests dominated by Douglas-fir (*Pseudotsuga menziesii*), true fir (*Abies* spp.) and western hemlock (*Tsuga heterophylla*); shrub communities dominated by vine maple (*Acer circinatum*), subalpine parkland, or in open sites on rock associated with other cryptogams in the genera *Cladonia*, *Stereocaulon*, and *Racomitrium*.

Pilophorus nigricaulis is reported as rare throughout its range. However, several populations in the Columbia River Gorge are reported to have large colonies consisting of several hundred individuals (Davis, pers. comm.).

II. CURRENT SPECIES SITUATION

A. Status History

Pilophorus nigricaulis was considered at risk under the Northwest Forest Plan because of its rarity and limited distribution within the range of the northern spotted owl (USDA and USDI 1994a, 1994b). Initially, it was a Survey and Manage strategy 1 and 3 species (USDA and USDI 1994c). With the completion of the 2000 SEIS, it was removed from Survey and Manage because information indicated it was not closely associated with late-successional and old growth forest (USDA and USDI 2001).

The Natural Heritage Program ranked *Pilophorus nigricaulis* with a Global Heritage Rank of G3 and a State Heritage Rank of S2 for Oregon; Rank 3 is described as rare, uncommon or threatened, but not immediately imperiled, typically with 21-100 occurrences; Rank 2 is

described as imperiled because of rarity or because it is vulnerable to extinction, typically with 6 to 20 occurrences (ORNHIC 2004). This lichen was also assigned to Oregon Heritage Program's List 2, which contains taxa that are threatened with extirpation and rare (ORNHIC 2004). This lichen was not listed with the Washington Heritage Program. As of Spring 2012, the Natural Heritage Program ranking and listing have not changed (ORBIC 2012; WNHP 2012).

The species is currently a Sensitive Species for the Forest Service and BLM in Oregon, and a Strategic species for both agencies in Washington.

B. Major Habitat and Viability Considerations

The major viability consideration for *Pilophorus nigricaulis* is loss of populations resulting from management activities that affect the populations or the habitat. A major consideration would be quarrying or road building that directly affects the colonized rock substrates. Some known sites indicate habitat as rock substrates in an old-growth forest matrix. Removing forest canopy and subsequent changes in microclimate may affect *P. nigricaulis* at these sites. 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. nigricaulis*. Sites in the Columbia River Gorge are susceptible to air pollution effects, given the vicinity to the Portland metropolitan area and other near-by pollution sources (Geiser and Neitlich 2007; Geiser et al. 2010).

Pilophorus nigricaulis appears restricted in its ecological amplitude, and thus is limited in distribution partly because of the specificity of its habitat requirements.

C. Threats to the Species

Threats to *Pilophorus nigricaulis* are those actions that disrupt habitat conditions necessary for its survival, including treatments that destroy populations by quarrying and road building, or stand treatments that alter the microclimate. As a nitrogen-fixing species, *P. nigricaulis* may be affected by a significant deterioration of air quality. Collecting specimens may be a threat where the species is rare or of limited abundance. Climate change will likely be a threat to *P. nigricaulis*.

D. Distribution Relative to Land Allocations

Some known sites of *Pilophorus nigricaulis* relative to federal land use allocations are these: In Washington, Mt Baker National Recreation Area site is Congressionally Reserved, the sites in the Little Nisqually River basin are in Late-Successional Reserves (LSR), the Bluff Mountain site is Administratively Withdrawn. In Oregon, CRGNSA site is in LSR, Opal Creek Wilderness site is Congressionally Reserved, and the Carolyn Crown/Shaffer Creek RNA site in LSR (USDA 2002; USDA 2012; USDI 2012).

III. MANAGEMENT GOALS AND OBJECTIVES

Management for this species follows Forest Service Region 6 Sensitive Species (SS) policy (FS Manual 2670), and/or OR/WA BLM Special Status Species (SSS) policy (6840).

For OR/WA BLM administered lands, SSS policy details the need to manage for species conservation. For Forest Service Region 6, SS policy requires the agency to maintain viable populations of all native and desired non-native wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands. Management “must not result in a loss of species viability or create significant trends toward federal listing” (FSM 2670.32) for any identified SS.

IV. HABITAT MANAGEMENT

A. Lessons From History

Very little is known about the ecology of this species, or how past actions have affected its distribution or viability. 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). The air pollution sensitivity of *Pilophorus nigricaulis* is unknown; but it may be sensitive to pollution, as other nitrogen-fixing lichen species have been shown to be.

B. Identifying Species Habitat Areas

All sites of *Pilophorus nigricaulis* on federal lands administered by the Forest Service Region 6 and/or OR/WA BLM are identified as areas where the information presented in this Conservation Assessment could be applied. A species habitat area is defined as the suitable habitat occupied by a known population, plus the surrounding habitat needed to support the site.

C. Managing in Species Habitat Areas

The objective of species habitat areas is to maintain habitat conditions such that species viability will be maintained at an appropriate scale, in accordance with agency policies. Specific management considerations include:

- Determine the extent of the local population and species habitat area with a site visit.
- Include an area that is large enough to maintain the habitat and associated microclimate of the population.
- Maintain occupied or potentially suitable substrate within the habitat area.
- Minimize effects to substrates occupied by *Pilophorus nigricaulis*, and restrict activities such as quarrying and road building in habitat areas.
- Restrict collection of specimens where the species is rare or of limited abundance.

V. RESEARCH, INVENTORY, AND MONITORING OPPORTUNITIES

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 and Information Gaps

- Revisit sites to verify the status of known populations, determine the extent of the populations and abundance, and characterize ecological conditions.
- Verify the taxonomic identity of the population reported from the Sulphur Creek Lava flow on the Mt. Baker-Snoqualmie National Forest.
- Determine the distribution of *Pilophorus nigricaulis* in areas identified as potentially suitable habitat.
- Report documented sites to ORBIC and Washington Natural Heritage Programs and enter data into agency regional databases.
- Report changes in documented and suspected status as quickly as possible to the interagency (OR/WA BLM and Forest Service Region 6) Special Status/Sensitive Species Specialist in the State and Regional Office.
- Report sitings and survey work in the appropriate agency database: GeoBOB or NRIS.

B. Research Questions

- What habitat characteristics and ecological conditions are necessary for the establishment of *Pilophorus nigricaulis* propagules and the survival of established thalli?
- What are the dispersal mechanisms and dispersal distances of *Pilophorus nigricaulis*?
- What is the genetic diversity of this species within its local populations and across the region?
- Is *Pilophorus nigricaulis* sensitive to air pollution?
- How will projected climate change parameters affect *Pilophorus nigricaulis*?

C. Monitoring Opportunities and Recommendations

- If management activities occur near known sites, monitor populations to determine their response to treatment and effects on the local population.

REFERENCES

- Case, J.W. 1980. The influence of three sour gas processing plants on the ecological distribution of epiphytic lichens in the vicinity of Fox Creek and Whitecourt, Alberta, Canada. *Water, Air and Soil Pollution* 14:45-68.
- Davis, J. 1996. Personal communication. US Fish and Wildlife Service, Portland, OR.
- Ferry, B.W., M.S. Baddeley, and D.L. Hawksworth. 1973. *Air Pollution and Lichens*. University of Toronto Press. Toronto.
- Geiser, L. 1998. Personal communication. Siuslaw National Forest, Corvallis, OR.
- Geiser, L. and P. Neitlich. 2007. Air pollution and climate gradients in western Oregon and Washington indicated by epiphytic macrolichens. *Environmental Pollution* 145 (1): 203-218.
- Geiser, L.H., S.E. Jovan, D. A. Glavich, and M. Porter. 2010. Lichen-based critical loads for atmospheric nitrogen deposition in western Oregon and Washington Forests, USA. *Environmental Pollution* 158 (7): 2412-2421.
- Gilbert, O.L. 1992. Lichen reinvasion with declining pollution. pp. 159-177. *In: Bates, J.W. and A.M. Farmer (eds.). Bryophytes and Lichens in a Changing Environment*. Clarendon Press, Oxford, UK.
- Hawksworth, D. L. 1971. Lichens as a litmus for air pollution: a historical review. *International Journal of Environmental Studies* 1:281-296.
- Hawksworth, D.L. and F. Rose. 1976. Lichens as pollution monitors. *The Institute of Biology's Studies in Biology* no. 66. Edward Arnold, London.
- Jahns, H.M. 1981. The genus *Pilophorus*. *Mycotaxon* 13:289-330.
- McCune, B. and L. Geiser. 1997. *Macrolichens of Pacific Northwest Forests*. Oregon State University Press, Corvallis, OR. 386 p.
- ORBIC. 2012. Oregon Biodiversity Information Center. <http://orbic.pdx.edu/>
- ORNHC. 2004. Oregon Natural Heritage Information Center. <http://orbic.pdx.edu>
- Rao, D.N. and F. LeBlanc. 1967. Influence of an iron-sintering plant on corticolous epiphytes in Wawa, Ontario. *Bryologist* 70(2):141-157.
- Sigal, L.L. and T.H. Nash III. 1983. Lichen communities on conifers in southern California Mountains: an ecological survey relative to oxidant air pollution. *Ecology* 64(6):1343-1354.

