

Conservation Assessments for 8 species of Coastal Lichens

Bryoria pseudocapillaris Brodo & D. Hawksw.

Bryoria spiralifera Brodo & D. Hawksw.

Bryoria subcana (Nyl. ex Stizenb.) Brodo & D. Hawksw.

Erioderma soledatum D.J. Galloway & P.M. Jørg.

Heterodermia leucomela (L.) Poelt

Leioderma soledatum D.J. Galloway & P.M. Jørg.

Niebla cephalota (Tuck.) Rundel & Bowler

Teloschistes flavicans (Sw.) Norman

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**Updated June 2013 by
Doug Glavich**

DOUG GLAVICH is a botanist at the Siuslaw National Forest, Forest Supervisor's Office

Edited by Rob Huff, Interagency Special Status and Sensitive Species Program,
Region 6 Forest Service and Oregon/Washington BLM

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. 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, the habitat, range, taxonomic and site information have also been updated to be current. 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.

April 2013: 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. All of the species listed in this document have status under the Region 6 Forest Service and BLM Oregon/Washington Interagency Sensitive and Special Status Species Program and/or the Survey and Manage Standards and Guidelines. For most recent lists and statuses, please check these websites: <http://www.blm.gov/or/plans/surveyandmanage/> and <http://www.fs.fed.us/r6/sfpnw/issssp/>.

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 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
***Bryoria pseudocapillaris* Brodo & D. Hawksw.**

Originally issued
as Management Recommendations
March, 2000
Linda Geiser, 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, new information has been collected regarding the range and habitat of *Bryoria pseudocapillaris* and is presented herein.

Species: *Bryoria pseudocapillaris* Brodo & D. Hawksw.

Taxonomic Group: Lichen

Management Status: Forest Service and Bureau of Land Management (BLM) Survey and Manage species, Category A: manage all known sites and conduct pre-disturbance surveys. From NatureServe, the species is ranked with a Global Heritage Rank of G3 and a state rank of S3 for Oregon. Rank 3 is described as rare, uncommon or threatened, but not immediately imperiled with 21 to 100 known sites. It is on the Oregon Heritage List 4, described as a species of conservation concern but not rare enough to be categorized as threatened or endangered.

Range: Global distribution is restricted to coastal northwest United States from Puget Sound, Washington to San Luis Obispo County, California. Sites on federal lands include the Siuslaw National Forest, Eugene BLM, and Coos Bay BLM in Oregon, and Humboldt Bay National Wildlife Refuge, Lanphere Dunes Unit, Humboldt County, California.

Specific Habitat: *Bryoria pseudocapillaris* grows in areas of frequent maritime fog on exposed trees (especially Sitka spruce and shore pine) and shrubs growing on coastal windswept dunes, rocky headlands, and in one case, coastal mountains, up to 680 meters (2240 feet) above sea level within 15 km (10 miles) of the ocean.

Threats: The main threats are activities that directly harm the populations, their habitat, or the potential habitat surrounding populations. Examples of potential threats include: burning (in some places); harvesting trees; constructing roads, trails or buildings; recreational activities; grazing; invasive exotic plants; changes in local hydrology; and air pollution.

Management Considerations:

- Develop practices to route human use away from species habitat areas (divert roads, trails, etc., where possible).
- Manage fire in species habitat areas, with an emphasis on prevention.
- Restrict removal of trees, shrubs, or other vegetation from sites except when removal will not harm habitat integrity.

Data and Information Gaps:

- Visit sites to determine the extent of local populations and improve habitat descriptions.
- Determine if additional populations exist in areas identified as potential suitable habitat.

I. NATURAL HISTORY

A. Taxonomy and Nomenclature¹

Bryoria pseudocapillaris Brodo & D. Hawksw. was described in 1977 (Brodo and Hawksworth 1977). No nomenclatural changes nor synonyms have followed. It was placed in the *Implexae* section of *Bryoria*, which includes the following, mainly coastal species: *B. capillaris*, *B. friabilis*, *B. implexa*, *B. nadvornikiana*, *B. pikei*, *B. pseudofuscescens*, *B. salazinica* and *B. spiralifera*. The section is characterized by β -orcinol depsidones other than fumarprotocetraric acid, small pseudocyphellae and a characteristic cortical structure that tends to make the branches more friable than usual. Because of their unusual pseudocyphellae, Brodo and Hawksworth placed both *B. pseudocapillaris* and the rare California endemic, *B. spiralifera*, in this group, but with some hesitation. The distinctively depressed pseudocyphellae and pale to reddish-brown color of both species are closer to the chemically similar genus *Sulcaria* and the two species may actually have an intermediate taxonomic standing between *Bryoria* sect. *Implexae* and the genus *Sulcaria*. In addition, similarities in branching type, color, and habitat requirements between *B. pseudocapillaris* and *B. spiralifera* indicate they are very closely related.

B. Species Description

1. Morphology and Chemistry¹

Bryoria pseudocapillaris is a dark, filamentous, epiphytic lichen (Figure 1). It is fruticose and subpendent, 5-7 cm long, and somewhat stiff. Thallus color varies from very pale brown to chestnut-colored, and has a matt (not shiny) surface. The branching pattern is mainly isotomic dichotomous (branches in y's of equal size) and acute to perpendicular angled short side branches are frequent. The main branches are mostly round in cross section, between 0.25-0.33 mm in diameter, and are even, smooth, and neither flattened nor twisted. True lateral spinules, isidia, and soralia are absent. The long (1.2-3.0 mm), white pseudocyphellae are distinctively depressed and usually linear, although they can sometimes be slightly twisted around the filaments (branches). Sexual reproductive structures such as apothecia and pycnidia are unknown. The cortex is K+ yellow, C+ pink, KC+ pink, PD+ deep yellow; the medulla is K-, C-, KC-, PD-. This lichen contains alectorialic and barbatolic acids, together with an unidentified substance (Brodo and Hawksworth 1977).

Bryoria pseudocapillaris can be confused with two other chestnut-colored coastal tree hair lichens; *B. spiralifera* is most similar. It is known only from coastal Humboldt County, California, and from Bluegill Lake, Oregon Dunes National Recreation Area. It differs from *B. pseudocapillaris* by its K+ red, C-, and KC- reactions of the cortex, and the extremely long (up to 4 mm), spiraling pseudocyphellae (Glavich 2003). The unique deep, longitudinal sulcae

¹ See McCune and Geiser (1997) for glossary and diagrams of lichenological terms used in this section.

(grooves or fissures) of *Sulcaria badia* readily distinguish it from *B. pseudocapillaris* (McCune and Geiser 1997).



Figure 1. Line drawing of *Bryoria pseudocapillaris* by Alexander Mikulin.

Pale individuals of *Bryoria pseudocapillaris* can be confused with other pale coastal tree hair lichens:

- *Bryoria capillaris* is the most common pale brown to pale grayish *Bryoria* in the Coast Range. Although they both contain alectorialic and barbatolic acids and have the same reaction to chemical spot tests, *B. capillaris* lacks the frequent short side branches typical of *B. pseudocapillaris* and, most definitively, has short, inconspicuous (as opposed to long, white, conspicuous) pseudocyphellae.
- *Bryoria trichodes* ssp. *trichodes* is easily distinguished from *B. pseudocapillaris* by its K-, C- and KC- spot tests. In addition, the medulla is usually P+ red (contains fumarprotocetraric acid), as opposed to P+ deep yellow (Brodo and Hawksworth 1977).
- *Bryoria subcana* is very pale and has abundant, conspicuous, white soralia. Soralia are usually not present in *B. pseudocapillaris* but have been observed (Glavich, pers obs). *Bryoria subcana* is easily distinguished by its strong P+ red reaction (fumarprotocetraric acid) (Brodo and Hawksworth 1977).
- *Bryoria friabilis* can be distinguished by the presence of gyrophoric acid only, usually yielding K-, P-, and KC+ pinkish-orange reaction.
- *Bryoria pseudofuscescens* has short, pseudocyphellae and is distinguished by its K+ yellow to red, KC-, and P+ yellow reactions.

2. Reproductive Biology

Bryoria pseudocapillaris reproduces asexually by thallus fragmentation. Smaller asexual propagules containing both fungal and algal partners (for example, soredia or isidioid spinules) are absent for this species, and sexual reproductive structures (fungal apothecia) have never been observed (Brodo and Hawksworth 1977).

Like other pendent lichens in the genera *Alectoria*, *Bryoria* and *Usnea* that reproduce by thallus fragmentation (Esseen *et al.* 1981, Stevenson 1988, Dettki 1998), *Bryoria pseudocapillaris* reproduces effectively over short distances (within a few hundred meters) but may be dispersal limited over long distances. Many lichens produce microscopic sexual and asexual propagules that are dispersed long distances by wind, animals, or birds (Bailey 1976). The thallus fragments of *B. pseudocapillaris* are less likely to be carried as far by wind or animal vectors. Because the habitat appears limited, even propagules which are transported across long distances are unlikely to encounter conditions suitable for establishment. In addition, because current populations are widely separated, and because *B. pseudocapillaris* apparently lacks the means for sexual reproduction, genetic diversity within populations might be low and exchange of genetic material between populations may be absent.

3. Ecological Roles

Little is known about the ecological roles of *Bryoria pseudocapillaris*. Other *Bryoria* species provide forage and nesting material for a variety of animal species such as insects, birds, small mammals, and ungulates (McCune and Geiser 1997). The dune forests of the Samoa Peninsula, Humboldt County, California and the Oregon Dunes National Recreation area are the largest known populations of *B. pseudocapillaris* (Glavich et al 2005a). Because the lichen can be found abundantly draped over trees in many sites of these areas, it is probable that some animals utilize it.

C. Range and Sites

The global range of *Bryoria pseudocapillaris* is restricted to the Pacific coast of northwest United States, mostly occurring within 16 km (0-10 miles) of the coast from Puget Sound, Washington south to San Luis Obispo County, California. Sites in Washington occur in Island and Clallam Counties. In Oregon, sites are known from Clatsop, Lane, Douglas, Coos, and Curry Counties. The one non-coastal occurrence of this species at Saddle Mountain in Clatsop County, Oregon, is 16 km (10 miles) inland. California sites occur in Del Norte, Humboldt, Mendocino, and San Luis Obispo Counties.

Selected records (Glavich *et al.* 2004) include CALIFORNIA. Mendocino Co. H.J. Ranch, Point Arena, *Glavich 611* (OSC). Humboldt Co. Samoa Peninsula, BLM parcel, *Glavich 523* (OSC); Humboldt Bay National Wildlife Refuge, Lanphere Dunes, *Glavich 527* (OSC); Humboldt Lagoons State Park, Dry Lagoon, *Glavich 530* (OSC); Little River State Park, *Glavich 595* (OSC); Patrick's Point State Park, *Glavich 503* (OSC); Redwood National Park, Crescent Overlook, *Glavich 548* (OSC); Trinidad Beach State Park, *Glavich 534* (OSC). Del Norte Co. Lake Earl State Park, *Glavich 544* (OSC). OREGON. Curry Co. Cape Blanco State Park, *Glavich 552* (OSC); Samuel Boardman State Park, Natural Bridges Cove, *Glavich 551* (OSC). Coos Co. New River BLM-ACEC, Muddy Lake, *Mikulín 1227* (OSC); Cape Arago State Park, *Mikulín 1292* (OSC); Oregon Dunes National Recreation Area, North Eel Campground vicinity, *Mikulín 1217* (OSC). Douglas Co. Umpqua Lighthouse State Park, Lake Marie, *Geiser 7098* (OSC); Oregon Dunes National Recreation Area, Takenitch Ck trail, *Mikulín 1310* (OSC). Lane Co. Siuslaw National Forest: Sutton Creek, *Mikulín 1141* (OSC); Heceta Beach *Mikulín 1149* (OSC); Oregon Dunes National Recreation Area, Goose Pasture, *Mikulín 1152* (OSC). Clatsop Co. Saddle Mountain State Park, *Mikulín 1180* (OSC). WASHINGTON. Clallam Co. Olympic National Park, Sand Point vicinity, *Mikulín 1291* (OSC). Island Co. Deception Pass State Park, *Mikulín 1260* (OSC).

D. Habitat Characteristics and Species Abundance

Bryoria pseudocapillaris has a narrow ecological amplitude throughout its range, occurring in maritime-influenced sites with moderated temperatures and high humidity provided by frequent fog. It grows on exposed or moderately exposed coastal trees, shrubs, and (once) on rock, in old scrub forests of windswept dunes or rocky headlands up to 680 meters (2240 feet) elevation (Glavich et al. 2005b). *B. pseudocapillaris* is found predominantly on shore pine (*Pinus contorta*) and Sitka spruce (*Picea sitchensis*), but can also be found frequently on Douglas fir

(*Pseudotsuga menziesii*), Grand fir (*Abies grandis*), and Evergreen Huckleberry (*Vaccinium ovatu*) within dune and Sitka spruce forests (Glavich 2003; Glavich et al. 2005b). It shares the same habitat with a closely related California-Oregon endemic, *B. spiralifera* (Brodo and Hawksworth 1977; Glavich 2003; Glavich et al. 2005b). The most common associated lichens are *Hypogymnia heterophylla*, *Parmelia sulcata*, *Pyrrhospora quernea*, *Ramalina farinacea*, *Ramalina menziesii*, and *Tuckermanopsis chlorophylla* (Glavich et al. 2005b).

The largest populations of *Bryoria pseudocapillaris* occur on the Dunes of the Samoa Peninsula, Humboldt County, California and the Oregon Dunes National Recreation Area, which seem to define its optimal range (Glavich et al. 2005a). In this range, aside from dune forests, it has been found in coastal Sitka spruce forests on beach margins and headlands from northern California to Central Oregon. Small populations have been found in coastal scrub of central California and other coastal forest types in the Puget Sound and the Olympic peninsula.

II. CURRENT SPECIES SITUATION

A. Status History

Bryoria pseudocapillaris 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). In 1998, the species was given Bureau of Land Management (BLM) Assessment Status based on Oregon Natural Heritage Information Center (ORNHIC) ranking of List 2 (USDI Bureau of Land Management 1998). With the completion of the 2001 Survey and Manage Record of Decision, it was assigned to Management Category A (USDA and USDI 2001). In 2004, *B. pseudocapillaris* was designated a Sensitive species for Forest Service Region 6 and Bureau Sensitive for the Bureau of Land Management in Washington, Oregon and California; the Survey and Manage Standards and Guidelines were also removed at this time. After a legal hiatus, the Survey and Manage (S&M) Standards and Guidelines were re-instated in 2009, with a settlement agreement in 2011 (USDA-USDI 2011). The settlement agreement maintains *B. pseudocapillaris* as S&M management category A, manage all known sites and conduct pre-disturbance and strategic surveys (USDA and USDI 2001).

In 2011, *B. pseudocapillaris* was removed from the Region 6 Forest Service and OR/WA BLM Sensitive Species lists, due to a drop in the conservation concern for this species. *Bryoria pseudocapillaris* had a Global Heritage Rank of G1/G2 and State Heritage Rank of S1 for Oregon and Washington. Rank 1 is described as critically imperiled, and Rank 2 is described as imperiled with fewer than 20 known sites. With more sites found, it was re-ranked to G3 and S3 for Oregon only (ORBIC 2012). The species was also changed from Natural Heritage List 1 (threatened or endangered) to List 4, which is described as taxa that of conservation concern but are not currently threatened or endangered (ORBIC 2012).

B. Major Habitat and Viability Considerations

The major concerns for this species are the small number of known populations globally, the limited range of the species which is restricted to coastal habitat in Washington, Oregon and

California, the limited amount of suitable habitat within its range on federal land, and management or recreational activities that may adversely affect populations or habitat. Climate change and air pollution could also cause a decline in vigor of this species or contribute to extirpation of local populations.

The persistence of this lichen is uncertain because of the rarity of the species, and because most sites along the coast are on private land. The largest population is on the Samoa Peninsula, much of which is in private ownership. Expansion of the area open to recreational activities or additional development could further restrict its habitat on the Samoa Peninsula and Oregon Dunes. These disturbance activities or timber harvest could also reduce habitat in other forest types on the immediate coast.

Even though more *Bryoria pseudocapillaris* sites have been found in recent years, its range has not been expanded and remains very small. Because of the small number of known *Bryoria pseudocapillaris* sites globally, the discovery of additional populations would reduce concerns about its viability.

Genetic isolation may also be a concern. For species such as *Bryoria pseudocapillaris* that have inefficient means for long-distance dispersal, isolation of populations may also lead to genetic isolation. Almost nothing is known about the genetics of lichen populations or the effects of gene pool isolation on local extinction rates of populations.

C. Threats to the Species

Threats to *Bryoria pseudocapillaris* are those actions that disrupt forest stand conditions necessary for its survival anywhere within its range. Such actions include removing colonized bark or wood substrates; decreasing exposure to light; adversely affecting integrity of species habitat areas; reducing or fragmenting potential habitat; or degrading air quality.

Recreational activities and developments may inadvertently alter the habitat of this species. Trampling by recreational vehicles and frequent foot traffic are serious threats, especially in shore pine woodlands and edge communities, as habitat is easily degraded by disturbing fragile root systems of trees and shrubs, and the fragile protective mats of ground cryptogams, which stabilize the soil (Christy *et al.* 1998). Off highway vehicles (OHV) can destabilize tree island habitats or increase the rate of sand drift and thus burial of *B. pseudocapillaris* substrate trees. Buildings, roads, campgrounds and trails along the immediate coast have replaced many natural habitats to improve access, facilitate scenic views, or develop recreational uses.

Other threats to the integrity of habitat and potential species habitat areas include logging, grazing, agriculture, and activities that alter local hydrology, or increase fire frequency (Christy *et al.* 1998). Concern about fire varies with the various plant communities and successional stages that exist among the coastal dunes and headlands; fire is beneficial to some communities but damaging to others. Invasion or planting of exotics such as Scots broom (*Cytisus scoparium*), European beachgrass, tree lupine (*Lupinus arboreus*), birdsfoot-trefoil (*Lotus corniculatus*), and iceplant (*Mesembryanthemum* spp.) can have profound effects on nitrogen-poor dune soils by increasing nitrogen and soil moisture. These conditions foster invasion of

other weeds, eventually disrupting native plant communities (Christy *et al.* 1998) and reducing plant and animal diversity (USDI 1997).