- Skye, E. and I. Hallberg. 1969. Changes in the lichen flora following air pollution. *Oikos* 20:547-552.
- Tehler, A. 1996. Systematics, phylogeny and classification. pp. 217-239. *In*: Nash, T. H. III, (ed.). *Lichen Biology*. Cambridge University Press, Cambridge, UK.
- USDA. 2002. USDA Forest Service Region 6 Land Use Allocation corporate GIS data; Northwest Forest Plan GeoDatabase.
- USDA. 2012. USDA Forest Service Natural Resources Manager database.
- USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Portland, OR
- USDA Forest Service and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl, Appendix J2: Results of Additional Species Analysis. Portland, OR. 476 p.
- USDA Forest Service and USDI Bureau of Land Management. 1994c. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents and Standards and Guidelines for Management of Habitat for Late-successional and Old-growth Forest Related Species within the Range of the Northern Spotted Owl. Portland, OR.
- USDA Forest Service and USDI Bureau of Land Management. 2001. Record of Decision for Amendments to the Survey and Manage Protection Buffer, and other Mitigation Measures Standards and Guidelines. Portland, OR.
- USDI. 2012. USDI Bureau of Land Management GeoBob database.
- WNHP. 2012. Washington Natural Heritage Program.
http://www.dnr.wa.gov/researchscience/topics/naturalheritage/pages/amp_nh.aspx

Conservation Assessment
for
Pseudocyphellaria rainierensis Imshaug

Originally issued
as Management Recommendations
March, 2000
Robin Lesher, Author

Reconfigured September, 2004
M. Stein

Updated May, 2012
Doug Glavich

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SUMMARY

Preface: Since the Conservation Assessment in 2005, additional sites have been reported for *Pseudocyphellaria rainierensis* and information about them is included herein.

Species: *Pseudocyphellaria rainierensis* Imshaug

Taxonomic Group: Lichen

Other Management Status: Forest Service Region 6 Strategic Species for Washington and Survey & Manage (S&M) species for Forest Service and BLM. From the Natural Heritage Program, *P. rainierensis* is ranked with a Global Heritage Rank of G3/G4, a State Heritage Rank of S3 for Oregon, and a State Rank of S2 for Washington. Rank 2 is described as imperiled because of rarity or vulnerable to extinction, typically with 6 to 20 occurrences; Rank 3 is described as rare, uncommon or threatened, but not immediately imperiled, typically with 21 to 100 occurrences; Rank 4 is described as not rare and apparently secure, but with cause for long-term concern, typically with more than 100 occurrences. The Oregon Biodiversity Information Center includes this lichen on List 4, which contains taxa which are of conservation concern but are not currently threatened or endangered.

Range: Global distribution is northwest North America from southeast Alaska south through British Columbia and Washington to Douglas County, Oregon. Federal lands with sites include the Mt. Baker-Snoqualmie, Olympic, and Gifford Pinchot National Forests; Mt. Rainier and Olympic National Parks in Washington; and the Siuslaw, Mt. Hood, Willamette, Umpqua National Forests; Salem and Roseburg Districts BLM in Oregon.

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). 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 *Pseudocyphellaria 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. *P. 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 contribute to the isolation of populations. Climate change is likely to become a primary threat to this lichen.

Management Considerations:

- Restrict collection of specimens where the species is rare or of limited abundance.

Data and Information Gaps:

- Determine the distribution of populations, species abundance, and ecological requirements of *Pseudocyphellaria rainierensis*. Verify the current status of known populations.

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. *P. 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.

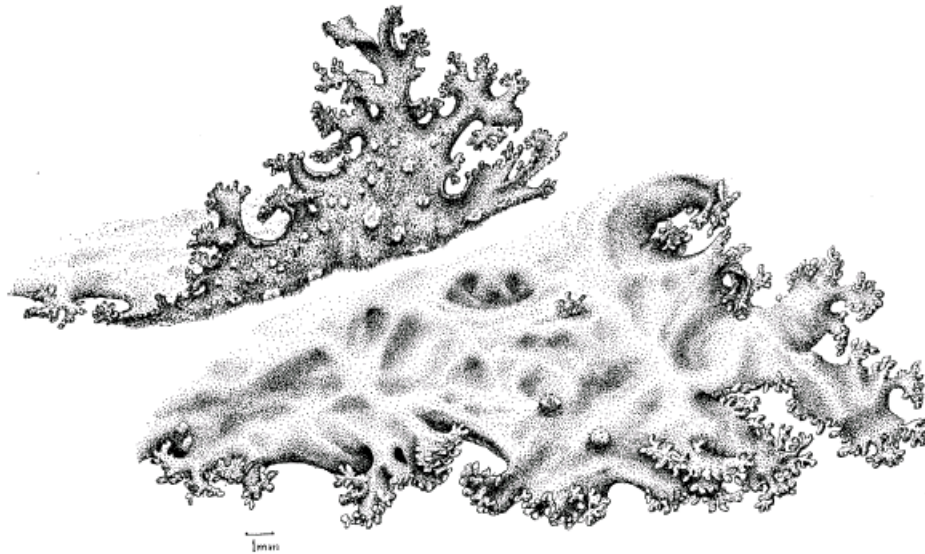


Figure 3. Line drawing of *Pseudocyphellaria rainierensis* by Alexander Mikulin.

C. Range and 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 Washington and Oregon, it is reported from over 200 sites, mostly on federal lands. It is reported from Washington in Whatcom, Snohomish, King, Pierce, Lewis, Skamania, Clallam, Skagit, 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. In Region 6, this lichen mostly occurs in the Washington and Oregon Cascades, but it is also known from the Olympics and the Oregon Coast Range (USDI 2012; USDA 2012b). Washington sites were mostly reported from the Mount Baker-Snoqualmie and Gifford Pinchot NFs but also have been found in the Olympic NF; many Oregon sites have been reported from Willamette National Forest, especially in the HJ Andrews, and Quartzville Creek watershed vicinities—sites also are known from Umpqua, Mt. Hood, and Siuslaw National Forests (Sillett and Goward 1998; USDA 2012). It is also known from Salem, Eugene, and Roseberg BLM districts (USDI 2012). Selected herbarium specimens.

WASHINGTON. Mt. Baker-Snoqualmie NF: Confluence of Middle Fork and South Fork Cascade Rivers *Ann Risvold AR08M* (WTU); Sulphur Creek Lava Flow *Ryan 4782* (WTU); White Chuck River area *Emerson 979* (WTU); Downey Creek area *Nemens 01DGN03C* (WTU); Deception Creek trail *Burnett SN* (WTU); near Barclay Creek *Burnett L4447* (WTU); near North Fork Skykomish River *Burnett L4359* (WTU); Downy Creek Trail *Masters DRDGM650* (WTU); near Baker Lake *Arnett AR-23-M* (WTU). Gifford Pinchott NF: Goat Creek-Tumwater junction *Riley 1111* (ASU); East Canyon Creek *Ruchty 7-3-02PSRA1* (WTU); Clear Creek area *Pechanec 123* (WTU); Outlaw Creek area *Derr 2482* (WTU); in the vicinity of Rush Creek *Scott MTALICH09* (WTU); near Big Hollow Creek *DeShong MTALICH15* (WTU); Upper Trout

Creek *Shaw MTALICH12* (WTU); Panther Creek drainage *Trabant 01LAT09F* (WTU); East Fork Wind River drainage *Reynolds 11* (WTU); Paradise Creek Campground *Sharnoff & Sharnoff 1250.09* (CANL). Olympic NF: Petes Creek—Westfork Humtulpis Watershed *Hutten 6194* (WTU); Quinault Ridge *Hutten 6217* (WTU); Matheny Ridge *Hutten 6529* (WTU); Rex River *Hutten 12104* (WTU); Rule Creek *Maertens LICH/TM-269* (WTU). Olympic National Park: Barnes Creek Trail *Dahl & Krog 956* (WTU). Mount Rainier National Park: Eunice Lake Trail *Howard 4172* (WTU). OREGON. Mount Hood NF: near Lost Creek, Old Maid Flat *Boyll s.n.* (herb. Mt. Hood NF). Willamette NF: Ivy Creek northwest of Pinnacle Peak *Geiser s. n.* (herb. Siuslaw NF); Quartzville Creek watershed *Bacheller NJB434* (OSC); Canal Creek area *Bacheller NJB424* (OSC); South Fork Brietenbush River *Bacheller NJB10May2001* (OSC); Opal Creek *McCune 22075* (herb. McCune); Mack Creek, HJ Andrews Experimental Forest *Sillett 154* (herb. McCune). Middle Santiam Wilderness *McCune 22712* (herb. McCune). Salem BLM: Carolyn Crown/Shaffer Creek RNA *McCune 19606* (ASU); Snow Peak area *Hibler n.a.* (herb. McCune); near Shedd Camp near the Middle Santiam River *McCune 21617* (ASU); Saddle Bag Mountain, Coast Range *Exeter s.n.* (herb. Salem BLM). Siuslaw NF: Cape Perpetua *McCune 16221* (herb. McCune). Umpqua NF: North Fork Cedar Creek *Heinrich AH002* (OSC) Oregon State Parks: Oswald West State Park *Shushan sl-2185* (BRY).

D. Habitat Characteristics and Species Abundance

Pseudocyphellaria rainierensis appears to have factors that limit its dispersal and establishment as it is often absent from suitable habitat (Sillett 1994; Sillett and Goward 1997). When present, *P. rainierensis* is typically not abundant; within stands it often has a patchy distribution and can be absent on suitable substrate. The dispersal and establishment limitations, along with other factors, mostly restrict *P. rainierensis* to late-seral and old-growth 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*) (Sillett and Goward 1997; USDA 2012b; USDI 2012). 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 *Pseudocyphellaria 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 Oregon, the majority of sites are in old-growth conifer forests. Typical habitat for *Pseudocyphellaria rainierensis* is old-growth Douglas-fir/western hemlock forests from 490 m to 900 m (1600-2950 ft) elevation. 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; Sillett and Goward 1997), 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 understory Pacific yew trees (Glavich pers. obs.).

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*.

II. CURRENT SPECIES SITUATION

A. Status History

In 1994, *Pseudocyphellaria rainierensis* was considered at risk under the Northwest Forest Plan because of its rarity, limited distribution, and association with old-growth forests; therefore, it was listed in the Survey and Manage Program and assigned management strategies 1 (manage known sites), 2 (perform pre-disturbance surveys), and 3 (locate and manage new sites) (USDA and USDI 1994a, 1994b). With completion of the 2000 SEIS, the management categories changed, and *P. rainierensis* was assigned to Management Category A—manage all known sites, and pre-disturbance surveys required (USDA USDI 2001). In 2004, *P. rainierensis* was designated a Sensitive Species for the Forest Service Region 6. In 2011, this lichen changed status from Sensitive Species in Oregon and Washington to Strategic Species in Washington only (USDA-USDI 2011a). Also in 2011, after a S&M hiatus, the S&M Standards and Guidelines were reinstated, following the 2001 Record of Decision Standards and Guidelines; *Pseudocyphellaria rainierensis* returned to Management Category A on this list (USDA-USDI 2001; USDA-USDI 2011b)

In 2004, the Natural Heritage Program ranked *P. rainierensis* with a Global Heritage Rank of G3/G4, a State Heritage Rank of S3 for Oregon and Washington. Rank 3 is described as rare, uncommon or threatened, but not immediately imperiled, typically with 21 to 100 occurrences; Rank 4 is described as not rare and apparently secure, but with cause for long-term concern, typically with more than 100 occurrences. The Oregon Natural Heritage Program included this lichen on List 4, which contains taxa which are of conservation concern but are not currently threatened or endangered (NatureServe 2012; ORNHIC 2004). In 2011, the only change is that the Washington Rank changed to S2; Rank 2 is described as imperiled because of rarity or vulnerable to extinction, typically with 6 to 20 occurrences (WNHP 2011).

B. Major Habitat and Viability Considerations

The close association of *Pseudocyphellaria 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.

Within its range, *P. rainierensis* is limited by the availability of old-growth forest habitat; however, as climate parameters are one of the strongest factors controlling lichen distribution, climate change is likely to majorly affect habitat and viability of this lichen as well.

C. Threats to the Species

Threats to *Pseudocyphellaria 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, or 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. Climate change is likely to become a major threat to this lichen.

D. Distribution Relative to Land Allocations

The distribution of known sites of *P. rainierensis* on federal lands include 30 (10%) in Congressionally reserved allocations, 132 (46%) in Late-Successional Reserves, 41 (14%) in Adaptive Management Areas, 13 (4%) in Administratively withdrawn allocations, 71 (24%) in matrix and 3 (2%) of unknown land use allocation (USDA 2002; USDA 2012; USDI 2012).

III. MANAGEMENT GOALS AND OBJECTIVES

For both Forest Service and Bureau of Land Management within the Northwest Forest Plan area, management follows the 2001 Survey and Manage Record of Decision Standard and Guidelines (USDA-USDI 2001; USDA-USDI 2011).

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). In the US Pacific Northwest, analyses suggest cyanolichen biomass is negatively affected by heavy forest thinnings (Berryman 2002). 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 *Pseudocyphellaria 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 to retain sites, 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 *Pseudocyphellaria 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 Species Habitat Areas

All sites of *Pseudocyphellaria rainierensis* on federal lands administered by the Forest Service Region 6 and/or OR/WA BLM are identified as areas where the information presented in this Conservation Assessment could be applied. A species habitat area is defined as the suitable habitat occupied by a known population, plus the surrounding habitat needed to support the site.

C. Managing in Species Habitat Areas

The objective of Species Habitat Areas is to maintain habitat conditions such that species viability will be maintained at an appropriate scale, in accordance with agency policies. Specific management considerations include:

- Determine the extent of the local population and species habitat area with a field visit.
- Include an area large enough to maintain the ecological conditions associated with *Pseudocyphellaria rainierensis*, including undisturbed forest structure and interior forest microclimatic conditions.

- Maintain occupied substrate and manage a species 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.
- Utilize or prevent fire in species habitat areas with emphasis on fire suppression.
- Restrict collection of specimens in areas where this species is rare or of limited abundance.

V. RESEARCH, INVENTORY AND MONITORING OPPORTUNITIES

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 and Information Gaps

- Revisit 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 *Pseudocyphellaria rainierensis* into agency databases.
- Locate and determine the status of reported populations on the Olympic Peninsula.
- Determine the distribution of *Pseudocyphellaria 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 *Pseudocyphellaria 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.
- Report documented sites to ORBIC and Washington Natural Heritage Programs and enter data into agency regional databases.
- Report changes in documented and suspected status as quickly as possible to the interagency Sensitive/Special Status Species Specialist in the State and Regional Office.
- Report sitings and survey work in the appropriate agency database.

B. Research Questions

- What habitat characteristics and ecological conditions are necessary for establishment of *Pseudocyphellaria rainierensis* propagules and survival of established thalli?
- What are the dispersal mechanisms and dispersal distances of *Pseudocyphellaria 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 *Pseudocyphellaria rainierensis* have persisted after harvest treatments, as reported by Sillett (1994, 1995)?
- Is *Pseudocyphellaria rainierensis* sensitive to air pollution?
- How will projected climate change parameters will affect *Pseudocyphellaria rainierensis*?

C. Monitoring Opportunities 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 *Pseudocyphellaria 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.
- Monitor coast range populations.