Although the air-pollution sensitivity of this species is unknown, other coastal members of this genus are sensitive to sulfur- and nitrogen-based acidifying pollutants (Wetmore 1983, Insarova *et al.* 1992, McCune and Geiser 1997). Because the primary habitat of this lichen is the coastal fog belt, and because fog significantly concentrates pollutants--especially acidic forms of SO_x and NO_x to which lichens are most sensitive, the potential vulnerability of *Bryoria pseudocapillaris* to air-quality deterioration is a reasonable concern. Although air quality is generally good at known sites, rising pollution emissions from increased traffic (mainly NO_x) and new or expanded point sources (SO_x and NO_x) in the Arcata/Eureka, CA vicinity, Coos Bay and Florence, OR, and elsewhere, including Asia, might threaten this species in the future.

Climate change is currently one of the largest concerns facing lichens. Along with air chemistry, climate parameters are main drivers of lichen distribution (Geiser and Neitlich 2007; Jovan 2008; Jovan and McCune 2004). Climate change-driven alteration of coastal fog patterns could be expected to affect the vigor of this species, possibly resulting in an even more restricted distribution or contributing to local extirpation. Changes in precipitation and winter temperature will likely affect *B. pseudocapillaris* (Glavich *et al.* 2005b).

D. Distribution Relative to Land Allocations

Many sites of *Bryoria pseudocapillaris* on federal land include the Oregon Dunes Recreation Area, Siuslaw National Forest which is administratively withdrawn, with a management emphasis on recreation. Another federally managed Oregon site is in the BLM Heceta Beach Area of Critical Environmental Concern (ACEC) and the BLM New River ACEC. All other Oregon sites occur within the State Park system. In Washington, the sites are in Olympic National Park, which is congressionally reserved and Deception Pass State Park. Federally-managed sites in California include Redwood National Park and Humboldt Bay National Wildlife Refuge, Lanphere Dunes Unit (USDI 1997), both congressionally reserved. A BLM site occurs in the Samoa Dunes ACEC. Most of the Samoa Peninsula habitat is in private ownership, but important habitat on the southern end of the peninsula is owned by the city of Eureka (Eureka Dunes Protected Area). A 100 acre parcel near the town of Manila (central peninsula) is owned by the Manila Community Services District and this, too, supports a large population of *B. pseudocapillaris*. The remaining sites in California are in State Parks. More information on these sites can be found in USDI (2012), Geiser *et al.* (2004) and Glavich *et al.* (2005a).

III. MANAGEMENT GOALS AND OBJECTIVES

Management for this species follows the 2001 Record of Decision Standards and Guidelines for Survey and Manage (S&M) (USDA-USDI 2001; USDA-USDI 2011).

The primary objective of the S&M Standards and Guidelines is to conserve late-seral forest associated species. Species listed under the Standard and Guidelines have concern for a

reasonable assurance of species persistence and are assigned to management categories, depending on rarity, surveyability, and other factors (USDA-USDI 2001).

IV. HABITAT MANAGEMENT

A. Lessons From History

Habitat destruction or alteration has made a significant contribution to the decline of lichens world-wide (Seaward 1977). Rare lichens that are limited to habitats optimal for human activities, such as *Bryoria pseudocapillaris*, are especially vulnerable. At the northern Samoa Peninsula in Humboldt County, California, on county and state land near the mouth of the Little River, the native dune communities have been nearly eliminated by the invasion of European beachgrass and human activities, and only a fragment of the dune forest remains. Lichens are also absent from the southern end of the Peninsula's dune forest, where the trees are young and there is more evidence of off-road vehicle use (Glavich, pers. obs.). Even foot traffic has been documented to damage fragile shore pine/bearberry (*Arctostaphylos uva-ursi*) communities of coastal dunes (Brown 1990). In coastal Oregon, activities of the past 140 years (increased fire, agriculture, grazing, logging, changes in hydrology, and recreation) have affected plant succession in a major way (Christy *et al.* 1998). At Sand Lake dunes in Oregon, an area known for rare lichens, off-road vehicles have destroyed nearly all the shore pine woodlands in just thirty years (Wiedemann 1984, 1990 as cited by Christy *et al.* 1998).

Lichens have been known to be sensitive to air pollution for more than a century. Populations of many species in eastern United States and Europe (Hawksworth and Rose 1976) have declined precipitously from exposure to sulfur dioxide and other air pollutants. In the United States, lichens are one of the components used to indicate stress to forests from air pollution (McCune *et al.* 1996), and dozens of studies in the United States have used lichens as air-quality indicators (see bibliography in USDA 1998). In the Pacific Northwest, species sensitive to air pollution are already declining in some areas (Denison and Carpenter 1973, Taylor and Bell 1983) and lichens are identified as Air Quality Related Values in USDA Forest Service air resource management regional guidelines (Peterson *et al.* 1992).

B. Identifying Species Habitat Areas

All sites of *Bryoria pseudocapillaris* 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.
- 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 maintain or improve the species habitat area for *Bryoria pseudocapillaris* (for example, by preventing deeply shaded conditions or by removing invasive exotics).
- Utilize or prevent fire in species habitat areas, depending on the plant community, according to management guidelines suggested by Christy *et al.* (1998).
- Maintain integrity of the foredunes where they protect species habitat areas.
- Restrict commercial collection of moss or fungi or other special forest products if these activities would adversely affect the integrity of *Bryoria pseudocapillaris*.

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 update the status of the species that have not been further mapped, and determine the extent of local populations.
- Determine whether additional populations exist in areas identified as potentially suitable habitat, such as Cape Perpetua, Puget Sound, and continue mapping populations on the Oregon Dunes National Recreation Area.
- Report documented sites to Oregon Biodiversity Information Center 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 Special Status and Sensitive Species Specialist in the State and Regional Office.
- Report sitings and survey work in the appropriate agency database.

B. Research Questions

- What are the dispersal rates and mechanisms of *Bryoria pseudocapillaris*?
- Which habitat and microclimate characteristics are necessary for establishing *Bryoria pseudocapillaris* thallus fragments and survival of established thalli?
- What is the genetic diversity of *Bryoria pseudocapillaris* within local populations and across the region?

- What is the air pollution sensitivity of *Bryoria pseudocapillaris*?
- What are the minimum and optimum patch sizes of colonized habitat necessary to provide for *Bryoria pseudocapillaris*?
- Can transplants be used to create local populations of *Bryoria pseudocapillaris* to increase its population base?
- How will projected climate change parameters affect the distribution of *Bryoria pseudocapillaris* in the Pacific Northwest?

C. Monitoring Opportunities and Recommendations

- Monitor sites for changes in microclimatic conditions, successional changes, and for inadvertent habitat damage from human activities or wildfire.
- Monitor dispersal and population trends of existing populations.
- Monitor air quality near key populations of *Bryoria pseudocapillaris* on federally-managed lands of the Forest Service Region 6 and OR/WA BLM and assess threats to this species from present or projected air-quality trends.

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Conservation Assessment
for
***Bryoria spiralifera* Brodo & D. Hawksw.**

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Doug Glavich

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SUMMARY

Preface: Since the Conservation Assessment in 2005, new site information has been collected regarding *Bryoria spiralifera* and is presented herein.

Species: *Bryoria spiralifera* Brodo & D. Hawksw.

Taxonomic Group: Lichen

Management Status: Forest Service Region 6 and Bureau of Land Management (BLM) Sensitive Species in Oregon. Forest Service and Bureau of Land Management (BLM) Survey and Manage species, Category A: manage all known sites and conduct pre-disturbance surveys. From NatureServe the species has 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 to 100 occurrences. Rank 2 is described as imperiled because of rarity or because other factors demonstrably make very vulnerable extinction, typically with 6 to 20 occurrences. *Bryoria spiralifera* is also on the Oregon Heritage List 2, which contains species that are threatened with extirpation or presumed to be extirpated from the state.

Range: Global distribution is restricted to coastal northwest United States from Umpqua County, Oregon to San Luis Obispo County, California. Although sites are found in Del Norte, Humboldt, Sonoma, Monterey, and San Luis Obispo Counties, California and Coos and Umpqua Counties, Oregon, there are two main population areas: Samoa Peninsula dunes, Humboldt County, California and the Oregon Dunes National Recreation Area (ODNRA). Federal land parcels on the Samoa Peninsula are managed by the Arcata Field Office of the BLM and Lanphere Dunes Unit of the Humboldt Bay National Wildlife Refuge. The ODNRA is managed by the Siuslaw National Forest. Eight sites are managed by Coos Bay BLM.

Specific Habitat: *Bryoria spiralifera* mostly occurs in coastal dune forests on exposed trees (especially Sitka spruce and shore pine) and shrubs. However, it can also occur in other forest types within 3 km (2 miles) from the ocean and up to 60 meters (200 ft) in elevation. Frequent fog and various ocean-influenced climatic, vegetative, and edaphic factors appear to be important factors influencing the distribution of this species, which appears to have a narrow ecological amplitude.

Threats: The main threats are activities that directly harm the populations, their habitat, or the potential habitat surrounding populations. Examples of threats include: trampling from recreational activities; harvesting trees; constructing roads, trails or buildings; invasive exotic plants; burning (in some places); grazing; changes in local hydrology; and air pollution.

Management Considerations:

- Develop practices to route human use away from species habitat areas.
- Manage fire in the species habitat areas, with an emphasis on prevention.
- Restrict removal of trees, shrubs, or other vegetation from the species habitat areas except when removal will not harm habitat integrity.

Data Gaps and Information Needs:

- Visit sites to determine the extent of local populations and improve habitat descriptions.
- Determine if additional populations exist in areas identified as potential suitable habitat.

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Bryoria spiralifera Brodo & D. Hawksw. was described in 1977 from a single location on the Samoa Peninsula, Humboldt County, California (Brodo and Hawksworth 1977) and has no synonyms. It was placed in the *Implexae* section of *Bryoria*, which includes *B. capillaris*, *B. friabilis*, *B. implexa*, *B. nadvornikiana*, *B. pikei*, *B. pseudocapillaris*, *B. pseudofuscescens*, and *B. salazinica*. The section is characterized by the occurrence of b-orcinol depsidones other than fumarprotocetraric acid, small pseudocyphellae and a characteristic cortical structure that tends to make the branches more friable than usual. Because of their unusual pseudocyphellae, both *B. spiralifera* and *B. pseudocapillaris* were placed in this group with some hesitation. The distinctively depressed pseudocyphellae and pale brown to chestnut color of both species are closer to the chemically similar genus *Sulcaria*. The two species may actually have an intermediate taxonomic standing between the *Bryoria* section *Implexae* and the genus *Sulcaria*. In addition, similarities in branching type, color, and ecology between *B. spiralifera* and *B. pseudocapillaris* indicate they are particularly closely related.

B. Species Description

1. Morphology and Chemistry

Bryoria spiralifera is a dark to pale reddish-brown, filamentous, epiphytic lichen (Figure 1). It has a short, pendent thallus, 6-7 cm long with conspicuous, long (up to 4 mm), white, linear, sometimes furrowed pseudocyphellae, most of which are twisted in long spirals around the branches. Other distinctive features are the numerous short, slender perpendicular branches, paler than the main branches. The main branches are 0.2-0.25 mm in diameter, uneven in cross section, and straight to twisted. The branching pattern is isotomic dichotomous at the base, with main branches becoming anisotomic dichotomous. True lateral spinules, isidia, and soralia are absent. Apothecia and pycnidia are unknown. The cortex is K+ red, C-, KC-, PD+ yellow; the medulla is K-, C-, KC-, and PD-. This lichen contains large amounts of norstictic acid, together with smaller quantities of connorstictic acid and atranorin (Brodo and Hawksworth 1977; Glavich 2003).

Bryoria spiralifera can be confused with other chestnut-colored coastal treehair lichens. *B. pseudocapillaris*, for example, shares the same habitat. Although similar in appearance, the two species have a very different chemistry. *B. pseudocapillaris* contains only alectorialic and barbatolic acids, and the cortex is K+ yellow, C+ pink, and KC+ pink. The pseudocyphellae of *B. pseudocapillaris* are also different; they are usually long and straight, as opposed to long and spiraling (Brodo and Hawksworth 1977; Glavich 2003). *Nodobryoria oregana* is a reddish-

colored *Bryoria* of the Coast Range that has distinctive spinules and contains no lichen substances (K-, C-, KC-, and PD-).



Figure 2. Line drawing of *Bryoria spiralifera* by Alexander Mikulin.

Pale individuals of *Bryoria spiralifera* can be confused with other pale coastal tree hair lichens:

- *Bryoria capillaris* is the most common pale brown to pale grayish *Bryoria* in the Coast Range and co-occurs in the Oregon Dunes. It can be distinguished by its short (~1 mm) pseudocypellae and its K+yellow, C-, KC-, P+Y reactions (alectorialic and barbatolic acids).
- *Bryoria trichodes* ssp. *trichodes* is easily distinguished from *B. spiralifera* by its K-, C- and KC-, P+red spot tests (fumarprotocetraric acid), as opposed to P+ deep yellow (Brodo and Hawksworth 1977).
- *Bryoria subcana* has abundant, conspicuous, white soralia and strong P+red thallus reaction (fumarprotocetraric acid) (Brodo and Hawksworth 1977).
- *Bryoria friabilis* can be separated by the presence of psromic acid, usually indicated by K-, P-, and KC+ pinkish-orange reactions.
- *Bryoria pseudofuscescens* has the same chemistry as *B. spiralifera*, but can be distinguished by its short pseudocypellae.
- *Bryoria pseudocapillaris* (see discussion above).

2. Reproductive Biology

Bryoria spiralifera reproduces asexually by thallus fragmentation. Asexual propagules (for example, soredia or isidioid spinules) and sexual reproductive structures (fungal apothecia) for this species have never been observed (Brodo and Hawksworth 1977).

Like other pendent lichens in the genera *Alectoria*, *Bryoria* and *Usnea* that reproduce by thallus fragmentation (Esseen *et al.* 1981, Stevenson 1988, Dettki 1998), *Bryoria spiralifera* reproduces effectively over short distances (within a few hundred meters) but it may be dispersal limited over long distances. Many lichens produce microscopic sexual and asexual propagules that are dispersed long distances by wind, animals, or birds (Bailey 1976). The thallus fragments of *Bryoria spiralifera* are less likely to be carried as far by wind or animal vectors. Because the habitat is rare, even propagules that are transported across long distances are unlikely to encounter conditions suitable for establishment. In addition, because current populations are widely separated, and because *B. spiralifera* apparently lacks the means for sexual reproduction, genetic diversity within populations may be low and exchange of genetic material between populations may be absent.

3. Ecological Roles

Little is known about the ecological roles of *Bryoria spiralifera*. Other *Bryoria* species provide forage and nesting material for a variety of animal species such as insects, birds, small mammals, and ungulates (McCune and Geiser 1997). The Samoa Peninsula in Humboldt County, California is home to the largest population of *B. spiralifera* (Glavich 2003; Glavich 2005a). Because the lichen can be found abundantly draped over trees in many places, it is probable that some animals utilize it.

C. Range and Sites

The global range of *Bryoria spiralifera* is restricted to within 3 km (2 miles) of the Pacific coast in the northwest United States from Umpqua, Coos, and Douglas Counties, Oregon; and Del Norte, Humboldt, Monterey, Sonoma, and San Luis Obispo Counties, California. However, there are two main population sites: the Samoa Peninsula dunes and the Oregon Dunes National Recreation Area. Current information suggests that this lichen is both rare and limited to the immediate coast. Extensive surveys conducted by the Forest Service on seven national forests, other federal lands, and state parks from northern California to the Washington-Canadian border resulted in few detections (Glavich 2005a; USDA 1998).

In California, Riefner *et al.* (1995) reported sites from Baywood Park, San Luis Obispo County, the Point Lobos vicinity, Monterey County and Stewart's Point Road in Sonoma County.

Selected records (Geiser *et al.* 2004) include California: Sonoma Co. Stewarts Point Rd., Riefner 87 – 128 (CANL). Humboldt Co. Samoa Peninsula, BLM parcel, Glavich 524 (OSC); Humboldt Bay National Wildlife Refuge, Lanphere Dunes, Glavich 522 (OSC). Del Norte Co. Lake Earl State Park, Glavich 590 (OSC). OREGON. Coos Co. Siuslaw National Forest: Bluebill Lake, Mikulin 1000 (OSC), Spinreel Campground, Mikulin 1023 (OSC); Oregon Dunes

National Recreation Area, e of Sandpoint Lake, *Mikulin 1225* (OSC). Douglas Co. Umpqua Lighthouse State Park, *Mikulin 1012* (OSC).

D. Habitat Characteristics and Species Abundance

Bryoria spiralifera has a narrow ecological amplitude. It grows on exposed or moderately exposed coastal trees, snags and shrubs, in forests or woodlands of windswept dunes and headlands. All known sites are at or near sea level (< 60 m (200 ft) elevation) and within 3 km (2 miles) of the ocean (Glavich et al. 2005a; 2005b). This lichen is found predominantly on shore pine (*Pinus contorta*) and Sitka spruce (*Picea sitchensis*) but is also found on grand fir (*Abies grandis*), evergreen huckleberry (*Vaccinium ovatum*), chaparral broom (*Baccharis pilularis*) and occasionally on red alder (*Alnus rubra*) and willow species (*Salix* spp.) (Glavich 2003; Glavich et al. 2005b). Associated lichen species are *Hypogymnia heterophylla*, *Ramalina menziesii*, *Tuckermanopsis chlorophylla*, *Cavernularia hultenii*, *Pyrrhospora quernea*, and *Ramalina farinacea* (Glavich et al. 2005b). It is scattered on the Oregon Dunes, but there are some locally abundant sites on the southern end of the NRA around Horsfall dunes and Bluebill lake (Glavich pers. obs.).

The following coastal plant communities, described by Christy *et al.* (1998), are preferred habitat for *Bryoria spiralifera*: Sitka Spruce/Evergreen Huckleberry forest, Sitka Spruce-Shore Pine/Evergreen Huckleberry forest, Shore Pine/Hairy Manzanita (*Arctostaphylos columbiana*) woodland, and Shore Pine/Bearberry (*Arctostaphylos uva-ursi*) woodland. At its largest population site, the Samoa Peninsula, it achieves its highest density on the exposed branches in the canopy and on the edge of the moving dunes, especially on the oldest trees (Glavich 2003). Some of the old snags of shore pine and Sitka spruce, partially buried at the apex of moving dunes, support the largest, most well-established thalli. In the open shore pine woodland stand types, it can be found through out the tree crowns and on understory shrubs (Glavich per obs.).

The dune forests that *Bryoria spiralifera* typically occupies have a maximum tree age of around 150 years old with a median stand age of 90 years old (Glavich et al. 2005b). Research suggests that these dune forests have been around, at least on the Samoa Peninsula, for a few thousand years (Leroy 2000).

II. CURRENT SPECIES SITUATION

A. Status History

Bryoria spiralifera 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 (S&M) strategy 1 and 3 species (USDA and USDI 1994c). In 1998, the species was given Bureau of Land Management (BLM) Assessment Status (USDI Bureau of Land Management 1998). With the completion of the 2001 Survey and Manage Record of Decision, it was assigned to Management Category A (USDA and USDI 2001). In 2004, *B. spiralifera* was designated a Sensitive species for Forest Service Region 6 in Oregon and OR/WA BLM; the Survey and Manage Standards and Guidelines were also removed at this time. After a legal hiatus, the Survey and Manage (S&M) Standards and Guidelines were

re-instated in 2009, with a settlement agreement in 2011 (USDA-USDI 2011). The settlement agreement maintains *B. spiralifera* as S&M management category A, manage all known sites and conduct pre-disturbance and strategic surveys (USDA and USDI 2001).

From NatureServe, *Bryoria spiralifera* has a Global Heritage Rank of G3 and a State Heritage Rank of S2 for Oregon (ORBIC 2012). A heritage rank of 3 is described as rare, uncommon or threatened, but not immediately imperiled, typically with 21 to 100 occurrences, and a heritage rank of 2 is described as imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction, typically with 6 to 20 occurrences. No State Heritage Rank has been assigned by the Washington Natural Heritage Program, as no sites have ever been located there. The species is on the Oregon Heritage List 2, which contains taxa that are threatened with extirpation or presumed to be extirpated from the state (ORBIC 2012).

B. Major Habitat and Viability Considerations

Major concerns for *Bryoria spiralifera* are not only the small number of known populations globally, but the small number of known populations within its very limited range. Due to this, there is the potential for loss of populations from management or recreational activities that damage the populations, their substrate trees or the remaining habitat in general. Climate change or air pollution could also cause a decline in vigor of this species or contribute to extirpation of local populations.

The persistence of this lichen is uncertain because of its small range and that most habitat along the coast is on private land, thus there is limited opportunity for federal management. Discovering or establishing additional populations would lower concerns about its viability. The largest population is on the Samoa Peninsula, much of which is in private ownership. Expansion of the area open to recreational activities, or additional development could further restrict its habitat on the Samoa Peninsula, Oregon Dunes, and elsewhere along the coast.

Because of the small number of known *Bryoria spiralifera* sites globally, the discovery of additional populations would reduce concerns about its viability.

Genetic isolation may also be a concern. For species such as *Bryoria spiralifera* that have inefficient means for long-distance dispersal, isolation of populations may also lead to genetic isolation. Almost nothing is known about the genetics of lichen populations or the effects of gene pool isolation on local extinction rates of populations.

C. Threats to the Species

Threats to *Bryoria spiralifera* are those actions that disrupt stand conditions necessary for its survival anywhere within its range. Such actions include removing colonized bark or wood substrates; decreasing exposure to light; adversely affecting integrity of habitat areas; reducing or fragmenting potential habitat; or degrading air quality.

Recreational activities and developments may inadvertently alter the habitat of this species. Trampling by recreational vehicles and frequent foot traffic are serious threats, especially in

shore pine woodlands and edge communities, as these degrade the habitat by disturbing fragile root systems of trees and shrubs, and the fragile protective mats of ground cryptogams, which stabilize the soil (Christy *et al.* 1998). Off-highway vehicles (OHV) can destabilize tree island habitats or increase the rate of sand drift; and, thus burial of *B. spiralifera* substrate trees. Buildings, roads, campgrounds and trails along the immediate coast have replaced many natural habitats to improve access, facilitate scenic views, or develop recreational uses.

Other threats to the integrity of habitat and potential habitat areas include logging, grazing, agriculture, and activities that alter local hydrology, or increase fire frequency (Christy *et al.* 1998). Concern about fire varies--many different plant communities and successional stages exist among the coastal dunes and headlands; fire is beneficial to some communities but damaging to others. Invasion or planting of exotics such as Scots broom (*Cytisus scoparium*), European beachgrass, tree lupine (*Lupinus arboreus*), birdsfoot-trefoil (*Lotus corniculatus*), and iceplant (*Mesembryanthemum* spp.) can have profound effects on nitrogen-poor dune soils by increasing nitrogen and soil moisture. These conditions foster invasion of other weeds, eventually disrupting native plant communities (Christy *et al.* 1998) and reducing plant and animal diversity (USDI 1997).

Although the air-pollution sensitivity of this species is unknown, other coastal members of this genus are sensitive to sulfur- and nitrogen-based acidifying pollutants (Wetmore 1983, Insarova *et al.* 1992, McCune and Geiser 1997). Because the primary habitat of this lichen is the coastal fog belt, and because fog significantly concentrates pollutants--especially acidic forms of SO_x and NO_x to which lichens are most sensitive--the potential vulnerability of *Bryoria spiralifera* to air-quality deterioration is a reasonable concern. Although air quality is generally good at documented sites, rising pollution emissions from increased traffic (mainly NO_x) and new or expanded point sources (SO_x and NO_x) in the Arcata/Eureka, CA vicinity, Coos Bay and Florence, OR, and elsewhere along the coast, might threaten this species in the future.

Climate change is currently one of the largest concerns facing lichens. Along with air chemistry, climate parameters are main drivers of lichen distribution (Geiser and Neitlich 2007; Jovan 2008; Jovan and McCune 2004). Climate change-driven alteration of coastal fog patterns and winter temperature will likely affect *B. spiralifera* (Glavich *et al.* 2005b).

D. Distribution Relative to Land Allocations

Bryoria spiralifera populations on protected federal lands are on the Samoa Peninsula in northern California: Humboldt Bay National Wildlife Refuge, Lanphere Dunes Unit, and Ma-le'l Dunes South, Bureau of Land Management Arcata Field Office. The Samoa Peninsula population extends into the Manila Community Services District-owned parcel and private land. Other sites in California are in State Parks. The populations in Oregon on the Siuslaw NF are on the Oregon Dunes National Recreation Area (ODNRA), which is administratively withdrawn. Although much of the ODNRA is managed for recreation, including off-highway vehicles, some areas occupied by this lichen are managed for plants and wildlife; these areas are restricted to foot traffic only. The Coos Bay BLM sites are within protective buffers within Matrix and General Forest Management Area land allocations. There is one Oregon State Park site.

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). Management for this species also follows the 2001 Record of Decision Standards and Guidelines for Survey and Manage (S&M) (USDA-USDI 2001; USDA-USDI 2011).

For OR/WA BLM administered lands, SSS policy details the need to manage for species conservation. Policy objectives also state that actions authorized or approved by the BLM do not contribute to the need to list species under the Endangered Species Act.

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.

The primary objective of the S&M Standards and Guidelines is to conserve late-seral forest associated species. Species listed under the Standard and Guidelines have concern for a reasonable assurance of species persistence and are assigned to management categories, depending on rarity, surveyability, and other factors (USDA-USDI 2001).

IV. HABITAT MANAGEMENT

A. Lessons from History

Habitat destruction or alteration has made a significant contribution to the decline of lichens world-wide (Seaward 1977). Rare lichens that are limited to habitats optimal for human activities, such as *Bryoria spiralifera*, are especially vulnerable. At the northern Samoa Peninsula, on county and state land near the mouth of the Little River, the native dune communities have been nearly eliminated by the invasion of European beachgrass and human activities, and only a tiny fragment of the dune forest remains. Lichens are also absent from the southern end of the Peninsula’s dune forest, where the trees are young and there is more off-road vehicle evidence (Glavich, pers. obs.). Even foot traffic has been documented to damage fragile shore pine/bearberry (*Arctostaphylos uva-ursi*) communities of coastal dunes (Brown 1990). In coastal Oregon, activities of the past 140 years (increased fire, agriculture, grazing, logging, changes in hydrology, and recreation) have affected plant succession in a major way (Christy *et al.* 1998). At Sand Lake dunes in Oregon, an area known for rare lichens, off-road vehicles have destroyed nearly all the shore pine woodlands in just thirty years (Wiedemann 1984, 1990 as cited by Christy *et al.* 1998).

Lichens have been known to be sensitive to air pollution for more than a century. Populations of many species in eastern United States and Europe (Hawksworth and Rose 1976) have declined precipitously from exposure to sulfur dioxide and other air pollutants. In the United States,

lichens are one of the components used to indicate stress to forests from air pollution (McCune *et al.* 1996), and dozens of studies in the United States have used lichens as air-quality indicators (see bibliography in USDA 1998). In the Pacific Northwest, sensitive species are already declining in some areas (Denison and Carpenter 1973, Taylor and Bell 1983) and lichens are identified as Air Quality Related Values in USDA Forest Service air resource management regional guidelines (Peterson *et al.* 1992).

B. Identifying Species Habitat Areas

All sites of *Bryoria spiralifera* 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.
- 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 maintain or improve the habitat for *Bryoria spiralifera* (for example, by preventing deeply shaded conditions or by removing invasive exotics).
- Utilize or prevent fire in species habitat areas, depending on the plant community, according to management guidelines suggested by Christy *et al.* (1998).
- Maintain integrity of the foredunes where they protect species habitat areas.
- Restrict commercial collection of moss or fungi or other special forest products if these activities would adversely affect *Bryoria spiralifera*.

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 or monitor the status of the population.
- Continue mapping the Oregon Dunes NRA population.
- Report new documented sites to ORBIC and Washington Natural Heritage Programs and enter data into agency regional databases.
- Report changes in documented and suspected site status as quickly as possible to the interagency Special Status and Sensitive Species Specialist in the State and Regional Office.
- Report sitings and survey work in the appropriate agency database.

B. Research Questions

- What are the dispersal rates and mechanisms of *Bryoria spiralifera*?
- Which habitat and microclimate characteristics are necessary for establishing *Bryoria spiralifera* thallus fragments and survival of established thalli?
- What is the genetic diversity of *Bryoria spiralifera* within local populations and across the region?
- What is the air pollution sensitivity of *Bryoria spiralifera*?
- What are the minimum and optimum patch sizes of colonized habitat necessary to provide for *Bryoria spiralifera*?
- Can transplants be used to create local populations of *Bryoria spiralifera* to increase its population base?
- How will projected climate change parameters affect the distribution of *Bryoria spiralifera* in the Pacific Northwest?

C. Monitoring Opportunities and Recommendations

- Monitor sites for changes in microclimatic conditions, successional changes, and for inadvertent habitat damage from human activities or wildfire.
- Monitor dispersal and population trends of existing populations.
- Monitor air quality near key populations of *Bryoria spiralifera* on federal lands (currently the Lanphere Dunes (USFWS) and the Siuslaw National Forest) and assess threats to this species.

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Conservation Assessment

for

Bryoria subcana (Nyl. ex Stizenb.) Brodo & D. Hawksw.

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M. Stein

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Doug Glavich

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SUMMARY

Preface: Since the Conservation Assessment in 2005, new site information has been collected regarding *Bryoria subcana* and is presented herein.

Species: *Bryoria subcana* (Nyl. ex Stizenb.) Brodo & D. Hawksw.

Taxonomic Group: Lichen

Management Status: Forest Service Region 6 and Bureau of Land Management (BLM) Sensitive Species in Oregon. Forest Service and Bureau of Land Management (BLM) Survey and Manage species, Category B: manage all known sites and conduct equivalent-effort pre-disturbance for habitat disturbing projects in old-growth, and strategic surveys.

From NatureServe the species is ranked with a Global Heritage Rank of G3/G4 and a State Heritage Rank of S2 for Oregon. Rank 2 is described as Imperiled due to 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 21-100 occurrences; Rank 4 is described as not rare and apparently secure but with cause for long-term concern, typically with over 100 occurrences. This lichen is on the Oregon Biodiversity Information Center's list 2, which contains species that are threatened with extirpation within the state due to extreme rarity.

Range: Global distribution is northwest North America from south-central Alaska south to Santa Cruz County California, and in Great Britain. Sites on federal lands include the Siuslaw National Forest in Tillamook County near the Little Nestucca River and near Cedar Lake, Grass Mountain Area of Critical Environmental Concern on Salem District BLM in Benton County and Walker Mountain on the Olympic NF. There are a cluster of sites on Coos Bay BLM lands in the coast range, east of Coos Bay, Oregon, as well as sites on the Willamette National Forest.

Specific Habitat: *Bryoria subcana* grows on the bark and wood of conifers on summits and ridges of coast range forests within 50 km (30 mi) of the ocean. A few sites occur in the western Cascade range at 140 km (85 mi) from the coastline.

Threats: The major threat to *Bryoria subcana* is loss of populations from activities that directly affect the habitat or the population.

Management Considerations:

- Develop practices to route human use away from habitat areas.
- Manage fire in species habitat areas, with emphasis on prevention.
- Restrict removal of trees, shrubs, or other vegetation from species habitat areas, except when removal will not harm habitat integrity.
- Consider opportunities for managing sites during Forest Plan and Resource Management Plan revisions, such as administratively withdrawn designations, or by prescribing special standards and guidelines.

Data and Information Gaps:

- Visit sites to determine the extent of local populations and improve habitat descriptions.
- Determine whether additional populations exist in areas identified as potential suitable habitat, particularly in the Cascade Range.

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Bryoria subcana (Nyl. ex Stizenb.) Brodo & D. Hawksw. was first described in 1892 by Stizenberger, who recognized it as a variety of *Alectoria prolixa* (*A. prolixa* var. *subcana* Nyl. ex Stiz.), a species complex originally described by Nylander. Gyelnik elevated the variety to species status in 1931 (*A. subcana* (Nyl. ex Stiz.) Gyeln.). In 1977, Brodo and Hawksworth subdivided the genus *Alectoria*, into *Alectoria*, *Bryoria*, *Pseudephebe*, *Sulcaria*, and *Oropogon*, and the current epithet was established. The type specimen of *B. subcana* was collected in Scotland in 1875 by J.M. Crombie (Herbarium Nylander 35835). *B. subcana* has also been known by at least 12 other names, none of which are currently used; Hawksworth (1972) details the long taxonomic history of this species.

Synonyms:

Alectoria haynaldii Gyeln., Nyt Mag. Naturv. 70: 49 (1932)

?*Alectoria implexa* var. *subimplexa* Ndv., Klick Urcovn R Lisejnikd CSR 1: 122 (1956), nom. inval. (Art. 36)

Alectoria jubata var. *subcana* (Nyl. ex Stiz.) D.T. & Sarnth, Flecht. Tirol. 11 (1902)

Alectoria prolixa var. *subcana* Nyl. ex Stiz, Annals Naturhist. Hofmus. Wien 7: 129 (1892)

Alectoria subcana Nyl. ex Cromb., J. Bot., Lond. 14:360 (1876), nom. inval. (Art. 32)

Alectoria subcana (Nyl. ex Stiz.) Gyeln., Magy. Bot. Lapok 30: 54 (1931)

?*Alectoria subcana* var. *obscurata* Mot., Fl. Polska, Porosty (2): 88 (1962), nom. inval. (Art. 37)

Alectoria subcana var. *subosteola* (Gyeln.) Mot., Fl. Polska, Porosty (2): 88 (1962)

Bryopogon haynaldii (Gyeln.) Zahlbr., Cat. Lich. Univ. 10: 557 (1940)

Bryopogon jubatus var. *subcanus* (Nyl. ex Stiz.) Oksn., Vznachik Lishainikov URSR: 276 (1937)

Bryopogon lanestris f. *haynaldii* (Gyeln.) Gyeln., Feddes Repert. 38: 227 (1935)

Bryopogon subcana (Nyl. ex Stiz.) Gyeln., Feddes Repert. 38: 226 (1935)

Bryopogon subosteolus Gyeln., Acta Geobot. Hungar. 2: 164 (1937)

B. Species Description

1. Morphology and Chemistry

Bryoria subcana is a short, pendant to almost tufted, fruticose lichen, up to 5 cm long (Figure 1). Its distinctive color (pale brown to greenish-white or whitish), nearly perpendicular branching angles, and typically abundant soralia, coupled with strong red color reaction of the cortex, medulla, and soralia to p-phenylenediamine (P), differentiate it from very pale forms of *B. trichodes* ssp. *trichodes*, which has a P+ red reaction in the cortex only, that also grow near the coast (Brodo and Hawksworth 1977; McCune and Geiser 1997).

The branching pattern is isotomic dichotomous, and the branches are round in cross-section, even in diameter, straight, often brittle, 0.15-0.3 mm in diameter. The basal parts are pale brownish- gray. The thallus surface is usually matte but occasionally shiny; apical parts are very pale brownish-gray to greenish-white or whitish, sometimes becoming variegated. True lateral spinules are absent. Pseudocyphellae are often present, sparse, inconspicuous, fusiform, and white. Soralia are usually abundant, tuberculate, as wide as or slightly broader than the branches on which they occur, occasionally becoming spinulose, to 0.8 mm in diameter. Apothecia and pycnidia have not been observed in North American material. Spot test reactions are K-, C-, KC, PD+ bright red (rapid) in the cortex, medulla, and soralia. *B. subcana* contains large amounts of fumarprotocetraric acid (Brodo and Hawksworth 1977).