REFERENCES

- Berryman, S. D. 2002. Epiphytic Macrolichens in Relation to Forest Management and Topography in a western Oregon Watershed. PhD dissertation. Oregon State University. Corvallis, OR.
- Case, J.W. 1980. The influence of three sour gas processing plants on the ecological distribution of epiphytic lichens in the vicinity of Fox Creek and Whitecourt, Alberta, Canada. *Water, Air and Soil Pollution* 14:45-68.
- Esseen, P.-A., B. Ehnstrom, L. Ericson, and K. Sjoberg. 1992. Boreal forests - the focal habitats of Fennoscandia. pp. 252-325. *In: Hansson, L. (ed.). Ecological Principles of Nature Conservation. Applications in Temperate and Boreal Environments.* Elsevier Applied Science, London.
- Ferry, B.W., M.S. Baddeley, and D.L. Hawksworth. 1973. *Air Pollution and Lichens.* University of Toronto Press. Toronto.
- Gilbert, O.L. 1992. Lichen reinvasion with declining pollution. pp. 159-177. *In: Bates, J.W. and A.M. Farmer (eds.). Bryophytes and Lichens in a Changing Environment.* Clarendon Press, Oxford.
- Goward, T. 1994. Status report on the oldgrowth specklebelly lichen, *Pseudocyphellaria rainierensis* in Canada. Unpublished manuscript prepared for the Committee on the Status of Endangered Wildlife in Canada.
- Hawksworth, D. L. 1971. Lichens as a litmus for air pollution: a historical review. *International Journal of Environmental Studies* 1:281-296.
- Hawksworth, D.L. and F. Rose. 1976. Lichens as pollution monitors. *The Institute of Biology's Studies in Biology* no. 66. Edward Arnold, London.
- Imshaug, H.A. 1950. New and noteworthy lichens from Mt. Rainier National Park. *Mycologia* 42:743-752.
- McCune, B. 1993. Gradients in epiphyte biomass in three *Pseudotsuga-Tsuga* forests of different ages in western Oregon and Washington. *The Bryologist* 96:405-411.
- McCune, B. and L. Geiser. 1997. *Macrolichens of Pacific Northwest Forests.* Oregon State University Press, Corvallis. 386 p.
- Messinger, W. 1999. Personal communication. Willamette National Forest, Eugene, OR.
- Norris, D. 1993. Personal communication during FEMAT process.

- Olsen, S.R. and Y. Gauslaa. 1991. *Usnea longissima*, a lichen of ancient forest, threatened in Nordmarka, SE Norway. *Svensk Bot. Tidskr.* 85:342-346.
- ORNHIC. 2004. Oregon Natural Heritage Information Center. <http://orbic.pdx.edu>
- Rao, D.N. and F. LeBlanc. 1967. Influence of an iron-sintering plant on corticolous epiphytes in Wawa, Ontario. *The Bryologist* 70(2):141-157.
- Rhoades, F.M. 1981. Biomass of epiphytic lichens and bryophytes on *Abies lasiocarpa* on a Mt. Baker lava flow, Washington. *The Bryologist* 84(1):39-47.
- Rose, F. 1988. Phytogeographical and ecological aspects of *Lobarian* communities in Europe. *Botanical Journal of the Linnaean Society* 96:69-79.
- Sigal, L.L. and T.H. Nash III. 1983. Lichen communities on conifers in southern California Mountains: an ecological survey relative to oxidant air pollution. *Ecology* 64(6):1343-1354.
- Sillett, S.C. 1994. Growth rates of two epiphytic cyanolichen species at the edge and in the interior of a 700 year-old Douglas-fir forest in the western Cascades of Oregon. *The Bryologist* 97(3):321-324.
- Sillett, S.C. 1995. Branch epiphyte assemblages in the forest interior and on the clearcut edge of a 700 year-old Douglas-fir canopy in western Oregon. *The Bryologist* 98(3):301-312.
- Sillett, S.C. 1997. Distribution and ecology of *Pseudocyphellaria rainierensis*, an epiphytic cyanolichen endemic to the Pacific Northwest. pp. 254-260. *In*: T.N. Kaye, A. Liston, R.M. Love, D.L. Luoma, R.J. Meinke and M.V. Wilson (eds.). *Conservation and Management of Native Plants and Fungi*. Native Plant Society of Oregon, Corvallis, OR. 296 p.
- Sillett, S.C. and T. Goward. 1998. Ecology and conservation of *Pseudocyphellaria rainierensis*, a Pacific Northwest endemic lichen. pp. 377-388. *In*: M.G. Glenn, R.C. Harris, T. Dirig and M.S. Cole (eds.). *Lichenographia Thomsoniana: North American Lichenology in Honor of John W. Thomson*. Mycotaxon Ltd., Ithaca, NY. 445 p.
- Sillett, S.C. and P.N. Neitlich. 1996. Emerging themes in epiphyte research in westside forests with special references to cyanolichens. *Northwest Science* 70:54-60.
- Skye, E. and I. Hallberg. 1969. Changes in the lichen flora following air pollution. *Oikos* 20:547-552.
- Tehler, A. 1996. Systematics, phylogeny and classification. pp. 217-239. *In*: Nash, T. H. III, (ed.). *Lichen Biology*. Cambridge University Press, Cambridge, UK.

- USDA. 2002. USDA Forest Service Region 6 Land Use Allocation corporate GIS data; Northwest Forest Plan GeoDatabase.
- USDA. 2012. USDA Forest Service Natural Resources Manager database.
- USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Portland, OR.
- USDA Forest Service and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl, Appendix J2: Results of Additional Species Analysis. Portland, OR. 476 p.
- USDA Forest Service and USDI Bureau of Land Management. 1994c. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents and Standards and Guidelines for Management of Habitat for Late-successional and Old-growth Forest Related Species within the Range of the Northern Spotted Owl. Portland, OR.
- USDA Forest Service and USDI Bureau of Land Management. 2001. Record of Decision for Amendments to the Survey and Manage Protection Buffer, and other Mitigation Measures Standards and Guidelines. Portland, OR.
- USDA Forest Service and USDI Bureau of Land Management. 2004. Record of Decision to Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines in Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. Portland, OR.
- USDA and USDI. 2011a. USDA Forest Service Sensitive Species and USDI Bureau of Land Management Special Status lists. Available on-line: <http://www.fs.fed.us/r6/sfpnw/issssp/>
- USDA and USDI. 2011b. USDA Forest Service and USDI Bureau of Land Management 2011 Settlement Agreement in Litigation over the Survey and Manage Mitigation Measure in *Conservation Northeast et al. v. Sherman et al.*, Case No. 08-1067-JCC (W.D. Wash.) Available on-line: <http://www.blm.gov/or/plans/surveyandmanage/gg.htm>
- USDI, Bureau of Land Management. 1998. Bureau Special Status Species Policy (6840) and Oregon/Washington Special Status Species List, Internal Memorandum OR-98-342, August 28, 1998, including attachments.
- USDI. 2012. USDI Bureau of Land Management GeoBob database.
- Wetmore, C.M. 1983. Lichens of the air quality Class 1 National Parks. Final Report, National Park Service Contract CX 0001-2-0034. Denver, CO.

WNHP. 2012. Washington Natural Heritage Program.

http://www.dnr.wa.gov/researchscience/topics/naturalheritage/pages/amp_nh.aspx

Conservation Assessment

for

Sticta arctica Degel.

Originally issued
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Chiska Derr, Author

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M. Stein

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Doug Glavich

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SUMMARY

Preface: Since the Conservation Assessment in 2005, some management designations have changed, but no additional site or habitat information for *Sticta arctica* has been recorded.

Species: *Sticta arctica* Degel.

Taxonomic Group: Lichen

Other Management Status: Forest Service Region 6 Strategic Species for Oregon. From NatureServe the species is ranked with a Global Heritage Rank of G4, described as apparently secure, uncommon but not rare; some cause for long-term concern due to declines or other factors. The State Heritage Rank for Oregon is S1, considered critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation in the State. The Oregon Biodiversity Information Center (ORBIC) ranks the species Heritage List 2, described as taxa threatened, endangered or possibly extirpated in Oregon but more stable or common elsewhere.

Range: *Sticta arctica* is known from Siberia, Kamchatka, and North America from arctic Alaska east to Baffin Island, Canada, and as far south as Juneau, Alaska with single disjunct sites near the summit of Saddle Mountain State Park in Clatsop County, Oregon, and Deception Pass State Park, Washington. *S. arctica* is not known to occur on federal land in Oregon or Washington.

Specific Habitat: *Sticta arctica* is an arctic-alpine lichen that grows among mosses and on hummocks in dry and moist tundra in the northern part of its range. In its southern range, it is found on rocky ledges and mossy soil near the edges of marine beaches. The habitat at the Oregon site is a moss-covered, wind swept basalt outcrop on a rocky mountain summit at 900 m (2950 ft) near the coast. The habitat at the Washington site consists of soil and rock substrates along ocean bluffs. It can be easily overlooked because it is small and grows intermingled with bryophytes.