Figure 3. Line drawing of *Bryoria subcana* by Alexander Mikulin.

2. Reproductive Biology

Sexual reproductive structures are unknown for North American material. *Bryoria subcana* reproduces asexually via soredia and thallus fragmentation.

Soredia are microscopic, usually spherical clusters of fungal mycelium and green algal cells that can be dispersed long distances by wind or animals. Birds can be important vectors, dispersing lichen propagules as a kind of litter along the migratory coastal highway (McCune *et al.* 1997). In contrast, thallus fragments are heavier and are more important for dispersal over short distances, usually within a few tree lengths.

3. Ecological Roles

Little is known about the ecological roles of *B. subcana*. Other *Bryoria* species provide nesting material and forage for small mammals (Maser *et al.* 1985 and 1986, Rosentreter and Eslick 1993) and critical winter forage for ungulates (Stevenson and Rochelle 1984). Lichen foraging is optimal in late-seral and old-growth forests, places where there has been sufficient time to develop a large biomass (Stevenson and Rochelle 1984, Neitlich 1996).

C. Range and Sites

Bryoria subcana is known only from coastal western North America between south-central Alaska and central California (Brodo and Hawksworth 1977) and from Great Britain (Purvis *et al.* 1992). In the Pacific Northwest, *B. subcana* is known from less than 30 sites, which most are within 50 km (30 mi) of the coast. In Oregon, there are few sites on the Siuslaw National Forest (one south of the Little Nestucca River about 5 km (3 mi) west of Dolph and one north of Cedar Lake on the Hebo Ranger District; on the Central Coast Ranger District, a site is known near Eel Creek on the Oregon Dunes National Recreation Area) (USDA 2012a USDA 2012b; Geiser *et al.* 2004; Glavich *et al.* 2005a). There are a few sites in the Oregon Cascades, and these are on Willamette National Forest (one near the Little North Santiam River, one near Roosevelt Creek, one near Moose Ridge, and one near Hehe Mountain). Voucher specimens originally thought to be *B. subcana* on the Mount Hood National Forest were re-examined by the author in 2013, and determined to be *B. glabra/fuscescens*. A site on the Umpqua National Forest (near Black Butte), was previously presented in an earlier version of this Conservation Assessment as *B. subcana*, but in actuality is *B. fuscescens* (Glavich, 2013). On Oregon BLM lands, there is a site on the Grass Mountain Area of Critical Environmental Concern (ACEC) (McCune *et al.* 1997), a cluster of new sites east of Coos Bay, and a Cascade Range site north of Upper Susan Creek Falls (USDI 2012). A site on Oregon State land is in Saddle Mountain State Park, Clatsop County (Pike 3818 in OSC Herbarium; Geiser *et al.* 2004). In Washington, sites are known from Walker Mountain on the Olympic National Forest, Anderson Lake State Park, and Moran State Park on Orcas Island (Geiser *et al.* 2004; Glavich *et al.* 2005a; USDI 2011; USDA 2012a; USDA 2012b). Four sites reported from the Washington Cascades and all are on the Gifford-Pinchot National Forest (near Hat Rock, Ollalie Lake, near Greenhorn Buttes, and near Mt. Beljica (USDA 2012b) have recently been reassessed and determined to be *B. fuscescens*, not *B.*

subcana (Glavich, pers. comm., 2013). In California, *B. subcana* is known from Point Reyes National Seashore on the Bolema Trail, Inverness Ridge area (Brodo and Hawksworth 1977)

Selected specimen records (Geiser *et al.* 2004) includes Oregon. Coos Co. Oregon Dunes National Recreation Area, Eel Creek, *Ingersoll* 957 (OSC). Douglas Co. Tillamook Co. Siuslaw National Forest, Cedar Lake, *Mikulin* 1290(OSC). Clatsop Co. Saddle Mountain State Park, *Mikulin* 1180 (OSC).

D. Habitat Characteristics and Species Abundance

Bryoria subcana is found on the bark and wood of conifers in Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), wet Douglas-fir (*Pseudotsuga menziesii*), wet noble fir (*Abies procera*), and mixed hardwood-coniferous forests mostly along Coast range ridges and mountain summits; it can also be found in the Cascades and near streams and dune forests (Brodo and Hawksworth 1977; Glavich *et al.* 2005b; USDI 2012; USDA 2012b). High humidity, either as coastal fog or high precipitation, appears to be an important habitat requirement. In western North America, *B. subcana* has mostly been found within 50 km (30 mi) of the ocean, but there are a few sites that are up to 140 km (85 mi) from the ocean. This lichen occurs at elevations mostly from sea level to 600 m (2000 ft), but it is also known to occur at elevations up to 1300 m (4400 ft) (USDI 2012; Glavich *et al.* 2005b).

Bryoria subcana has been found on Sitka spruce, western hemlock, Douglas-fir, and noble fir (Glavich *et al.* 2005). In the area where most of the *B. subcana* sites have been found, the Coast Range near Coos Bay, this lichen is typically found on sun-exposed Douglas-fir trees of at least 100 years of age (USDI 2012). At the summits of Grass Mountain and Saddle Mountain, it was found in wet noble fir forests. At the Eel creek site, it was found in an open canopy, mature western hemlock-Pacific rhododendron dune forest with mats of the lichen *Cladonia portentosa* on the forest floor.

Lichens associated with *Bryoria subcana* are *Hypogymnia enteromorpha*, *Hypogymnia inactive*, *Hypogymnia physodes*, *Platismatia glauca*, *Platismatia herrei*, *Platismatia stenophylla*, *Parmelia sulcata*, and *Sphaeophorus globosus* (Glavich *et al.* 2005b).

The largest density of sites occurs on BLM land east and south of Coos Bay (USDI 2012).

II. CURRENT SPECIES SITUATION

A. Status History

Bryoria subcana was considered at risk under the Northwest Forest Plan because of its rarity and limited distribution in the range of the northern spotted owl (USDA and USDI 1994a, 1994b). At the time of the lichen viability panel, it was known from only one site (USDA and USDI 1994a, 1994b). Ratings by the viability panel reflected a high level of concern for this species. The rare oceanic-influenced lichens as a group received the lowest viability ratings among all of the lichens considered (USDA and USDI 1994a). Initially, it was a Survey and Manage strategy

1 and 3 species with the dual objectives of managing known sites and conducting extensive surveys to find additional populations and identify other high-priority sites for species management (USDA and USDI 1994c). With completion of the 2001 Survey and Manage Record of Decision, it was assigned to Management Category B (USDA USDI 2001). In 2004, *B. subcana* was designated a Sensitive species in Oregon for the Forest Service and BLM; the Survey and Manage Standards and Guidelines were also removed at this time. After a legal hiatus, the Survey and Manage (S&M) Standards and Guidelines were re-instated in 2009, with a settlement agreement in 2011 (USDA-USDI 2011). The settlement agreement maintains *B. subcana* as S&M management category B, manage all known sites and conduct equivalent-effort pre-disturbance for habitat disturbing projects in old-growth, and strategic surveys (USDA and USDI 2001).

In 2004, the NatureServe program ranked *B. subcana* with a Global Heritage Rank of G2/G4, a State Heritage Rank of S2 and assigned it to Heritage List 2. Rank 2 is defined as imperiled due to rarity or other factors that demonstrate its vulnerability to extinction, typically with 6 to 20 occurrences. Rank 4 is defined as not rare and apparently secure but with cause for long-term concern, usually with more than 100 occurrences; List 2 contains species that are threatened with extirpation within the state (ORNHIC 2004). In 2011, the global ranking changed from G2/G4 to G3/G4; rank 3 is defined as rare, uncommon or threatened, but not immediately imperiled, typically with 21 to 100 occurrences (ORBIC 2012).

B. Major Habitat and Viability Considerations

Frequent fog along the coast and high precipitation summits of the Coast Range create a suitable environment for oceanic-influenced lichens such as *Bryoria subcana*. The major concerns for this lichen are the small number of populations on federal land and loss of populations from management activities that directly harm the populations or impact habitat areas. Much of the coastal forest land in the Pacific Northwest is under non-federal ownership, generally managed on short harvest rotations. The BLM parcels in the Coast Range near Coos Bay appear to harbor most of its known sites; there is a lot of private land interspersed in this area, and timber harvest could negatively impact its viability. Given that lichens are slow to establish in rapidly growing stands and do not become abundant until later in successional development (USDA and USDI 1994a), most of these stands are harvested before lichens have a chance to establish significant populations. One explanation for the limited distribution of *B. subcana* is that it may not have time to establish significant populations in areas where there is frequent disturbance of host plant communities.

C. Threats to the Species

Threats to *Bryoria subcana* are those actions that disrupt stand conditions necessary for its survival; such actions include treatments that reduce populations by removing colonized substrate trees; treatments that would alter the light, moisture or temperature regime in habitat areas; or reduce air quality.

Recreational activities and developments may inadvertently alter the habitat of this species. Trampling by recreational vehicles and frequent foot traffic are serious threats, especially in

shore pine woodlands and edge communities, as these degrade the habitat by disturbing fragile root systems of trees and shrubs, and the fragile protective mats of ground cryptogams, which stabilize the soil (Christy *et al.* 1998). Off highway vehicles (OHV) can destabilize dunes and affect dune forest habitats of *Bryoria subcana*. Buildings, roads, campgrounds, and trails along the immediate coast have replaced many natural habitats to improve access, facilitate scenic views, or develop recreational uses.

Although the air-pollution sensitivity of this species is unknown, other coastal members of this genus are sensitive to sulfur- and nitrogen-based acidifying pollutants (Wetmore 1983, Insarova *et al.* 1992, McCune and Geiser 1997). The primary habitat of this lichen is the coastal fog belt, and fog significantly concentrates pollutants--especially acidic forms of SO_x and NO_x to which lichens are most sensitive. Although air quality is generally good at known sites, rising pollution emissions from increased traffic (mainly NO_x) and new or expanded point sources (SO_x and NO_x) in the Coos Bay area and other areas along the coast, might threaten this species in the future.

Climate change is currently one of the largest concerns facing lichens. Along with air chemistry, climate parameters are main drivers of lichen distribution (Geiser and Neitlich 2007; Jovan 2008; Jovan and McCune 2004). Because temperature related climate parameters are very narrow and important to other coastal lichens (Glavich *et al.* 2005b), climate change-driven alteration of coastal fog patterns and winter temperature will also likely affect *B. subcana*.

D. Distribution Relative to Land Allocations

On Oregon and Washington federal land, *Bryoria subcana* sites (including those on BLM lands near the Coos Bay area) are mostly in Late-Seral Reserves or in other reserve lands (USDI 2012; USDA 2002). The Little Nestucca River site is in an Adaptive Management Area; the other Siuslaw NF site, near Cedar Lake, is in an unknown land use allocation, but it is within a Hebo RD long term restoration project area (Unit 93, block III). The Grass Mountain site is a BLM, Area of Critical Environmental Concern. Many other Oregon and Washington sites are in State or County Parks. In California, the Inverness Ridge site is in the Point Reyes Seashore National Park.

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). Management for this species also follows the 2001 Record of Decision Standards and Guidelines for Survey and Manage (S&M) (USDA-USDI 2001; USDA-USDI 2011).

For OR/WA BLM administered lands, SSS policy details the need to manage for species conservation. Policy objectives also state that actions authorized or approved by the BLM do not contribute to the need to list species under the Endangered Species Act.

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.

The primary objective of the S&M Standards and Guidelines is to conserve late-seral forest associated species. Species listed under the Standards and Guidelines have concern for a reasonable assurance of species persistence and are assigned to management categories, depending on rarity, surveyability, and other factors (USDA-USDI 2001).

IV. HABITAT MANAGEMENT

A. Lessons from History

Habitat destruction or alteration has made a significant contribution to the decline of lichens world-wide (Seaward 1977). Rare lichens, such as *Bryoria subcana*, that occur in habitats optimal for human activities, are especially vulnerable. In coastal Oregon, activities of the past 140 years (increased fire, agriculture, grazing, logging, changes in hydrology, and recreation) have affected plant succession in a major way (Christy *et al.* 1998). For example, at Sand Lake dunes of Oregon, a hotspot for lichen diversity, off-road vehicles have destroyed nearly all the fragile shore pine woodland habitat in just thirty years (Wiedemann 1984, 1990 as cited by Christy *et al.* 1998).

Lichens have been known to be sensitive to air pollution for more than a century now. Populations of many species in eastern United States and Europe (Hawksworth and Rose 1976) have declined precipitously from exposure to sulfur dioxide and other air pollutants. In the United States, lichens are one of the components used to indicate stress to forests from air pollution (McCune *et al.* 1996), and dozens of studies in the United States have used lichens as air-quality indicators (see bibliography in USDA 1998). In the Pacific Northwest, sensitive species are already declining in some areas (Denison and Carpenter 1973, Taylor and Bell 1983).

B. Identifying Species Habitat Areas

All sites of *Bryoria subcana* 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.

- Maintain suitable habitat around the current host trees and shrubs, so that the lichen may have adequate new substrate as current substrates decline.
- Retain groups of standing trees to maintain suitable microclimate and to aid dispersal. Avoid harvesting or thinning trees, and removing shrubs or other vegetation in the population and habitat area, unless these actions would maintain or improve the habitat for *Bryoria subcana*.
- Utilize or prevent fire in species habitat areas, depending on the role of fire in the plant community. Consider recommendations by Christy *et al.* (1998) for fire management in coastal plant communities.
- Restrict commercial collection of moss, fungi or other special forest products if these activities would adversely affect *Bryoria subcana*.

V. RESEARCH, INVENTORY, AND MONITORING OPPORTUNITES

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 *Bryoria subcana* all Cascade Range sites to map population extents.
- Revisit *Bryoria subcana* Eel Creek Dunes, Coast Range, and Olympic peninsula sites to map population extents.
- 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 Special Status and Sensitive Species Specialist in the State/Regional Office.
- Report sitings and survey work in the appropriate agency database.

B. Research Questions

- What are the dispersal rates and mechanisms of *Bryoria subcana*?
- Which habitat characteristics are necessary for establishing *Bryoria subcana* propagules and survival of established thalli?
- Can stands be managed to mimic those characteristics?
- What are the minimum and optimum patch sizes of colonized habitat necessary to provide for *Bryoria subcana*?
- How can conditions be optimized to encourage colonization of lichens from refugia into managed stands?
- What is the air pollution sensitivity of *Bryoria subcana*?
- How will projected climate change parameters affect the distribution of *Bryoria subcana* in the Pacific Northwest?

C. Monitoring Opportunities and Recommendations

- Monitor sites for changes in microclimatic conditions, successional changes, and for inadvertent habitat damage from human activities or wildfire.
- Monitor dispersal and population trends of existing populations.
- Establish air-quality monitoring sites near any key populations should air quality become an issue.

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Conservation Assessment

for

Erioderma solediatum D.J. Galloway & P.M. Jørg.

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SUMMARY

Preface: Since the 2005 Conservation Assessment, new information has been collected regarding the range and habitat of *Erioderma soledatium* and is presented herein.

Species: *Erioderma soledatium* D.J. Galloway & P.M. Jørg.

Taxonomic Group: Lichen

Management Status: Forest Service Region 6 and Bureau of Land Management Sensitive Species for Oregon and Strategic Species for Washington. From NatureServe, the species is ranked with a Global Heritage Rank 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 Rank of S2 in Oregon and S1 in Washington. Rank 2 is defined as imperiled because of rarity or vulnerability to extinction, typically with 6 to 20 sites; Rank 1 is defined as critically imperiled because of extreme rarity or especially vulnerable to extinction, typically with 5 or fewer sites. The Oregon Biodiversity Information Center has this species on Heritage List 2, which contains species that are very rare, threatened, endangered or presumed extinct within the state.

Range: *Erioderma soledatium* is paleotropical in distribution, also occurring in New Zealand and North America, where it is known from southeast Alaska through British Columbia, Washington, Oregon, and northern California. *Erioderma soledatium* is locally abundant in parts of the Oregon dunes, but otherwise rare in the Pacific Northwest.

Specific Habitat: *Erioderma soledatium* occurs in the coastal fog zone and it is most typically found on the immediate coast in dune forests of Sitka spruce and shore pine and interspersed willow/wax myrtle or ericaceous shrub thickets. It has also been found in western hemlock stands and in riparian alder stands to 23 km (12 miles) from the coast. In northern California, it has been found on Sitka spruce in an old-growth Redwood forest. The typical substrates for this lichen are evergreen huckleberry, Sitka spruce, and western hemlock, but it can also be found on Pacific rhododendron, hairy manzanita, and wax myrtle, willow, and shore pine.

Threats: The major threat to *Erioderma soledatium* is loss of local populations resulting from activities that harm the population or impact the habitat including altering the microclimate and removing colonized substrate. These activities would most likely be related to recreation, such as building trails and shelters; collecting firewood; and off-trail bicycle, off-road vehicle, and foot traffic. As a cyanolichen, it is probably sensitive to air pollution from vehicle exhaust and fire. It is vulnerable to loss of habitat from development along the coast. With its narrow range, it is likely vulnerable to climate change.

Management Considerations:

- Develop practices to route human use away from species habitat areas.
- Manage fire in species habitat areas, with an emphasis on prevention.
- Restrict collecting specimens, collecting firewood, operating off-road vehicles and bicycles, and other recreational activities or development that affect colonized substrate and harm populations.

Data Gaps and Information Needs:

- Verify the status of known populations and characterize their ecological conditions.

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Erioderma solediatum D.J. Galloway & P.M. Jørg. was described from New Zealand in 1975 (Galloway and Jørgensen 1975).

B. Species Description

1. Morphology and Chemistry

This foliose lichen looks like brownish-gray paint that has dried on the lid of a paint can. The margins of this paint pancake curl up, its lower surface is white, and the upper surface is covered with fine, cottony hairs (Figure 1). This species can be confused with *Leioderma solediatum*, another rare oceanic lichen, but *Erioderma solediatum* can be distinguished by the erect tomentum on its upper surface and its PD+ orange reaction (eriodermin) (Jørgensen 2000). It can also be superficially confused with diminutive *Peltigera collina*, but *E. solediatum* lacks veins below (McCune and Geiser 2009).