Threats: The major threat to *Sticta arctica* is loss of local populations resulting from activities that affect the population or its habitat, including collecting specimens, removing colonized substrate, and alter its microclimate. Recreation-related activities such as hiking, mountain biking, trail or shelter building would be most likely activities to threaten the species.

Management Considerations:

- Maintain existing habitat conditions, including occupied substrate and associated microclimatic conditions, and restrict collecting of specimens.

Data and Information Gaps:

- Assess the Oregon and Washington populations, abundance and ecological requirements of *Sticta arctica*.
- Survey federal land areas with potential habitat near known sites.

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Sticta arctica Degel. was described by Degelius in 1937 (in Medd. Goteborgs Bot. Tradg. 12:108).

B. Species Description

1. Morphology

Sticta arctica is a small, dark brown foliose lichen with scattered cyphellae on the lower surface (Figure 1). These cyphellae are large, white, circular, recessed pores that resemble lunar craters. The upper side is smooth with somewhat crisped edges; the underside is pale at the edges, dark toward the center, and covered with a fine tomentum (woolly or felt-like hairs).

Technical Description: Thallus foliose, dorsiventral, the lobes small, to 30 mm long and 12 mm broad, the edges somewhat crisped and turned up, upper surface paraplectenchymous, smooth, brown; underside pale at the edges, dark centrally, covered with a fine tomentum and with scattered cyphellae, attached to substrate by simple or branched rhizines. Apothecia and pycnidia are not known. Cyanobacterium is *Nostoc* (Thomson 1984). Chemistry: K-, C-, KC-, P-, I-.

2. Reproductive Biology

Sexual reproductive structures are unknown for *Sticta arctica*. It reproduces asexually by producing lobules; migrating arctic birds may be a vector for distributing lobules (McCune *et al.* 1997). This species also reproduces by fragmentation when thalli are broken apart by animals or disrupted by rolling rocks or wind, and pieces become reestablished nearby.

3. Ecological Roles

Very little is known about the ecological roles of this species in the Pacific Northwest. It appears to have a geographic affinity with northeastern Asia and the maritime Arctic (McCune *et al.* 1997), and may have ecological ties with associated northeastern Asia and maritime Arctic plant and animal communities and habitats. The widely disjunct sites in Washington and Oregon may be relicts from a previous, colder climatic period.

C. Range and Sites

Sticta arctica is known from Siberia, Kamchatka, and North America (Krog 1968). Until 1993, its North America distribution was known to extend from arctic Alaska east to Baffin Island, Canada, and as far south as Juneau, Alaska (Krog 1968). In 1993, a single disjunct site was found near the summit of Saddle Mountain State Park in Clatsop County, Oregon (*Derr #881*), extending its range over 1000 km (600 miles) to the south (McCune *et al.* 1997). Recent

herbaria searches provided information on two additional southern populations of *S. arctica*, one from the Queen Charlotte Islands, British Columbia, and one from Deception Pass State Park, Washington; they had been misidentified as *S. weigeli* (McCune *et al.* 1997). *S. arctica* is not known to occur on federal land in Oregon and Washington.

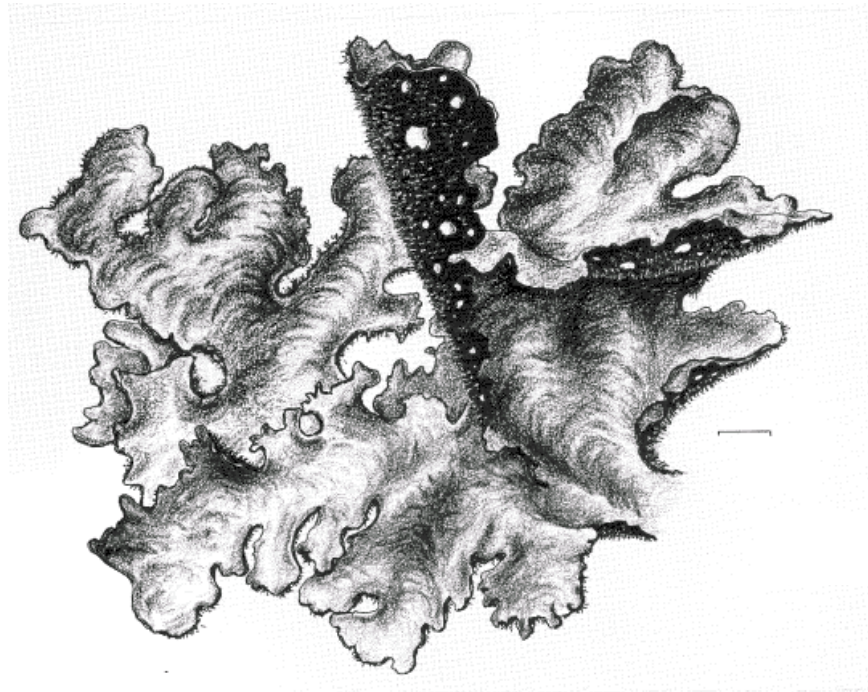


Figure 4. Line drawing of *Sticta arctica* by Alexander Mikulin.

D. Habitat Characteristics and Species Abundance

Sticta arctica is an arctic-alpine species that grows among mosses and on hummocks in both dry and moist tundras in the northern part of its range (Thomson 1984). In British Columbia and Washington, it is known from rocky ledges, soil, and rock at the edge of marine beaches (McCune *et al.* 1997). In Oregon, it is only known from a massive moss-covered basalt outcrop on the windswept ridge of an exposed rocky mountain summit of Saddle Mountain (elevation about 900 m (2950 ft)) near the coast, where only a few thalli were present (McCune *et al.* 1997). It can easily be overlooked because it is small and grows intermingled with bryophytes.

II. CURRENT SPECIES SITUATION

A. Status History

Sticta arctica 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). With the completion of the 2000 SEIS, it was removed from Survey and Manage because

information indicated it was not closely associated with late-successional and old growth forest (USDA and USDI 2001). In 2004, *S. arctica* was designated a Sensitive Species for Forest Service Region 6. The 2011 BLM-FS Sensitive Species program now lists *S. arctica* as a Strategic Species for Oregon only (USDI-USDA 2011).

In 2004, the Natural Heritage program ranked *Sticta arctica* with a Global Heritage Rank of G4, described as apparently secure, uncommon but not rare; some cause for long-term concern due to declines or other factors. The species has a State Heritage of S1 in Oregon, considered critically imperiled because of rarity due to a very restricted range, very few populations (often 5 or fewer), steep declines, or other factors (ORNHIC 2004). A State Rank has not been assigned by the Washington Natural Heritage Program. The species is on the Oregon Biodiversity Information Center List 2, described as taxa that are threatened, endangered or possibly extirpated from Oregon but more stable or common elsewhere. There was no change in ranks on the 2011 lists (ORBIC 2011; WNHP 2011).

B. Major Habitat and Viability Considerations

The major viability considerations for *Sticta arctica* are loss of local populations resulting from collecting specimens that could extirpate local populations, and management activities that adversely affect the individuals or their habitat. 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 *S. arctica*. If *S. arctica* relies to some extent on dispersal by migratory northern breeding birds that winter on the coast, ecological conditions in arctic nesting habitats could be important to this species.

C. Threats to the Species

Threats to *Sticta arctica* are actions that disrupt habitat conditions necessary for its survival, or collecting specimens for scientific purposes from limited populations. Because this species is found on coastal rocks and soil or on coastal mountain summits, recreational activities (eg. hiking, mountain biking), off-road vehicle use, and trail or shelter building could threaten this species. The Saddle Mountain population is very small, and collections from this site would threaten this lichen's viability (McCune et al. 1997).

D. Distribution Relative to Land Allocations

The two known sites of *Sticta arctica* in Washington and Oregon are within State Park Systems. No federal land sites are yet known in these states.

III. MANAGEMENT GOALS AND OBJECTIVES

Since this species is not yet documented from Forest Service or BLM lands in Oregon or Washington, the species is not specifically addressed under agency policies. However, should the species be documented on Forest Service or BLM lands in Oregon, the species would meet Agency Sensitive species criteria, and management and conservation goals would be addressed by both BLM and/or Forest Service Sensitive species policies.

IV. HABITAT MANAGEMENT

A. Lessons From History

No information on the history of *Sticta arctica* and management activities is available.