Technical description: Thallus foliose, lobate (to 40 mm broad), corticolous. Lobes broad, to 5 mm wide, short, margins ascending, sometimes strongly involute and crenate, developing prominent, bluish, limbiform soralia on the edges of the upturned lower surface of the lobes; soredia coarse, granular, grayish-blue, about 0.1 mm in diameter, often trapped on tomentum of the upper surface and thus becoming spread superficially over the lobes. Upper surface grayish-brown, finely tomentose. Tomentum rather variable in appearance and texture, from a uniform, thin, whitish bloom to a long (to 2 mm) buff or yellowish, tangled or loosely woven mat. Apothecia and pycnidia are not observed. Photobiont is a cyanobacterium. Lower surface white or pale cream, not distinctly yellow. Lower cortex and veins absent; rhizines blue-black, simple to squarrosely branched (to 3 mm long), restricted to margins where they form small dense tufts (Galloway and Jørgensen 1975).

2. Reproductive Biology

Erioderma solediatum reproduces asexually by producing soredia, which are probably distributed by wind, gravity, animals, or birds (McCune *et al.* 1997). No sexually reproductive structures are known for this species.

3. Ecological Roles

Little is known about the ecological roles of *Erioderma solediatum*. This lichen is a nitrogen-fixing species, providing a small amount of usable nitrogen to the ecosystems it inhabits. In sites where abundant, this lichen is probably a food source for invertebrates. Like other nitrogen-

fixing species it is likely to be sensitive to air quality, though its specific sensitivity is unknown.

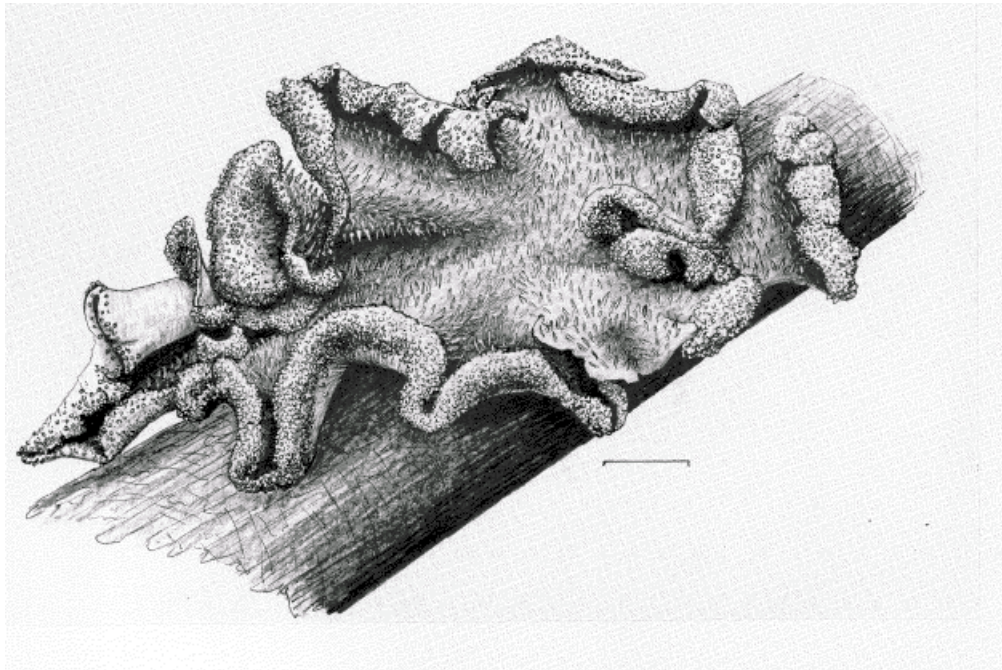


Figure 4. Line drawing of *Erioderma solediatum* by Alexander Mikulin.

C. Range and Sites

Erioderma solediatum has a paleotropical distribution, as well as in New Zealand and North America, where it is rare from southeast Alaska (Geiser *et al.* 1998), through British Columbia, Washington and Oregon (Geiser *et al.* 2004; Glavich *et al.* 2005a), and California (Ellyson and Sillett 2003). In Washington, *E. solediatum* is known from multiple sites on the Olympic Peninsula and one site on the Long Beach peninsula. On the Olympic Peninsula, it is known from 3 sites on the Olympic National Seashore and 5 sites in the Hoh River Valley, Olympic National Park; the Long Beach Peninsula site is in Leadbetter Point State Park (Geiser *et al.* 2004; USDI 2012; USDA 2012b). The largest number of sites occurs in the Oregon Dunes, where it is common on ericaceous shrubs. Sites include the Oregon Dunes Recreation Area and Sutton Recreation Area (managed by Siuslaw National Forest), Eugene Bureau of Land Management's Hecta Dunes Area of Critical Environmental Concern, and near Jordan Lake at the southern end of the Oregon Dunes (Coos Bay Bureau of Land Management) (Geiser *et al.* 2004; Glavich *et al.* 2005a; McCune *et al.* 1997; USDA 2012a; USDA 2012b). A new site was recently discovered on Coos Bay BLM, approximately 14 miles inland from the Pacific Ocean (Sperling 2012). Other sites in Oregon, all on the Siuslaw National Forest, include upper Lewis Creek drainage, Hebo RD, Canal Creek, Beaver Creek, and the North Fork Siuslaw watershed (Geiser *et al.* 2004; USDA 2012a and 2012b; Glavich pers. obs.; herb. Siuslaw). In

California, it is known Redwood National Park (Ellyson and Sillett 2003).

Selected specimen records (Geiser *et al.* 2004) – OREGON. Coos Co. Siuslaw National Forest: Bluebill Lake, *Mikulin 1002* (OSC), Spinreel Campground, *Mikulin 1024* (OSC). Lane Co. Siuslaw National Forest: Sutton Creek, *Mikulin 1130* (OSC), Heceta Head vicinity, *Mikulin 1188* (OSC), ridge s of Cummins Ck., *Mikulin 1299* (OSC). Lincoln Co. Siuslaw National Forest, Waldport vicinity: Lower Canal Ck., *Geiser 720* (OSC), Beaver Ck, *Ingersoll 958* (OSC). Tillamook Co. Siuslaw National Forest, Neskowin vicinity, *Mikulin 1215* (OSC). WASHINGTON. Pacific Co. Leadbetter Point State Park, *Mikulin 1230* (OSC). Jefferson Co. Olympic National Park, Hoh River Valley, *Mikulin 1177 and 1283* (OSC). Clallam Co. Olympic Seashore National Park: James Lake, *Mikulin 1191* (OSC), Point of Arches vicinity, *Mikulin 1200* (OSC).

D. Habitat Characteristics and Species Abundance

Erioderma solediatum occurs in the coastal fog zone, and it is most typically found on the immediate coast in dune forests, shore pine (*Pinus contorta*) and Sitka spruce (*Picea sitchensis*) forests interspersed with willow/wax myrtle (*Salix sp./Morella californica*), or ericaceous shrub thickets (Glavich et al. 2005a; McCune *et al.* 1997). It has also been found in western hemlock and riparian alder stands in coastal mountains, up to 23 km (14 miles) from the coast. In northern California, it has been found on Sitka spruce in an old-growth Redwood forest (Ellyson and Sillett 2003). Common substrates for this lichen are evergreen huckleberry (*Vaccinium ovatum*), Sitka spruce, and western hemlock (*Tsuga heterophylla*), but it has also been found on Pacific rhododendron (*Rhododendron macrophyllum*), hairy manzanita (*Arctostaphylos columbiana*), waxmyrtle (*Morella californica*), willow (*Salix sp.*), and red alder (*Alnus rubra*) (Glavich et al. 2005b; McCune et al. 1997). Associated lichens are *Hypotrachyna sinuosa*, *Menegazzia terebrata*, *Sphaerophorus globosus*, and *Usnea cornuta* (Glavich et al. 2005b). This lichen can become locally abundant in parts of the Oregon Dunes. The largest known population in the Pacific Northwest is in the Sutton Recreation Area (USDA 2012a), but it is rare across the west coast. Most sites in the coastal mountains have low abundance (Glavich pers. obs).

II. CURRENT SPECIES SITUATION

A. Status History

Erioderma solediatum 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). In 1998, the species was given BLM Assessment Status (USDI Bureau of Land Management 1998). With the completion of the 2001 Survey and Manage Record of Decision, 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). Because of the limited distribution and low number of sites on federally managed land, it was determined that all alternatives would provide inadequate habitat to maintain the species and that it would be evaluated for inclusion in the Agencies' special status species programs (USDA and USDI 2001). Both the Forest Service Region 6 and BLM Oregon/Washington have included this species in their Special Status and Sensitive Species programs: in 2004, *E. solediatum* was

designated a Sensitive Species for the Forest Service Region 6. In 2011, this lichen is currently on the Forest Service Region 6 and Oregon BLM Sensitive Species List, and is listed on the Strategic Species List for Washington (USDA-USDI 2011).

From NatureServe, *Erioderma soledadense* is ranked with a Global Heritage Rank 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 Rank of S2 in Oregon and S1 in Washington. Rank 2 is defined as imperiled because of rarity or vulnerability to extinction, typically with 6 to 20 sites; Rank 1 is defined as critically imperiled because of extreme rarity or especially vulnerable to extinction, typically with 5 or fewer sites. The Oregon Biodiversity Information Center has this species on Heritage List 2, which contains species that are very rare, threatened, endangered or presumed extinct within the state.

B. Major Habitat and Viability Considerations

The major viability consideration for *Erioderma soledadense* is loss of sites resulting from management, development, or recreation activities that damage populations or habitat.

C. Threats to the Species

Threats to *Erioderma soledadense* are those actions that affect its habitat at any site on federal lands, including altering the microclimate and removing colonized substrate, which could result in the loss of individuals and populations. These activities would most likely be related to recreation (ex. building trails and shelters); collecting firewood; and off-trail bicycle, off-road vehicle, and foot traffic. It is probably sensitive to air pollution and new and expanded point sources (including vehicle exhaust) within its range, especially near Coos Bay and Florence could threaten this species. Collecting specimens may be a threat in populations with low numbers of individuals. It is vulnerable to loss of habitat from construction or clearing along the coast. Climate change is currently one of the largest concerns facing lichens. Along with air chemistry, climate parameters are main drivers of lichen distribution (Geiser and Neitlich 2007; Jovan 2008; Jovan and McCune 2004). Because temperature related climate parameters are very narrow and important to other coastal lichens (Glavich et al. 2005b), climate change-driven alteration of coastal fog patterns and winter temperature will also likely affect *E. soledadense*.

D. Distribution Relative to Land Allocations

All sites for *Erioderma soledadense* on federal land in Washington are on National Park lands that are Congressionally Reserved and protected. Most of the *E. soledadense* sites in Oregon are on Administratively Withdrawn lands of Siuslaw National Forest, which are the Oregon Dunes National Recreation Area and the Sutton Recreation Area. Other sites in the Oregon Dunes, include the BLM Heceta Dunes, managed as an Area of Critical Environmental Concern (USDA 2012; USDA 2002; USDI 2012), and Coos Bay BLM sites near Jordan Lake, managed as Administratively Withdrawn areas. The remaining sites on the Siuslaw National Forest are on Late Successional Reserves. The Redwood National Park site is Congressionally Reserved.

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. Policy objectives also state that actions authorized or approved by the BLM do not contribute to the need to list species under the Endangered Species Act.

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

No specific historical lessons are known for *Erioderma sorediatum*, but as a nitrogen-fixing lichen it is probably sensitive to air pollution, and in many industrialized parts of the world, nitrogen-fixing lichens have disappeared because of air quality degradation (Rhoades 1988, Ryan and Rhoades 1992, Geiser *et al.* 1994).

In many parts of the industrialized world, lichens are declining because of habitat alteration (Seaward 1977). *Erioderma sorediatum* habitat is at risk because of development of coastal properties along the Oregon dunes.

B. Identifying Species Habitat Areas

All sites of *Erioderma sorediatum* 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.
- Allow existing habitat conditions to persist and evolve naturally.
- Restrict firewood collecting.
- Restrict collecting voucher specimens unless the specimen is found in litterfall.

- Restrict off-trail use of vehicles and bicycles in coastal ericaceous shrub habitats.
- Minimize the extent of shrub and tree clearing along trails during maintenance activities.
- Develop practices to route human use away from the populations (such as diverting trails and roads). The trampling of shrubs, removing trees or branches, introducing non-native species by seed dispersal or planting, and compacting of tree or shrub roots which support the species are examples of potential recreational impacts.

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

- Continue mapping the extent of the populations at known sites.
- Revisit Washington sites to update status and map population extents.
- Continue surveying potential habitat in coastal forests for additional sites.
- Report documented sites to ORBIC and Washington Natural Heritage Programs and enter data into agency regional databases.
- Report changes in documented and suspected site status as quickly as possible to the interagency Special Status and Sensitive Species Specialist in the State and Regional Office.
- Report sitings and survey work in the appropriate agency database.

B. Research Questions

- What are the dispersal rates and mechanisms of *Erioderma sorediatum*?
- Which habitat characteristics and ecological conditions are necessary for survival of *Erioderma sorediatum* propagules?
- What limits dispersal and establishment of propagules and colonizing of suitable *Erioderma sorediatum* habitat?
- Is *Erioderma sorediatum* sensitive to air pollution?
- Which other rare lichens occur with *Erioderma sorediatum*?
- How do populations of *Erioderma sorediatum* respond to successional changes and associated changes in microclimate?
- How will projected climate change parameters affect the distribution of *Erioderma sorediatum* in the Pacific Northwest?

C. Monitoring Opportunities and Recommendations

- Monitor the effects of recreational activities on populations of *Erioderma sorediatum* in its dune habitat area.

- Monitor dispersal and population trends of existing populations.
- Monitor air quality near key populations (Coos Bay and Florence, Oregon) and assess threats to this species from present or projected air quality trends.

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Conservation Assessment
for
***Heterodermia leucomelos* (L.) Poelt**

Originally issued
as Management Recommendations
March, 2000
Chiska Derr, Author

Reconfigured June, 2004
M. Stein

Updated April, 2012
Doug Glavich

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SUMMARY

Preface: Since the the Conservation Assessment in 2005, new site information has been collected for *Heterodermia leucomelos* and is presented herein.

Species: *Heterodermia leucomelos* (L.) Poelt

Taxonomic Group: Lichen

Management Status: Forest Service and Bureau of Land Management (BLM) Sensitive Species in Oregon. From NatureServe, the species has a Global Heritage Rank of G4 and a State Heritage Rank of S2/S3 for Oregon. Rank 4 is described as not rare and apparently secure, but with cause for long-term concern, typically with more than 100 occurrences. Rank 2 is described as imperiled because of rarity or because it is very 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. The Oregon Biodiversity Information Center (ORBIC) lists the species on Heritage List 2, which contains taxa that are threatened with extirpation or presumed extirpated within the state.

Range: *Heterodermia leucomelos* is found in the Americas, England, Europe, Africa, and Asia, and is widespread in the tropics and subtropics. In North America, it is known from the coasts of British Columbia, Washington, Oregon, California, and Mexico. In Washington, there are only two sites. One site is in Fort Canby State Park and the other site is in Olympic National Forest. In Oregon there are a number of sites that range from Cape Lookout, through the Oregon Dunes to California. In the Northwest Forest Plan area in California, it ranges from Lake Earl State Park in Del Norte County down to Manchester Beach State Park in Mendocino County.

Specific Habitat: *Heterodermia leucomelos* is a lichen of the immediate coast in the Pacific Northwest, occurring within 4 km (2.5 mi) from the coastline. This lichen mostly occurs on windswept dune forests, forested headlands, and marine terraces on Sitka spruce and shore pine from sea level to 200 m (660 ft). It is also often found on grand-fir, western hemlock, coyote brush, and silk tassel. In California, it has been found high up in old Sitka spruce crowns in an old- growth Redwood forest. Its distribution is influenced by winter temperature and may be influenced by coastal fog. The species is typically epiphytic but occasionally grows on rocks.

Threats: The major threat to *Heterodermia leucomelos* is loss of populations resulting from activities that harm the populations or affect their habitat, including altering microclimate and removing colonized substrate, recreation impacts and collecting specimens. Most populations are known from scattered refugia in state and national parks and reserved Forest Service and Bureau of Land Management lands along developed coastal areas in Oregon and California.

Management Considerations:

- Restrict building, burning, collecting specimens and firewood, and any other recreational activities or development that could harm known populations.

Data and Information Gaps:

- Verify the status of known populations of *Heterodermia leucomelos* and characterize their ecological conditions.
- Locate additional populations of *Heterodermia leucomelos* in potentially suitable habitats on federal land along the immediate Oregon coast.

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Heterodermia leucomelos (L.) Poelt was described in 1965.

Synonym: *Anaptychia leucomelaena*

B. Species Description

1. Morphology

This foliose lichen forms loose rosettes of narrow lobes with long gray or black cilia (Figure 1). The white, ascending, extended lobes and long, marginal, often intertwined dark cilia are characteristic. Characteristic of this lichen is the lack of a cortex on the underside, which contains soredia. Soredia development is variable; when present, they develop on the distal portion of the underside, which is strongly reflexed and exposed by upward curling of the lobes (Purvis *et al.* 1992). It could be confused with wide-lobed *Physcia tenella*, but that species is P-, and it has an intact lower cortex. *Anaptychia crinalis* is also very similar; lacking a lower cortex, but it also lacks soredia and is K- (McCune and Geiser 2009).

Technical Description: Thallus 5-15 cm across, often in loose rosettes forming entangled mats, more or less loosely attached; lobes 0.5-3 mm wide, elongate, mostly dichotomously branched, entangled, sometimes ascending at the tips, sometimes reflexed, with conspicuous, long, gray or black, simply or sparsely branched to squarrosely branched marginal cilia, 5-9 mm long; upper surface ivory white, smooth; lower surface white, channeled, central part arachnoid or powdery and somewhat sorediate; lower cortex not developed. Apothecia not observed. Medulla Pd+ yellow, K+ yellow-red, KC+ yellow-red, C- (Purvis *et al.* 1992).