B. Identifying Species Habitat Areas

All future sites of *Sticta arctica* on federal lands administered by the Forest Service Region 6 and/or OR/WA BLM are areas where the information presented in this Conservation Assessment could be applied. A species habitat area is defined as the suitable habitat occupied by a known population, plus the surrounding habitat needed to support the site.

C. Managing in Species Habitat Areas

The objective of species habitat areas is to maintain habitat conditions such that species viability will be maintained at an appropriate scale, in accordance with agency policies. Specific management considerations include:

- Determine the extent of the local population and species habitat area with a site visit.
- Maintain suitable habitat around the current host trees and shrubs, so that the lichen may have adequate new substrate as current substrates decline.
- Develop practices to route human use away from the populations in species habitat areas (for example, divert roads, trails and off-road vehicles). Trampling shrubs or cryptogam mats, compacting roots, damaging trees or branches that serve as substrates, and introducing non-native species by seed dispersal or planting, can all adversely affect habitat integrity.
- Avoid harvesting trees, shrubs, or other vegetation from the population and the species habitat area unless these actions would do no harm to, or would improve, the species habitat area for *Sticta arctica* (for example, by preventing deeply shaded conditions or by removing invasive exotics).

V. RESEARCH, INVENTORY, AND MONITORING OPPORTUNITIES

The objective of this section is to identify opportunities to acquire additional information that 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 and Information Gaps

- Determine if *Sticta arctica* occurs on BLM or Forest Service lands in Washington or Oregon by conducting surveys in areas identified as potential suitable habitat.
- Determine mechanisms and rates of reproduction, dispersal, and growth.
- Report documented sites to ORBIC and Washington Natural Heritage Programs and enter data into agency regional databases.
- Report changes in documented and suspected status as quickly as possible to the interagency Sensitive and Special Status Species Specialist in the Regional/State Office.
- Report sitings and survey work in the appropriate agency database.

B. Research Questions

- Are the southern sites of *Sticta arctica* glacial relicts?
- How do the genotypes of the southern populations of *Sticta arctica* compare to populations in the center or more northern parts of its range?
- What are the dispersal distances of *Sticta arctica*?
- Are the habitat characteristics for *Sticta arctica* in Washington and Oregon similar to those of its arctic counterparts?
- How will forecasted climate change parameters will affect *Sticta arctica*?

C. Monitoring Opportunities and Recommendations

- Monitor population trends at any sites discovered on National Forest System Lands.

REFERENCES

- Krog, H. 1968. The Macrolichens of Alaska. Norsk Polarinstitut, Oslo. 180 p.
- McCune, B., R. Rosentreter and A. DeBolt. 1997. Biogeography of rare lichens from the coast of Oregon. pp. 234-241. *In*: T.N. Kaye, A. Liston, R.M. Love, D.L. Luoma, R.J. Meinke and M.V. Wilson (eds.). Conservation and Management of Native Plants and Fungi. Native Plant Society of Oregon, Corvallis, OR. 296 p.
- ORBIC. 2012. Oregon Biodiversity Information Center. <http://orbic.pdx.edu>
- ORNHIC. 2004. Oregon Natural Heritage Information Center. <http://orbic.pdx.edu>
- Thomson, J.W. 1984. American Arctic Lichens: 1. The Macrolichens. Columbia University Press, New York, NY.
- USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Portland, OR.
- USDA, Forest Service and USDI, Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl, Appendix J2, Results of Additional Species Analysis. Portland, OR.
- USDA Forest Service and USDI Bureau of Land Management. 2001. Record of Decision for Amendments to the Survey and Manage Protection Buffer, and other Mitigation Measures Standards and Guidelines. Portland, OR.
- USDA and USDI. 2011. USDA Forest Service Sensitive Species and USDI Bureau of Land Management Special Status lists. Available on-line: <http://www.fs.fed.us/r6/sfpnw/issssp/>
- WNHP. 2012. Washington Natural Heritage Program.
http://www.dnr.wa.gov/researchscience/topics/naturalheritage/pages/amp_nh.aspx

Conservation Assessment

for

Tholurna dissimilis (Norman) Norman

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SUMMARY

Preface: Since the transmittal of the Conservation Assessment in 2005, one new site for *Tholurna dissimilis* has been collected.

Species: *Tholurna dissimilis* (Norman) Norman

Taxonomic Group: Lichen

Other Management Status: In Oregon, the species is Sensitive for both the Forest Service Region 6 and Bureau of Land Management, while in Washington the species is Strategic for the Forest Service. From NatureServe the species is ranked with a Global Heritage Rank of G3/G5, from vulnerable (G3), described as at moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors to secure (G5), considered common, widespread and abundant. The State Heritage Rank is S2 for Washington and Oregon, described as imperiled because of rarity due to very restricted range, very few populations (often fewer than 20), steep declines, or other factors making it vulnerable to extinction from the State. The Oregon Biodiversity Information Center ranks the species Heritage List 2, defined as threatened, endangered, or possibly extirpated in Oregon but more stable or common elsewhere.

Range: *Tholurna dissimilis* was previously thought to be endemic to Scandinavia until it was discovered in North America. It ranges from the Northwest Territories, Yukon, and British Columbia, south into Washington and Oregon, where it reaches its southern limit in the central Oregon Cascades. It is known from 18 sites in Washington and 4 sites in Oregon; all but one known site is on federal land. In Washington, it occurs on the Mt. Baker-Snoqualmie, Wenatchee, Okanogan, and Gifford Pinchot National Forests; Mt. Rainier and Olympic National Parks; and Carson National Fish Hatchery where it has been extirpated. In Oregon, it is reported from the Mt. Hood and Willamette National Forests.

Specific Habitat: In the Pacific Northwest, the typical habitat for *Tholurna dissimilis* is on krummholz or flag-form subalpine fir and Engelmann spruce on windswept ridges in the upper montane and subalpine zones up to timberline. It has also been reported from the top of an old-growth Douglas-fir at the canopy crane site in southern Washington. The elevational range of known sites is from near sea level at Port Angeles, Washington to 2042 m (6700 ft). In Oregon, reported populations occur at treeline on subalpine fir, and in an alpine area on wild currant twigs.

Threats: The main threat to *Tholurna dissimilis* is loss of populations resulting from activities that affect the populations or their habitat, particularly removing colonized substrate. Current known populations in Washington are considered at low risk from management activities because most sites are not managed for timber production. This species is at higher risk in Oregon because it is known from only three sites. A warming climate may stress populations at the southern limit of this species' range, and could result in a decline in vigor and a more restricted distribution.

Management Considerations

- Develop practices to route human use away from species habitat areas.

Data and Information Gaps:

- Determine the distribution of populations, species abundance and ecological requirements of *Tholurna dissimilis* across Washington and Oregon.
- Determine if *Tholurna dissimilis* is sensitive to air pollution.

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Tholurna dissimilis (Norman) Norman is monotypic. The species is in the family Caliciaceae, order Caliciales (Tehler 1996). No specific information is currently available regarding its taxonomic history.

B. Species Description

1. Morphology

Tholurna dissimilis is a very distinctive, dwarf, fruticose lichen composed of short, erect, hollow gray stalks (Figure 1). The tiny stalks are 1-3 (5) mm tall and 1 mm broad, arising from a squamulose to nearly crustose primary thallus. The brownish-gray stalks form a coarse stubble, and terminate with black apothecia, which dissolve into a powdery mass of spores. *Tholurna dissimilis* is obscure because of its diminutive size.

Technical description: Squamulose thallus of once-pinnate sterile lobes bearing erect, nearly cylindrical sulcate fertile podetia 1-3 mm high. Thallus dark brown to black and with upper and lower cortex and a spongy medulla. Green algal photobiont is *Protococcus*. Cup-shaped black apothecia are solitary on the apices of the gray podetia, which are expanded to a disciform receptacle. Asci slender and narrowed at the base to a thin stalk, 8-spored, the spores uniseriate. Spores composed of two globose cells and constricted in the middle; each cell with spiral diagonal-stripped apispore. Conceptacle of the pycnoconidia at the edge of the thallus, small, wart-like and brownish, and with a soft wall. Sporophores septate and with nearly globose cells; pycnoconidia straight, constricted in the middle, possessing secondary branches (Otto 1964).

2. Reproductive Biology

Tholurna dissimilis reproduces sexually by producing ascospores. It is not known to produce isidia or soredia.