2. Reproductive Biology

This species reproduces asexually by producing soredia that may be distributed by wind, gravity, animals, or birds. No sexually reproductive structures are known for *Heterodermia leucomelos*.

3. Ecological Roles

Little is known about the ecological roles of *Heterodermia leucomelos*. In areas where this lichen has some high abundance sites, such as the dune forests on the Samoa Peninsula, Humboldt County, California (Glavich *et al.* 2005a), it is likely used as a food source for invertebrates or as nesting material by birds. This lichen has been used as nesting material by bushtits (Carlberg 2009).

C. Range and Sites

The range of *Heterodermia leucomelos* is incompletely circumpolar. It is found in the Americas, England, Europe, Africa, and Asia, and is widespread in the tropics and subtropics. In North

America, it is known from the Pacific coast of British Columbia, Washington, Oregon, California, and Mexico (McCune and Geiser 2009). In Washington, this species is known from only two sites. One site is on Mount Walker in Olympic National Forest and the other is in Fort Canby State Park (Glavich *et al.* 2005a; USDA 2012). There are about nine sites on federal land in Oregon, which include the Oregon Dunes National Recreation Area and Sutton Dunes Recreation Area (Siuslaw National Forest), Yaquina Head Natural Area (Salem BLM), New River and North Spit Areas of Environmental Concern (Coos Bay BLM), and Heceta Head (US Coast Guard) (Glavich *et al.* 2005a; USDA 2012). Additional sites on Oregon State Park land include Cape Lookout, Cape Arago, Cape Blanco, and the largest known Oregon population on Cape Sebastian (Glavich *et al.* 2005a). In California, the largest known population is on the Samoa Peninsula in the US Fish and Wildlife Lanphere Dunes unit, and it is also abundant on the BLM Mal'el Dunes parcel there. There is another federal land site in Redwood National Park. Multiple sites are in California State Parks: Trinidad Beach, Patrick's Point, Manchester Beach, Lake Earl, and Humboldt Lagoons (Glavich *et al.* 2005a).

Selected specimen records (Geiser *et al.* 2004) – CALIFORNIA. Mendocino Co. Manchester State Beach, *Glavich 538* (OSC). Humboldt Co. Trinidad Beach State Park, College Cove, *Glavich 535* (OSC); Humboldt Lagoons State Park, Dry Lagoon, *Glavich 549* (OSC); Humboldt Bay National Wildlife Refuge, Lanphere Dunes, *Glavich 578* (OSC); Samoa Peninsula, BLM parcel, *Glavich 554* (OSC); Patrick's Point State Park, *Glavich 537* (OSC); Redwood National Park, Prairie Creek, *Glavich 526* (OSC). Del Norte Co. Lake Earl State Park, *Glavich 529* (OSC). OREGON. Curry Co. Cape Blanco State Park, *Glavich 575* (OSC); Samuel Boardman State Park, Natural Bridges Cove, *Glavich 574* (OSC); Cape Sebastian State Park, *Mikulin 1266* (OSC). Douglas Co. Oregon Dunes National Recreation Area, 1 km s of Brushy Hill, Reedsport vicinity, *Mikulin 1197* (OSC). Coos Co. Cape Arago State Park, *Mikulin 1296* (OSC). Lane Co. Siuslaw National Forest: Sutton Creek, *Mikulin 1142* (OSC), Heceta Head, *Mikulin 1074* (OSC), ~ 4 km e of Devil's Elbow State Park, *Mikulin 1189* (OSC). Lincoln Co. Yaquina Head Natural Area, *Mikulin 1161*(OSC). Tillamook Co. Cape Lookout State Park, *Mikulin 1117* (OSC); Siuslaw National Forest, 1.6 km n of Cape Kiwanda, *Mikulin 1081*(OSC). WASHINGTON. Pacific Co. Fort Canby State Park, Cape Disappointment, *Mikulin 1157* (OSC).

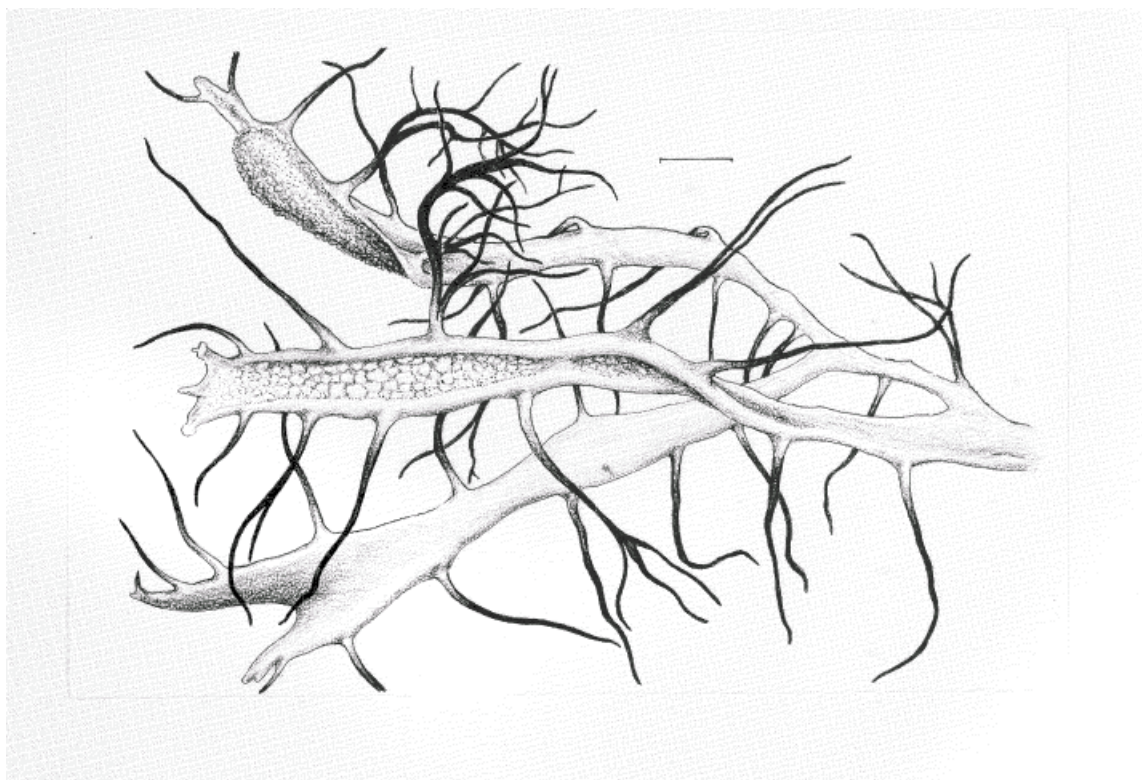


Figure 5. Line drawing of *Heterodermia leucomelos* by Alexander Mikulin.

D. Habitat Characteristics and Species Abundance

Heterodermia leucomelos is a lichen of the immediate coast in the Pacific Northwest, occurring within 4 km (2.5 mi) from the coastline (Glavich et al. 2005b). This lichen mostly occurs on windswept dune forests, forested headlands, and marine terraces on Sitka spruce (*Picea sitchensis*) and shore pine (*Pinus contorta*) from sea level to 200 m (660 ft). It is also often found on grand-fir (*Abies grandis*), western hemlock (*Tsuga heterophylla*), coyote brush (*Baccharis pilularis*), silk tassel (*Garrya elliptica*), and oak (*Quercus* sp.) (Glavich et al. 2005b; Hale and Cole 1988). Though it is typically epiphytic, it occasionally grows on rocks (Hale and Cole 1988). In California, it has been found high up in old Sitka spruce crowns in an old-growth Redwood forest. Its distribution is influenced by winter temperature and may be influenced by coastal fog (Glavich et al. 2005b).

II. CURRENT SPECIES SITUATION

A. Status History

Heterodermia leucomelos 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 2001 Survey and Manage Record of Decision, 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, *H. leucomelos* was designated a Sensitive Species in Oregon by the Forest Service and BLM, and still retains that status.

In 2010, the Heritage Rank for *Heterodermia leucomelos* changed from a Global Rank of G2/G3 to G4 and an Oregon State Rank of S2 to S2/S3 (ORBIC 2010). Rank 4 is described as not rare and apparently secure, but with cause for long-term concern, typically with more than 100 occurrences. Rank 2 is described as imperiled because of rarity or because it is very 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. The species remains on the Oregon Natural Heritage List 2, which contains taxa that are threatened with extirpation or presumed extirpated within the state (ORBIC 2010).

B. Major Habitat and Viability Considerations

The major viability consideration for *Heterodermia leucomelos* is loss of populations resulting from management, development, or recreation activities that harm populations or alter their habitat.

C. Threats to the Species

Threats to *Heterodermia leucomelos* are actions that disrupt stand conditions necessary for its survival, including treatments that harm local populations by removing coastal Sitka spruce and other colonized substrates; alter the light, moisture, or temperature regime; or degrade air quality. Recreation-related activities such as building trails and shelters and collecting firewood could adversely affect populations, as well as collecting of specimens. Because this species is apparently restricted to the immediate coast, particularly in Oregon, altering potentially suitable habitat could inhibit establishment. This species is vulnerable to loss of habitat because of increasing development along the coast. Climate change is currently one of the largest concerns facing lichens. Along with air chemistry, climate parameters are main drivers of lichen distribution (Geiser and Neitlich 2007; Jovan 2008; Jovan and McCune 2004). Because temperature related climate parameters are very narrow and important for *H. leucomelos* (Glavich et al. 2005b), climate change-driven alteration of coastal fog patterns and winter temperature will also likely affect this species.

D. Distribution Relative to Land Allocations

Heterodermia leucomela occurs on federal lands in Washington, Oregon, and California (Glavich et al. 2005a). The federal land site in Washington is on Mount Walker, an administratively withdrawn parcel on the Olympic National Forest (Glavich et al. 2005a; USDA 2002). Most of the Oregon federal land sites are in administratively withdrawn coastal dunes and natural areas (Siuslaw NF Oregon Dunes NRA and Sutton Creek Recreation Area; BLM Yaquina Head Outstanding Natural Area, and New River and North Spit Areas of Environmental Concern); coast range sites are in late successional reserves, and the Heceta Head coast guard land is of unknown land allocation (Glavich 2005a; USDA 2002; USDA 2012). In California,

federal land sites are on congressionally reserved Redwood National Park (Glavich et al. 2005a) and Point Reyes National Seashore (Glacy et al. 2011) and administratively withdrawn BLM Mal'el Dunes, Humboldt County. The US Fish & Wildlife Service Lanphere Dunes Unit also contains a population; the land allocation is unknown, but the unit is managed for conservation (Glavich et al. 2005a; USDA 2002; USFWS 2012). Other sites are in state parks.

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. Policy objectives also state that actions authorized or approved by the BLM do not contribute to the need to list species under the Endangered Species Act.

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

The importance of lichens in forested and other habitats is recognized globally. Conversion of old-growth forests into young managed stands leads to a significant reduction in epiphytic lichen biomass, which in turn will probably affects nutrient cycling in forests and may have negative consequences for animals that use canopy lichens as food, shelter, or nesting material (Esseen 1996).

B. Identifying Species Habitat Areas

All sites of *Heterodermia leucomelos* 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:

- Allow existing habitat conditions to persist and evolve naturally.
- Restrict firewood collection.
- Restrict collecting voucher specimens for scientific purposes, unless they are found in litterfall.
- Restrict off-road vehicles, and bicycle and foot traffic in coastal ericaceous shrub habitats without trails.
- Minimize the extent of the clearing of shrubs and trees along trails during maintenance activities.
- Develop practices to route human use away from the populations (*e.g.*, divert trails and roads). Trampling of shrubs, removing of trees or branches, introducing non-native species by seed dispersal or planting, and compacting tree or shrub roots that support the species, are all examples of potential recreational impacts.

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

There are several federal parcels of coastal fog zone habitat with populations of other rare oceanic lichens with similar habitat requirements as *Heterodermia leucomelos*. These sites are identified as potential suitable *H. leucomelos* habitat, and could be evaluated for the presence for this species. They are Sutton Creek and Eel Creek, Gwynn Creek and Sand Lake (Siuslaw National Forest), BLM Heceta Dunes Area of Critical Environmental Concern; a small BLM parcel near Cape Lookout State Park; and other coastal BLM parcels.

- Continue to revisit sites to verify the status of known populations, determine the extent of the populations and abundance, and to characterize habitat conditions.
- Develop spatial predictor model, based on Glavich et al. (2005b).
- 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 Special Status and 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 are the dispersal rates and mechanisms of *Heterodermia leucomelos*?
- Which habitat characteristics and ecological conditions are necessary for survival of *H. leucomelos* propagules?
- What limits dispersal and establishment of propagules and colonization of suitable

Heterodermia leucomelos habitat?

- Is *Heterodermia leucomelos* sensitive to air pollution?
- Which suites of other rare lichens are found with *Heterodermia leucomelos*?
- How do populations of *Heterodermia leucomelos* respond to successional changes and associated changes in microclimate?
- How will projected climate change parameters affect the distribution of *Heterodermia leucomela* in the Pacific Northwest?

C. Monitoring Opportunities and Recommendations

Monitor the effects of recreational activities on populations of *H. leucomelos* in species habitat areas.

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Conservation Assessment
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SUMMARY

Preface: Since the 2005 Conservation Assessment, additional sites have been recorded for *Leioderma solediatum* and are included in this Assessment.

Species: *Leioderma solediatum* D.J. Galloway & P.M. Jørg.

Taxonomic Group: Lichen

Management Status: Forest Service Region 6 and Bureau of Land Management Sensitive Species in 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. It has an Oregon State Heritage Rank of S1, described as critically imperiled in the State because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as steep declines making it vulnerable to extirpation from the State. The Oregon Biodiversity Information Center (ORBIC) ranks the species Heritage List 2, described as threatened, endangered or presumed extinct from Oregon but more common or stable elsewhere. This lichen is not yet Heritage Ranked for Washington.

Range: *Leioderma solediatum* is distributed from the Pacific coast of North and South America to Asia, Australia, and New Zealand. In North America, it is known from southeast Alaska, British Columbia, Washington, and Oregon. There are three known sites in Washington and 8 known sites in Oregon, and all are in close proximity to the coast.

Specific Habitat: In northwest North America, *Leioderma solediatum* is found in semi-open coastal thickets, most often in dune woodlands, deflation plains, and ericaceous shrub thickets. *L. solediatum* is epiphytic over thin bryophyte mats on the stems of ericaceous shrubs. In Washington, it is found in a young riparian stand of red alder.

Threats: The major threat to *Leioderma solediatum* is a loss of populations resulting from activities that harm the population or impact its habitat, which includes altering the microclimate and removing colonized substrate. These activities would most likely be related to recreation, such as building trails and shelters, collecting firewood, and off-trail bicycle, off-road vehicle and foot traffic. It is probably sensitive to air pollution from vehicle exhaust and burning. It is vulnerable to loss of habitat from development along the coast, and the encroachment of non-native invasive plants. Climate change will also threaten this lichen.

Management Considerations:

- Restrict building, burning, collecting specimens; collecting firewood; operating off-road vehicles and bicycles; and other recreational activities or development that could affect colonized substrates and harm known populations.
- Develop practices to route human use away from sites to minimize impact to the populations and their habitat.

Data and Information Gaps:

- Revisit sites to verify the status of known populations, determine the extent of the populations and abundance, and to characterize ecological conditions.

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Leioderma sorediatum D.J. Galloway & P.M. Jørg. was described in 1987 by Galloway and Jørgensen.

B. Species Description

1. Morphology and Chemistry

Leioderma sorediatum is a small, stratified, foliose lichen that lacks a lower cortex and is sorediate above (Figure 1). The upper surface is grayish, bearing distinctive minute appressed woolly hairs; thallus lobes are loosely attached and round. The lower surface lacks veins and has short to longish marginal or scattered rhizines. *L. sorediatum* could be confused with *Erioderma sorediatum*, but the latter species has erect tomentum on the upper surface and has a PD+ reaction (eriodermin) (McCune and Geiser 2009; Jørgensen 2000). *L. sorediatum* is PD- and has appressed woolly hairs. *L. sorediatum* superficially resembles *Peltigera collina*; the latter has veins on the lower surface (McCune and Geiser 2009).

Technical description: Thallus foliose, lobate, orbicular to irregularly spreading 1-3(4) cm diameter, rather loosely attached. Lobes to 6 mm wide, discrete to imbricate. Margins slightly thickened, sinuous, subascendent, entire, delicately incised or crenulate, sorediate. Soralia marginal, often more or less sinuous, linear to limbiform, occasionally round, and spreading on to upper (or lower) surface; soredia coarsely granular, bluish. Upper surface more or less uniformly arachnoid-tomentose, dark blue-green when wet, pale-grayish or olivaceous-gray when dry, often with pale, pinkish-brown apothecial initials. Lower surface white, ecorticate, arachnoid, especially at the margins, pale buff towards center, rhizinate; rhizines white, buff to bluish, rarely blackened, in fascicles tufted at apex, in scattered groups or more or less densely developed. Photobiont is a cyanobacterium. Apothecia rare (Galloway and Jørgensen 1987; Jørgensen 2000).

2. Reproductive Biology

This species reproduces asexually by producing soredia that are distributed by wind, gravity, animals, or birds (McCune and Geiser 2009). Because apothecia are very rare in *Leioderma sorediatum*, sexual reproduction is probably also rare.

3. Ecological Roles

Because of its extreme rarity in North America, very little is known about the ecological roles of *Leioderma sorediatum* in Washington and Oregon. This lichen is a nitrogen-fixing species, providing a small amount of usable nitrogen to the ecosystems it inhabits.