3. Ecological Roles

Little is known about the ecological role of *Tholurna dissimilis*.

C. Range and Sites

Tholurna dissimilis, once thought to be endemic to Scandinavia (Otto 1964), is known from the Northwest Territories, Yukon, and British Columbia south into Washington and Oregon (Otto 1983). It reaches its southern limit in the central Oregon Cascades, and is known from 18 sites in Washington and 4 sites in Oregon. All known sites are on federal land with the exception of a Port Angeles location. In Washington it is found in Clallam, Whatcom, Snohomish, King,

Chelan, Pierce, Lewis, and Skamania counties. Sites on federal lands in Washington include Hurricane Ridge (Olympic National Park); the Mt. Baker-Snoqualmie National Forest on Skyline Divide, Table Mountain, Tomyhoi Peak area, White Mountain in the Glacier Peak Wilderness, Mt. Defiance in Alpine Lakes Wilderness, and Crystal Mountain Ski Area; Lake Wenatchee Ranger District on the Wenatchee National Forest, and above Harts Pass near the Cascade Crest on the Okanogan National Forest. It has been reported on the Gifford Pinchot National Forest from Castle Butte on the Cowlitz Valley Ranger District, and the canopy crane site on the Wind River District. There was a known site at the Carson Fish Hatchery in southern Washington, although that population no longer exists (J. Davis, pers. comm.).

In Oregon, there are four known sites. It has been reported from the Mt. Hood Wilderness (USDA 2012). The other three sites are on the Willamette National Forest at Iron Mountain, Carpenter Mountain, and Fuji Mountain and represent the known southern limit of this species. The rarity of *Tholurna dissimilis* in Oregon, its sparseness, and stunted condition suggest that conditions at the southernmost site are near the limit for its growth (Pike 1972).

Selected herbarium specimens:

WASHINGTON. Mount Baker-Snoqualmie NF: Crystal Mountain *Glew 719962* (WTU); Mt Watson *Rhoades WWU1356* (WTU); Mount Baker *Arnot L1316* (WTU). Wenatchee NF: Big Chief Mountain *Burnett L3114* (WTU); Wildhorse Creek area *Burnett 1116* (WTU); Labyrinth Mountain *Burnett 1118* (WTU); Lichtenberg Mountain *Arnot L813* (WTU); High Pass trail on Liberty Cap *Nash 2462* (ASU). Gifford-Pinchot NF: McCoy Peak *Bacheller NJBGP116* (WTU); Wind River Canopy Crane *McCune 23166* (OSC). Olympic NP: Hurricane Ridge *Anderson 7320* (ASU); Okanagon NF: Haystack Mountain northeast of Slate Peak *Rosentreter 16359* (SRP); Pacific Crest Trail east of Tatie Peak *Rosentreter 16359* (SRP). OREGON. Willamette NF: summit of Iron Mountain *Pike 3742* (OSC); Fuji Mountain *Stearns 080801 SS01* (OSC); Carpenter Mountain *Pike 3083* (OSC).

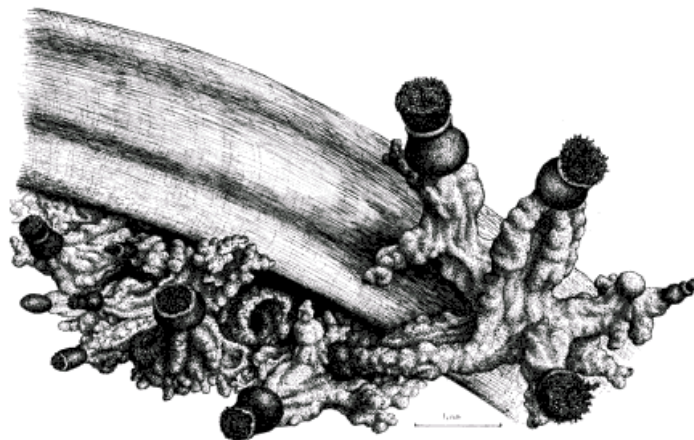


Figure 5. Line drawing of *Tholurna dissimilis* by Alexander Mikulin.

D. Habitat Characteristics and Species Abundance

In the Pacific Northwest, the typical habitat reported for *Tholurna dissimilis* is on krummholz or flag-form subalpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii*) on windswept ridges in the upper montane and subalpine zones up to timberline. The elevation of sites in this region ranges from near sea level to 2042 m (6700 ft). Atypical habitat characteristics include ornamental birch (*Betula* sp), rock, and wild currant (*Ribes triste*).

Tholurna dissimilis appears to be rare in Oregon, becoming more common to the north in British Columbia. Abundance data for this species are not currently available.

There has been only one report of *Tholurna dissimilis* from low-elevation tree canopies in the range of the northern spotted owl, but few if any surveys have been conducted in this habitat. In the Kitimat Valley of west-central British Columbia, it was found in the emergent crowns (40 m height, 131 ft) of dominant spruce (presumably *Picea sitchensis*) in low elevation forests (150 m, 492 ft) (Otto 1983). *T. dissimilis* was recently observed at the very top of an emergent spike-top old-growth Douglas-fir (*Pseudotsuga menziesii*) at the canopy crane site at Wind River on the Gifford Pinchot National Forest (J. Davis, pers. comm.). This recent discovery is evidence that *T. dissimilis* occurs in tree canopies other than krummholz, and at lower elevations.

II. CURRENT SPECIES SITUATION

A. Status History

Tholurna dissimiliss was considered at risk under the Northwest Forest Plan because of its rarity and limited distribution within the range of the northern spotted owl (USDA and USDI 1994a, 1994b). Initially, it was a Survey and Manage strategy 1 and 3 species (USDA and USDI 1994c). With the completion of the 2000 SEIS, sites north of the Columbia River were dropped as Survey and Manage because it was presumed that the high elevation habitat is within protected land allocations. South of the Columbia River, where there are fewer sites, concern for persistence remained and the species was assigned to Management Category B (USDA and USDI 2001). In 2004, *T. dissimilis* was designated a Sensitive Species for Forest Service Region 6 and a Bureau of Land Management (BLM) Assessment species in Washington and Oregon.

Tholurna dissimilis received the following ranks from the Natural Heritage Program in 2004, which have not changed in 2011 (ORNHIC 2004; ORBIC 2011; WNHP 2011). This lichen has a Global Natural Heritage Rank of G3/G5, from vulnerable (G3), described as at moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors to secure (G5), considered common, widespread and abundant. The species has a State Heritage Rank of S2 in Oregon and Washington, described as imperiled because of rarity due to very restricted range, very few populations (often fewer than 20), steep declines, or other factors making it vulnerable to extinction from the State. The species is on the ORBIC List 2, described as species that are threatened, endangered, or possibly extirpated in Oregon but more stable or common elsewhere.

B. Major Habitat and Viability Considerations

The major viability consideration for *Tholurna dissimilis* is loss of populations resulting from management activities that affect the populations or their habitat, particularly removing colonized substrate. Current known populations in northern Washington are considered at low risk from management activities because many known sites are krummholz trees at timberline, and most sites are in Wilderness areas, or in areas not managed for timber production. The occurrence of *T. dissimilis* in exposed ridgetop habitats may make it more vulnerable to air pollution, if it is determined that *T. dissimilis* is sensitive to pollutants. A warming climate may contribute to a decline in vigor of this species at the southern limit of its range, and could result in an even more restricted distribution for *T. dissimilis*.

C. Threats to the Species

Threats to *Tholurna dissimilis* are those actions that affect populations, particularly removing colonized substrate. A significant deterioration in air quality could threaten the viability of this species, considering the exposed nature of the habitat it occupies--that is ridgetops, mountain summits, and tree canopies. Climate change is likely to be a threat to the species.

D. Distribution Relative to Land Allocations

Sites of *Tholurna dissimilis* on federal land include 9 in Congressionally reserved land use allocations, 2 are administratively withdrawn, 2 are in an Adaptive Management allocation, and 3 are within matrix. The remaining federal sites are undetermined.

III. MANAGEMENT GOALS AND OBJECTIVES

Management for this species follows Forest Service Region 6 Sensitive Species (SS) policy (FS Manual 2670), and/or OR/WA BLM Special Status Species (SSS) policy (6840).

For OR/WA BLM administered lands, SSS policy details the need to manage for species conservation. For Forest Service Region 6, SS policy requires the agency to maintain viable populations of all native and desired non-native wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands. Management “must not result in a loss of species viability or create significant trends toward federal listing” (FSM 2670.32) for any identified SS.