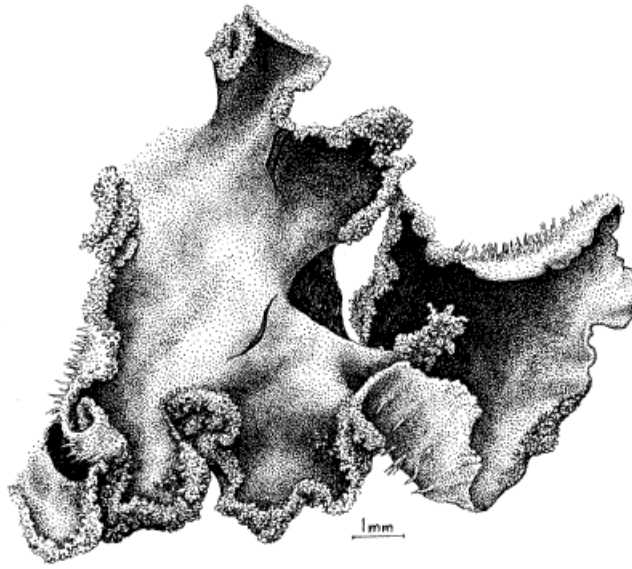


Figure 7. Line drawing of *Leioderma solediatum* by Alexander Mikulin.

C. Range and Sites

Leioderma solediatum is known mainly from the South Pacific, New Zealand, Australia, Sri Lanka, India, Malaya, Japan and Hawaii, with disjunct populations on the Pacific coasts of North and South America (Galloway and Jørgensen 1987; Jørgensen 2000). This lichen is known from around eleven localities in Oregon and Washington, and it has not yet been found in California. Eight of the sites occur in Oregon and most are in the Oregon Dunes region: Sutton Creek Recreation Area, Siuslaw National Forest; Eel Creek, Clear Lake, and Siltcoos Lake in the Oregon Dunes National Recreation Area, Siuslaw National Forest; Heceta Beach Area of Critical Environmental Concern, Bureau of Land Management. Other Oregon sites are South Beach State Park, Washburne Memorial State Park, and a site on private land in Florence, OR (Geiser et al. 2004; Glavich et al. 2005a; USDA 2012; USDI 2012). The few Washington sites are in Olympic National Park (Geiser et al. 2004; Glavich et al. 2005a; USDA 2012; USDI 2012). There is also one site on Vancouver Island, British Columbia (Goward et al. 1994) and a site in southeast Alaska (Dillman 2004).

Selected specimen records (Geiser et al. 2004). – OREGON. Douglas Co. Oregon Dunes National Recreation Area, 0.3 km sw of s shore of Clearwater Lake, *Gossen 960619-2* (OSC). Lane Co. Siuslaw National Forest, Sutton Creek, *Mikulin 1133* (OSC), Lincoln Co. South Beach State Park, *Mikulin 1301* (OSC). WASHINGTON. Clallam Co. Olympic National Seashore: James Lake, *Mikulin 1192* (OSC), Point of Arches vicinity, *Mikulin 1201* (OSC), Ozette Lake, *Hutten 3006* (herb. OLYM).

D. Habitat Characteristics and Species Abundance

Leioderma solediatum is rare in North America. This lichen is mostly found in dune forests of the Oregon Coast. Its dune forest habitat is often open shore pine (*Pinus contorta*) stands with an ericaceous shrub (*Vaccinium ovatum* and *Rhododendron macrophyllum*) understory (Glavich et al. 2005a, 2005b). The largest known Pacific Northwest population occurs at the Sutton Creek Recreation Area (Glavich et al. 2005a). This lichen is often epiphytic with other cyanolichens, including the similar *Erioderma solediatum*, over thin bryophyte mats on the stems of the understory ericaceous shrubs. It is also found on western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchensis*), and shore pine. In Washington, it was found in an unusual site for the species: on red alder (*Alnus rubra*) in a young riparian alder stand, abundant with the cyanolichen, *Lobaria oregana*, and surrounded by clearcuts (Tønsberg, pers. comm.). In British Columbia, it is found over mossy conifer branches in an open hyper-maritime forest (Goward et al. 1994). In the South Pacific, *L. solediatum* grows in damp, humid habitats such as rainforests and swampy areas, where it is most commonly epiphytic on trees and shrubs in moderate light, as well as on pumice, clay banks, or on mossy rocks (Galloway and Jørgensen 1987).

II. CURRENT SPECIES SITUATION

A. Status History

Leioderma solediatum 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). In 1998, the species was given BLM Assessment Status based on ORNHIC ranking of List 2 (USDI Bureau of Land Management 1998). With the completion of the 2001 Survey and Manage Record of Decision, 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, *L. solediatum* was designated a Sensitive species for Forest Service Region 6 in Washington and Oregon. Currently, *L. solediatum* is designated a Forest Service and Bureau of Land Management Sensitive Species in Oregon (USDA-USDI 2011).

From NatureServe, *Leioderma solediatum* has 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 Rank of S1 for Oregon, considered critically imperiled in the State because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as steep declines making it vulnerable to extirpation from the State (ORNHIC 2004). ORBIC has put this species on List 2, described as threatened, endangered or presumed extinct from Oregon but more common or stable elsewhere. There has been no change in the ranking for the Oregon Heritage program (ORBIC 2010), and it is not yet Heritage ranked for Washington (WNF 2010).

B. Major Habitat and Viability Considerations

The major viability consideration for *Leioderma solediatum* in Oregon and Washington is the loss of populations due to management activities and coastal development that harm populations

or their habitat. Because of the very limited range of this species and the limited extent of its Oregon coastal dune habitat, coupled with development on privately owned coastal land, all known sites on federal land are important for maintenance of the species.

C. Threats to the Species

Threats to *Leioderma soledadense* are those actions that harm the populations or impact their habitat, including altering the microclimate and removing colonized substrate, which could result in the loss of individuals and populations. These activities are mainly related to recreation and include building trails and shelters, collecting firewood, and off-trail bicycle, off-road vehicle, and foot traffic. As a cyanolichen, *L. soledadense* is probably sensitive to air pollution from vehicle exhaust and fire, although its specific sensitivity is unknown. It is vulnerable to loss of habitat resulting from increased development along the coast and the encroachment of non-native invasive plants.

Climate change is currently one of the largest concerns facing lichens. Along with air chemistry, climate parameters are main drivers of lichen distribution (Geiser and Neitlich 2007; Jovan 2008; Jovan and McCune 2004). Climate change-driven alteration of coastal fog patterns could shrink its already small range. Although climate parameters are not known for this species, precipitation and winter temperature are important factors in other coastal lichens (Glavich et al. 2005b).

D. Distribution Relative to Land Allocations

Five of the 11 known *Leioderma soledadense* sites in Oregon and Washington occur on federal administratively withdrawn land allocations in the Oregon Dunes; Oregon Dunes NRA and Sutton Creek RA, Siuslaw NF; Heceta Beach ACEC, BLM (USDA 2012; USDI 2012; USDA 2002). Two of the three Washington sites occur in the congressionally reserved land allocation of Olympic National Park (USDA 2012a; USDI 2012; USDA 2012c). The third Washington site is on an unknown federal land allocation, the Dungeness Wildlife Refuge (Mikulin 1300 OSC). The few other sites are on state park or private lands.

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. Policy objectives also state that actions authorized or approved by the BLM do not contribute to the need to list species under the Endangered Species Act.

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

No specific historical lessons are available for *Leioderma soledadum*. As a nitrogen-fixing lichen, however, it is probably sensitive to air pollution, and in many industrialized parts of the world nitrogen-fixing lichens have disappeared due to air quality degradation (Rhoades 1988; Ryan and Rhoades 1992; Geiser *et al.* 1994). In many parts of the industrialized world lichen populations are declining because of habitat alteration (Seaward 1977). The habitat for this lichen is at risk because of coastal development along the Oregon dunes.

B. Identifying Species Habitat Areas

All sites of *Leioderma soledadum* 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:

- Allow existing habitat conditions to persist and evolve naturally.
- Restrict firewood collection in the species habitat area.
- Restrict collecting voucher specimens for scientific purposes, unless they are found in litterfall.
- Restrict off-trail use of vehicles, bicycles, and foot traffic in species habitat areas in coastal ericaceous shrub habitats.
- Minimize the extent of shrub and tree clearing along trails during maintenance activities.
- Develop practices to route human use away from the populations (*e.g.*, divert trails and roads). The trampling of shrubs, removing trees or branches, introducing non-native species by seed dispersal or planting, compacting tree or shrub roots which support the species, are all examples of potential recreational impacts.

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

- Revisit sites to verify the status of known populations, determine the extent of the populations and abundance, and to characterize ecological conditions.
- Determine the distribution of *Leioderma soledium* in areas identified as potentially suitable habitat. Potentially suitable habitat is identified as coastal deflation dune systems with scattered old Sitka spruce, shore pine forests and ericaceous shrub thickets, and coastally influenced riparian alder stands. Areas with potentially suitable habitat include Gwynn Creek Recreation Area and Sand Lake, Siuslaw National Forest; BLM Heceta Dunes ACEC; and other coastal BLM parcels.
- 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 are the dispersal rates and mechanisms of *Leioderma soledium*?
- Which habitat characteristics and ecological conditions are necessary for survival of *Leioderma soledium* propagules?
- What limits dispersal and establishment of propagules and colonization of suitable *Leioderma soledium* habitat?
- Is *Leioderma soledium* sensitive to air pollution?
- Which suites of other rare lichens occur with *Leioderma soledium*?
- How do populations of *Leioderma soledium* respond to successional changes and associated changes in microclimate?
- How will projected climate change parameters effect the distribution of *Kaernefeltia californica*?

C. Monitoring Opportunities and Recommendations

- Monitor the effects of recreational activities on populations of *Leioderma soledium* in species habitat areas.

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Conservation Assessment
for
Niebla cephalota (Tuck.) Rundel & Bowler

Originally issued
as Management Recommendations
March, 2000
Linda Geiser, Author

Reconfigured June, 2004
M. Stein

Updated April, 2012
Doug Glavich

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SUMMARY

Preface: Since the Conservation Assessment in 2005, additional site and range information has been recorded for *Niebla cephalota* and is included in this Assessment.

Species: *Niebla cephalota* (Tuck.) Rundel & Bowler

Taxonomic Group: Lichen

Management Status: Forest Service Region 6 and Bureau of Land Management (BLM) Sensitive Species in Oregon. Forest Service and Bureau of Land Management (BLM) Survey and Manage species, Category A: manage all known sites and conduct pre-disturbance surveys. From NatureServe the species is ranked with a Global Heritage Rank of G3/G4, a State Heritage Rank of S1 for Washington and a State Rank of S2 for Oregon. Heritage Rank 1 is described as critically imperiled because of extreme rarity or vulnerability to extinction, typically with 5 or fewer occurrences; Heritage Rank 2 is described as imperiled because of rarity or vulnerability 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 *Niebla cephalota* on List 2, which contains taxa that are very rare and threatened with extirpation within the state.

Range: *Niebla cephalota* is endemic to the Pacific coast of North America, ranging from Washington to Baja California. The Northwest Forest Plan Area range for this lichen is Washington's Puget Sound and from the central Oregon coast down to coastal Mendocino County in California. In Washington, it is known from seven site areas in the Puget Sound: San Juan Island, San Juan County, Shaw Island, San Juan County, Lopez Island, San Juan County, Deception Pass State Park, Island County and northwest Fidalgo Island, Skagit County, Salt Creek Recreation Area, Clallam County, and Sequim Bay State Park, Clallam County. In Oregon, it is known from these locations: Sutton Creek Recreation Area and Oregon Dunes National Recreation Area, Siuslaw National Forest; North Spit Area of Critical Environmental Concern, Coos Bay BLM; Cape Arago State Park, Coos County; Cape Blanco State Park, near Gold Beach, and Harris Beach State Park, Curry County. California sites are known from Del Norte, Humboldt, Mendocino, San Luis Obispo, Santa Barbara, Ventura and Los Angeles Counties. Lake Earl State Park and Redwood National Park, Del Norte County; Patrick's Point, Humboldt Lagoons State Park, Trinidad State Park, Bureau of Land Management and National Refuge lands on the Samoa Peninsula, Humboldt County; Russian Gulch, Van Damme State Park, Manchester State Park and Point Arena, Mendocino County.

Specific Habitat: In the Pacific Northwest, the primary habitats for *Niebla cephalota* are Sitka spruce and shore pine stands on marine terraces and dunes in regions of moderate winter temperatures and rainfall on the immediate coast. This epiphyte has been found on exposed Sitka spruce, Hooker's willow, Monterey cypress, Douglas fir, Coyote brush, Oceanspray, Pacific Yew, and Pacific Ninebark.

Threats: The main threats are activities that directly harm the populations, their habitat, or the suitable habitat surrounding populations. Examples of threats include: burning (in some places);

harvesting trees; constructing roads, trails or buildings; recreational activities; grazing; invasive exotic plants; changes in local hydrology; and air pollution. Climate change will also likely alter the distribution of the species.

Management Considerations:

- Develop practices to route human use away from species habitat areas.
- Manage fire in species habitat areas, with an emphasis on prevention near occupied sites.
- Restrict removal of trees, shrubs, or other vegetation from the species habitat areas, except when removal will not harm habitat integrity.

Data and Information Gaps:

- Visit sites to describe the geographical extent of local populations, improve habitat descriptions.
- Determine if additional populations exist in areas identified as potential suitable habitat.
- Determine how predicted climate change parameters will affect this lichen.

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Niebla cephalota (Tuck.) Rundel & Bowler

Basionym: *Ramalina ceruchis* (Ach.) De Not. f. *cephalota* Tuck.

Synonyms: *Ramalina cephalota* Tuck.

Desmazieria cephalota (Tuck.) Follmann & Huneck

Niebla cephalota is a lichenized fungus in the family Ramalinaceae, order Lecanorales, class Ascomycetes (Tehler 1996). Within *Niebla*, *N. cephalota* is part of the “ceruchoid” group, species with a terpenoid chemistry and lacking well-developed chondroid strands (Bowler *et al.* 1994). *Niebla* is the Spanish word for “fog” or “mist”, a suitable epithet for the habitat of this species.

Niebla cephalota was first recognized as a taxonomic entity in 1882 by Tuckerman, who considered it a form of *Ramalina ceruchis*. Tuckerman himself later raised this lichen to the species level. In 1968, Follmann and Huneck transferred *Ramalina cephalota* to the genus *Desmazieria* Mont. But, the lichen genus *Desmazieria* Mont. was abandoned after Rundel and Bowler (1978) successfully argued that it was a homonym for the earlier legume genus, *Desmazeria* Dumortier. Because both were created in honor of the French botanist, J.B.H.J. Desmazières, the International Code of Botanical Nomenclature dictated that *Desmazieria* Mont., the later homonym, was invalid. To replace it, Rundel and Bowler created *Niebla*. Some members of *Desmazieria* were assigned to *Niebla*, the rest to *Ramalina*. *Niebla* is distinguished from *Ramalina* by the presence of either a thick palisade cell layer in the exterior cortex overlying supportive tissue or a simpler, less distinct cortex; the presence of black, usually abundant pycnidia; a high concentration of triterpenes; and unattached agglutinated hyphal strands in most species except the ceruchoid group (Bowler and Riefner 1995).

B. Species Description

1. Morphology and Chemistry

Niebla cephalota (Figure 1) is characterized by a fruticose thallus, 2-4 cm, tufted to drooping, pale greenish but often black spotted, in the herbarium becoming covered with filamentous crystals (with the appearance of mold); branches mostly < 2 mm diameter, roundish and pitted; soredia lateral, tinged with bluish-gray; spot tests negative except cortex KC+Y (McCune and Geiser 1997). It can sometimes be mistaken for a parasitized *Ramalina*, resulting in black spots on the thallus. However, the black spots of *N. cephalota* are characteristic rather than spots of infection. These lichens can be differentiated in that *Ramalina* typically is flat and strap-like; although *N. cephalota* might have flattened or foveolate sections, thallus branches are generally terete.

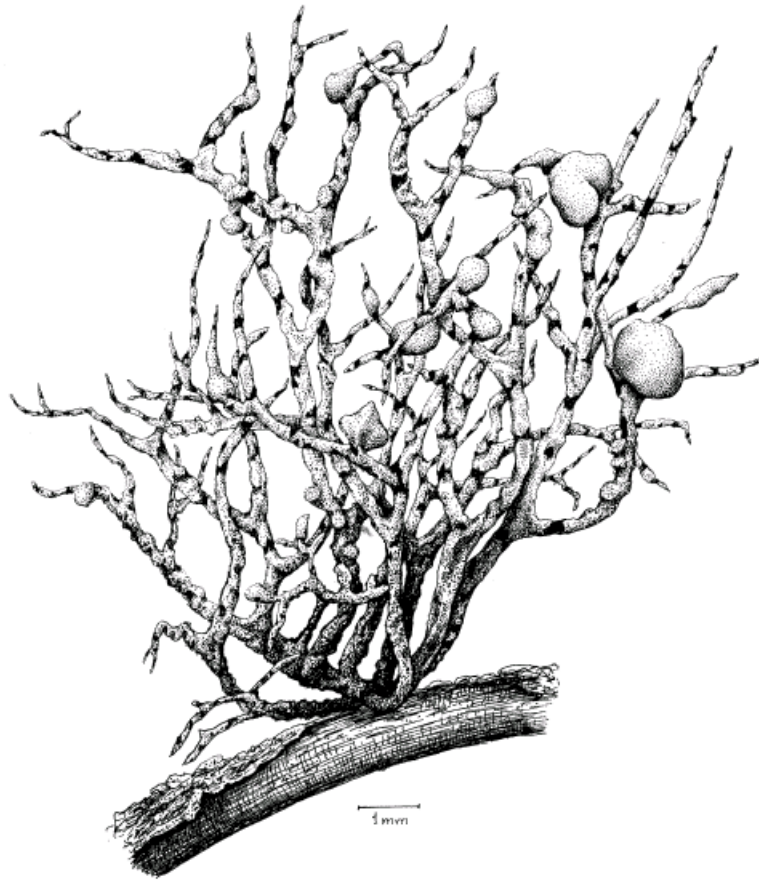


Figure 9. Line drawing of *Niebla cephalota* by Alexander Mikulin.