IV. HABITAT MANAGEMENT

A. Lessons From History

Tholurna dissimilis was recently discovered in North America (Otto 1964). Previously it was known only from Scandinavia. Since the discovery of *T. dissimilis* in western North America in the 1960s, many more sites have been documented. The number of known sites went from eight

in 1972 to 47 by 1981 (Otto 1983); 42 of these known sites are from western Canada in British Columbia, the Yukon and Northwest Territories (Otto 1983). Pike (1972) was the first to report *T. dissimilis* from Oregon; he also looked for this species in suitable habitat on Mt. Hood and Mt. Jefferson in Oregon, but did not find it. It has been reported from the Mt. Hood Wilderness. It is possible that with additional surveys, this species may not be as rare as currently thought. In addition, the recent discovery of *T. dissimilis* in the upper crown of old-growth Douglas-fir at the canopy crane site expands our concept of suitable habitat for this species in the area of the Northwest Forest Plan.

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). The sensitivity of *Tholurna dissimilis* to air pollution is unknown.

The decline of lichens in Europe has resulted in the development of lists of threatened species. Sweden has a “red list” of lichens that are threatened with extinction because of air pollution and habitat degradation (Thor 1990). *Tholurna dissimilis* is listed as rare on this list (Databanken for hotade arter och Naturvardsverket 1991). The International Association of Lichenology has recently initiated a listing of lichens threatened globally.

B. Identifying Species Habitat Areas

All sites of *Tholurna dissimilis* on federal lands administered by the Forest Service Region 6 and/or OR/WA BLM are identified as areas where the information presented in this Conservation Assessment could be applied. A species habitat area is defined as the suitable habitat occupied by a known population, plus the surrounding habitat needed to support the site.

C. Managing in Species Habitat Areas

The objective of a species habitat area is to maintain habitat conditions such that species viability will be maintained at an appropriate scale, in accordance with agency policies. Specific management considerations include:

- Determine the extent of the local population and species habitat area with a site visit.
- Maintain occupied substrate, provide additional suitable substrate for colonization as current occupied substrates decline, and avoid damage to colonized substrate.
- Develop practices to route human use away from the populations in species habitat areas (for example, divert roads, trails and off-road vehicles). Trampling shrubs or cryptogam mats, compacting roots, damaging trees or branches that serve as substrates, and introducing non-native species by seed dispersal or planting, can all adversely affect habitat integrity

Sites with populations that occur in the tops of old-growth trees may be problematic. It is often difficult to determine the extent of the population. Further considerations for these sites include:

- Maintain the tallest trees with exposed upper crowns in the stand, as well as trees with dead spike-tops if present. Select trees with these attributes for green tree retention.

V. RESEARCH, INVENTORY AND MONITORING OPPORTUNITIES

The objective of this section is to identify opportunities to acquire additional information that 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 and Information Gaps

- Determine if additional populations of *Tholurna dissimilis* exist in areas identified as potential suitable habitat. Assign priority surveys to timberline habitats especially near the southern edge of its range in Oregon and southern Washington, and to exposed upper crowns of conifers at lower elevation, particularly in areas of cold-air drainage.
- Determine the extent of the population of *Tholurna dissimilis* at the canopy crane site. This is a unique opportunity to survey traditionally inaccessible habitat and to develop additional information on the distribution and abundance of *T. dissimilis* in this type of stand, as well as characterizing its habitat in tree crowns. This information could be used to improve our management of this species elsewhere.
- Revisit sites to verify the status of known populations, determine the extent of the populations and abundance, and characterize ecological conditions.
- Report documented sites to ORBIC and Washington Natural Heritage Programs and enter data into agency regional databases.
- Report changes in documented and suspected status as quickly as possible to the interagency (BLM OR/WA and FS R6) Special Status/Sensitive Species Specialist in the State and Regional Office.
- Report sitings and survey work in the appropriate agency database: GeoBOB or NRIS.

B. Research Questions

- What habitat characteristics and ecological conditions are necessary for establishment of *Tholurna dissimilis* propagules and survival of established thalli?
- What are the dispersal mechanisms and dispersal distances of this species?
- Is *Tholurna dissimilis* sensitive to air pollution?
- What is the genetic diversity of this species within its local populations and across the region?
- How will forecasted climate change parameters affect *Tholurna dissimilis*?

C. Monitoring Opportunities and Recommendations

- If management treatments occur in the vicinity of known sites, monitor population to determine response to treatment and effects on population viability.

- Monitor selected sites to document population trends, particularly those populations at the edge of a species range, or those sites of atypical habitats.
- Consider establishing air quality monitoring sites near selected known populations of *Tholurna dissimilis*.

REFERENCES

- Case, J.W. 1980. The influence of three sour gas processing plants on the ecological distribution of epiphytic lichens in the vicinity of Fox Creek and Whitecourt, Alberta, Canada. *Water, Air and Soil Pollution* 14:45-68.
- Databanken for hotade arter och Naturvardsverket 1991: Hotade vaxter i Sverige 1990. Karlvaxter, mossor, lavar och svampar - forteckning och lansvis forekomst. (Sweden's red lists on vascular plants, bryophytes, lichens and macrofungi). Lund.
- Davis, J. 1999. Personal communication. US Fish and Wildlife Service, Portland, OR.
- Ferry, B.W., M.S. Baddeley, and D.L. Hawksworth. 1973. *Air Pollution and Lichens*. University of Toronto Press. Toronto.
- Gilbert, O.L. 1992. Lichen reinvasion with declining pollution. pp. 159-177. In: Bates, J.W. and A.M. Farmer (eds.). *Bryophytes and Lichens in a Changing Environment*. Clarendon Press, Oxford, UK.
- Hawksworth, D. L. 1971. Lichens as a litmus for air pollution: a historical review. *International Journal of Environmental Studies* 1:281-296.
- Hawksworth, D.L. and F. Rose. 1976. Lichens as pollution monitors. *The Institute of Biology's Studies in Biology* no. 66. Edward Arnold, London.
- ORBIC. 2012. Oregon Biodiversity Information Center. <http://orbic.pdx.edu>
- ORNHIC. 2004. Oregon Natural Heritage Information Center. <http://orbic.pdx.edu>
- Otto, G.F. 1964. *Tholurna dissimilis* new to North America. *Bryologist* 67:73-75.
- Otto, G.F. 1983. *Tholurna dissimilis* well established in western North America. *Bryologist* 86(3):263-265.
- Pike, L. H. 1972. *Tholurna dissimilis* in Oregon. *Bryologist* 75(4):578-580.
- Rao, D.N. and F. LeBlanc. 1967. Influence of an iron-sintering plant on corticolous epiphytes in Wawa, Ontario. *Bryologist* 70(2):141-157.
- Sigal, L.L. and T.H. Nash III. 1983. Lichen communities on conifers in southern California Mountains: an ecological survey relative to oxidant air pollution. *Ecology* 64(6):1343-1354.
- Skye, E. and I. Hallberg. 1969. Changes in the lichen flora following air pollution. *Oikos* 20:547-552.

- Tehler, A. 1996. Systematics, phylogeny and classification. pp. 217-239. *In*: Nash, T. H. III, (ed.). *Lichen Biology*. Cambridge University Press, Cambridge, UK.
- Thor, G. 1990. International Association of Lichenology committee for conservation of lichens red global list. Swedish threatened species unit. Swedish University of Agricultural Sciences, P.O. Box 7072, S-75007, Uppsala, Sweden.
- USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Portland, OR.
- USDA Forest Service and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl, Appendix J2: Results of Additional Species Analysis. Portland, OR. 476 p.
- USDA Forest Service and USDI Bureau of Land Management. 1994c. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents and Standards and Guidelines for Management of Habitat for Late-successional and Old-growth Forest Related Species within the Range of the Northern Spotted Owl. Portland, OR.
- USDA Forest Service and USDI Bureau of Land Management. 2001. Record of Decision for Amendments to the Survey and Manage Protection Buffer, and other Mitigation Measures Standards and Guidelines. Portland, OR.
- USDA Forest Service and USDI Bureau of Land Management. 2004. Record of Decision to Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines in Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. Portland, OR.
- USDA. 2012. USDA Forest Service Natural Resources Manager database.
- WNHP. 2012. Washington Natural Heritage Program.
http://www.dnr.wa.gov/researchscience/topics/naturalheritage/pages/amp_nh.aspx