2. Reproductive Biology

Apothecia are unknown for this species. Asexual reproduction occurs by soredia. The microscopic size of the reproductive propagules should enable them to be carried long distances by wind, animals, or birds. Birds in particular are thought to enhance arrival rates of rare oceanic species like *Niebla cephalota* by dispersing lichen propagules along coastal migratory routes of the Pacific Northwest (McCune *et al.* 1997).

3. Ecological Roles

The genus *Niebla* is particularly well adapted to low annual rainfall, frequent overcast and fog with associated high humidity. In North America, these conditions are typically found along the California and Baja California coasts. In these habitats, species of *Niebla* can almost completely cover the branches of shrubs and other plants, and dominate ground surfaces such as rocks, loose volcanic cinders, soil, and even sand, and likely play a role in nutrient cycling (Rundel *et al.*

1972). Little is known about the ecological roles of *N. cephalota* in the Pacific Northwest. The closely related species, *N. ceruchoides*, functions as a seed trap and nursery for several vascular plants, specifically species of *Dudleya* (Crassulaceae), in areas farther south (Riefner and Bowler 1995).

C. Range and Sites

Niebla cephalota is endemic to the Pacific coast of North America, ranging from Washington to Baja California. The Northwest Forest Plan Area range for this lichen is Washington's Puget Sound and from the central Oregon coast down to coastal Mendocino County in California (ASU 2012; Geiser et al. 2004; Glavich et al. 2005a; USDA 2012; USDI 2012). In Washington, it is known from seven site areas in the Puget Sound: San Juan Island, San Juan County, Shaw Island, San Juan County, Lopez Island, San Juan County, Deception Pass State Park, Island County and northwest Fidalgo Island, Skagit County, Salt Creek Recreation Area, Clallam County, and Sequim Bay State Park, Clallam County. In Oregon, it is known from these locations: Sutton Creek Recreation Area and Oregon Dunes National Recreation Area, Siuslaw National Forest; North Spit Area of Critical Environmental Concern, Coos Bay BLM; Cape Arago State Park, Coos County; Cape Blanco State Park, near Gold Beach, and Harris Beach State Park, Curry County. California sites are known from Del Norte, Humboldt, Mendocino, San Luis Obispo, Santa Barbara, Ventura and Los Angeles Counties. Lake Earl State Park and Redwood National Park, Del Norte County; Patrick's Point, Humboldt Lagoons State Park, Trinidad State Park, Bureau of Land Management and National Refuge lands on the Samoa Peninsula, Humboldt County; Russian Gulch, Van Damme State Park, Manchester State Park and Point Arena, Mendocino County.

Selected specimen records (Geiser *et al.* 2004) – CALIFORNIA. Mendocino Co. Van Damme State Park, *Glavich 569* (OSC); Manchester State Park, *Glavich 539* (OSC); Russian Gulch State Park, *Glavich 570* (OSC). Humboldt Co. Samoa Peninsula, BLM parcel, *Glavich 525* (OSC); Humboldt Bay National Wildlife Refuge, Lanphere Dunes, *Glavich 579* (OSC); Little River State Park, *Glavich 560* (OSC); Patrick's Point State Park, *Glavich 565* (OSC); Redwood National Park, Crescent Overlook, *Glavich 594* (OSC); Trinidad Beach State Park, College Cove, *Glavich 562* (OSC); Humboldt Lagoons State Park, Dry Lagoon, *Glavich 531* (OSC). Del Norte Co. Lake Earl State Park, *Glavich 589* (OSC). OREGON. Curry Co. Cape Blanco State Park, estuary of the Sixes River, *McCune 18309* (herb. McCune). Coos Co. Cape Arago State Park, *Mikulin 1296* (OSC). Lane Co. Siuslaw National Forest, Sutton Creek, *Mikulin 1147* (OSC), Lane Co. Siuslaw National Forest, 1 km north of Lily Lake *Glavich 610*. WASHINGTON. Island Co. Deception Pass State Park, *Mikulin 1262* (OSC). San Juan Co., Lopez Is., Shark Reef Sanctuary County Park, *Mikulin 1253* (OSC); Shaw Is., Hoffman Cove, *Glew 981016-12* (WTU).

D. Habitat Characteristics and Species Abundance

In the Pacific Northwest, the primary habitats for *Niebla cephalota* are Sitka spruce and shore pine stands on marine terraces and dunes in regions of moderate winter temperatures and rainfall on the immediate coast (Glavich et al. 2005b). It tends to be more abundant on wind and sun exposed sites, such as coastal forest edges facing the ocean (Glavich, Pers Obs; McCune et al. 1997). This epiphyte has been found on Sitka spruce (*Picea sitchensis*), Shore pine (*Pinus*

contorta var. *contorta*), Hooker's willow (*Salix hookeriana*), Monterey cypress (*Cupressus macrocarpa*), Douglas fir (*Pseudotsuga menziesii*), Coyote brush (*Baccharis pilularis*), Oceanspray (*Holodiscus discolor*), Pacific Yew (*Taxus brevifolia*), and Pacific Ninebark (*Physocarpus capitatus*) (Glavich et al. 2005b).

This lichen has been found abundant in dune forest sites on the Samoa Peninsula and a marine terrace forest in Patrick's Point State Park, in Humboldt County, California, and then in the Puget Sound, Washington (Glavich et al. 2005a). The northern Oregon through western Washington coastline appears to be too wet.

II. CURRENT SPECIES SITUATION

A. Status History

Niebla cephalota 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 (S&M) strategy 1 and 3 species (USDA and USDI 1994c). In 1998, the species was given BLM Assessment Status based on ORNHIC ranking of List 2 (USDI Bureau of Land Management 1998). With the completion of the 2001 Survey and Manage Record of Decision, it was assigned to Management Category A (USDA and USDI 2001). In 2004, *N. cephalota* was designated a Sensitive species for Forest Service Region 6 in Oregon and OR/WA BLM; the Survey and Manage Standards and Guidelines were also removed at this time. After a legal hiatus, the Survey and Manage (S&M) Standards and Guidelines were re-instated in 2009, with a settlement agreement in 2011 (USDA-USDI 2011). The settlement agreement maintains *N. cephalota* as S&M management category A, manage all known sites and conduct pre-disturbance and strategic surveys (USDA and USDI 2001).

From NatureServe in 2004, *Niebla cephalota* had a Global Heritage Rank of G1/G3, a State Heritage Rank of S1/S2 in Oregon and California, and a State Heritage Rank of S1 in Washington (ORNHIC 2004). The Oregon Heritage program included this species on List 2. In 2011, the Global Heritage Rank changed to G3/G4 (ORBIC 2012).

B. Major Habitat and Viability Considerations

Frequent fog, and various ocean-influenced climatic, vegetative, and soil factors, create the environment occupied by *Niebla cephalota*. Being limited to only portions of the west coastline of North America, this lichen occurs in habitats with a high rate of human disturbance (development and recreation).

The major concerns for *Niebla cephalota* in the Northwest Forest Plan area are the limited amount of suitable habitat for this species on federal land, and loss of populations from human activities. Climate change is also a major concern as this lichen is dependent on climatic factors, such as precipitation and coastal fog regimes. Degradation or change in habitat conditions could affect the vigor of this species, possibly resulting in a more restricted distribution or contributing to local extirpation.

C. Threats to the Species

Threats to *Niebla cephalota* are those actions that disrupt stand conditions necessary for its survival. Such actions include treatments that reduce local populations by removing colonized bark or wood substrates; decreasing exposure to light; adversely affecting integrity of species habitat areas; reducing or fragmenting potential habitat; or degrading air quality.

Recreational activities and developments may inadvertently alter the habitat of this species. Trampling by off highway vehicles (OHV) and frequent foot traffic are serious threats, especially in shore pine woodlands and edge communities, as these degrade the habitat by disturbing fragile root systems of trees and shrubs, and the fragile protective mats of ground cryptogams, which stabilize the soil (Christy *et al.* 1998). Destabilization of dunes by OHVs can increase sand drift, expediting the burial of dune forest edge trees (Christy *et al.* 1998), which are important *N. cephalota* habitat. Buildings, roads, campgrounds, and trails along the immediate coast have replaced many natural habitats to improve access, facilitate scenic views, or develop recreational uses.

Other threats to the integrity of habitat and potential species habitat areas include logging, grazing, agriculture, and activities that alter local hydrology, or increase fire frequency (Christy *et al.* 1998). Concern about fire varies. Many different plant communities and successional stages exist among the coastal dunes and headlands. Fire is beneficial to some communities but damaging to others. Invasion or planting of exotics such as Scots broom (*Cytisus scoparium*), European beachgrass, tree lupine (*Lupinus arboreus*), birdsfoot-trefoil (*Lotus corniculatus*), and iceplant (*Mesembryanthemum* spp.) can have profound effects on nitrogen-poor dune soils by increasing nitrogen and soil moisture. These conditions foster invasion of other weeds, eventually disrupting native plant communities (Christy *et al.* 1998) and reducing plant and animal diversity (USDI 1997).

Because the primary habitat of this lichen is the coastal fog belt, and because fog significantly concentrates pollutants, especially acidic forms of SO_x and NO_x to which lichens are most sensitive, the potential vulnerability of *N. cephalota* to air-quality deterioration is a reasonable concern. Although air quality is generally good at known sites, rising pollution emissions from increased traffic (mainly NO_x) and new or expanded point sources (SO_x and NO_x) in the Arcata/Eureka vicinity, and elsewhere along the coast, might threaten this species in the future.

Climate change affecting coastal fog patterns and an increase in rain could affect the vigor of this species, possibly resulting in a more restricted distribution or contributing to local extirpation.

D. Distribution Relative to Land Allocations

In Oregon, the sites on federal land are all on the administratively withdrawn Oregon Dunes National and Sutton Creek Recreation Areas, Siuslaw National Forest (USDA 2002) and on the North Spit Area of Critical Environmental Concern on Coos Bay BLM lands. Other Oregon sites are in State Parks. In the Northwest Forest Plan (NFP) area of California, there are three sites on federal land. One is in the congressionally reserved Redwood National Park, Del Norte County. The other two are on the Samoa Peninsula in Humboldt County; these are the Landphere Dunes

Unit, US Fish & Wildlife Service with an unknown land use allocation and Mal'el Dunes South, BLM, which is administratively withdrawn. Although the land use allocation is not known for the Landphere Dunes Unit, this parcel is managed for conservation. All other known NFP area California sites are in State Parks. There are no known federal land sites in Washington.

III. MANAGEMENT GOALS AND OBJECTIVES

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

For OR/WA BLM administered lands, SSS policy details the need to manage for species conservation. Policy objectives also state that actions authorized or approved by the BLM do not contribute to the need to list species under the Endangered Species Act.

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.

For Survey and Manage, management for *Niebla cephalota* follows the 2001 Record of Decision Standards and Guidelines for Survey and Manage species (USDA-USDI 2001; USDA-USDI 2011).

IV. HABITAT MANAGEMENT

A. Lessons From History

Habitat destruction or alteration has made a significant contribution to the decline of lichens world-wide (Seaward 1977). Rare lichens that occur in habitats optimal for human activities, such as the immediate coast, are especially vulnerable. At the northern Samoa Peninsula, on county and state land near the mouth of the Little River, the native dune communities have been nearly eliminated by the invasion of European beachgrass and human activities, and only a tiny fragment of the dune forest is left. Lichens are also absent from the southern end of the Peninsula's dune forest, where the trees are young and there is more off road vehicle evidence (Glavich, pers. obs.). At Lanphere Dunes, regular foot traffic has been documented to damage fragile shore pine/bearberry communities (Brown 1990). In coastal Oregon, activities of the past 140 years including logging, recreation, agriculture, grazing, fire, and changes in hydrology have significantly altered plant succession (Christy *et al.* 1998). For example, at Sand Lake dunes of Oregon, an area of high lichen diversity, off-road vehicles have destroyed nearly all the fragile shore pine woodland habitat in just thirty years (Wiedemann 1984, 1990 as cited by Christy *et al.* 1998).

Lichens have been known to be sensitive to air pollution for more than a century. Many species in Europe and eastern United States are in an active state of decline from sulfur dioxide, nitrogen oxides, and acidic deposition of sulfur- and nitrogen-containing pollutants (Ferry *et al.* 1973, Hawksworth and Rose 1976). Fog contains more dissolved ions and acidity than precipitation does (Wolseley and James 1992). Lichens that obtain most of their water from fog and dew are particularly vulnerable to air quality and weather pattern changes (Nash 1996). Follmann (1995) documented massive impoverishment and retrogression of lichens over much of the northern Chilean coastal fog belt over the past 20 years. Increasing frequency of El Niño events and gradually increasing aridity were postulated as likely, but not exclusively, causal factors in this decline. Species of *Niebla* are primary components of these communities. In the Pacific Northwest, sensitive species are already declining in some areas (Denison and Carpenter 1973, Taylor and Bell 1983) and lichens are identified as air quality related values in USDA Forest Service Region 6 regional guidelines (Peterson *et al.* 1992).

B. Identifying Species Habitat Areas

All known sites of *Niebla cephalota* on federal lands administered by the Forest Service Region 6 and the BLM in Washington, Oregon and California are identified as areas where this Conservation Assessment could be implemented. A species habitat area is defined as the suitable habitat occupied by a known population plus the surrounding habitat needed to support the species.

C. Managing 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 local populations and species habitat areas at known sites.
- 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 species habitat area unless these actions would maintain or improve the habitat for *Niebla cephalota* (for example, by preventing deeply shaded conditions or by removing invasive exotics).
- Utilize or prevent fire in species habitat areas, depending on the role of fire in the plant community. Consider recommendations by Christy *et al.* (1998) for fire management in coastal plant communities.
- Maintain integrity of the foredunes where they protect species habitat areas.
- Restrict commercial collection of moss, fungi or other special forest products if these activities would adversely affect *Niebla cephalota*.

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

- Visit sites to map the extent of local populations and their habitat.
- Determine whether additional populations exist 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 are the dispersal and growth rates of *Niebla cephalota*?
- Which habitat characteristics are necessary for survival of *Niebla cephalota* propagules and colonies? Are some conditions unique to old-growth habitats critical to the survival of this species? Can stands be managed to mimic those characteristics?
- What are the minimum and optimum patch sizes of colonized habitat necessary to provide for *Niebla cephalota*?
- How can young managed stands along the immediate coast be managed to conserve and promote populations of rare lichens?
- What is the air quality sensitivity of *Niebla cephalota*?
- How will the projected climate change parameters affect the distribution of *Niebla cephalota*?

C. Monitoring Opportunities and Recommendations

- Monitor sites for changes in microclimatic conditions, successional changes, and for inadvertent habitat damage from human activities or wildfire.
- Monitor dispersal and population trends of existing populations.
- Monitor air quality near key populations of *Niebla cephalota* on federally-managed lands and assess threats to this species from present or projected air-quality trends.

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Conservation Assessment
for
***Teloschistes flavicans* (Sw.) Norman**

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Linda Geiser, Author

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M. Stein

Updated September, 2012
Doug Glavich

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SUMMARY

Preface: Since the Conservation Assessment in 2005, additional sites have been recorded for *Teloschistes flavicans* and the new information is presented herein.

Species: *Teloschistes flavicans* (Sw.) Norman

Taxonomic Group: Lichen

Management Status: Forest Service Region 6 and Bureau of Land Management (BLM) Sensitive Species for Oregon; Survey and Manage (SM) species, Category A. Category A species require: manage all known sites; perform pre-disturbance surveys. From NatureServe the species is ranked with a Global Heritage Rank of G4/G5 and a State Heritage Rank of S1 for Oregon. Rank 4 is described as not rare and apparently secure, but with cause for long-term concern, usually with more than 100 occurrences; Rank 5 is described as demonstrably widespread, abundant, and secure; Rank 1 is described as critically imperiled because of extreme rarity or because it is vulnerable to extinction, typically with 5 or fewer occurrences. The Oregon Biodiversity Center includes this species on List 2, which contains taxa that are threatened with extirpation from the state of Oregon.

Range: *Teloschistes flavicans* is a widespread tropical and subtropical species that occurs in the Cape Verde and Canary Islands, Great Britain, Australia, South Africa, the Hawaiian Islands, and sporadically along the Atlantic and Pacific coasts of the Americas from Georgia to Nova Scotia and Chile to northern Oregon. In the western United States, *T. flavicans* is currently known in Oregon from Tillamook and Curry counties. Sites in California are known from Marin, Monterey, San Mateo, San Luis Obispo, Santa Barbara, Los Angeles and San Diego counties.

Specific Habitat: *Teloschistes flavicans* is confined to forested headlands and dunes of the coastal fog belt, especially on capes or peninsulas, and has been found in Sitka spruce-western hemlock, shore pine, and bishop pine stands. For substrates, it has been found on exposed branches, twigs, and boles of Sitka spruce, shore pine, Hooker's willow, and Coyote brush.

Threats: The main threats are activities that directly harm the populations, their habitat, or the potential habitat surrounding populations. Examples of potential threats include: burning (in some places); harvesting trees; constructing roads, trails or buildings; recreational activities; grazing; invasive exotic plants; hydrologic changes; climate change; and air pollution.

Management Considerations:

- Develop practices to route human use away from sites.
- Manage fire in species habitat areas, with an emphasis on prevention.
- Restrict removal of trees, shrubs, moss, or other vegetation from species habitat areas, except when removal will not harm habitat integrity.
- Consider opportunities for managing sites during Forest Plan and Resource Management Plan revisions, such as administratively withdrawn designations, or by prescribing special standards and guidelines.
- Consider climate change-based management plans.

Data Gaps and Information Needs:

- Map the extent of known populations and improve habitat descriptions.
- Determine if additional populations exist in areas identified as potential suitable habitat.

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Basionym: *Lichen flavicans* Swartz, Nov. Gen. Spec. Plant., 147 (1788)

Synonyms: *Teloschistes flavicans* Norman, Nyt. Mag. f. Naturvid, 7, 229 (1853)

Physcia flavicans Hook., Hadb. N.Z. Fl., 572 (1867)

Teloschistes chrysophthalmus var. *flavicans* (Swartz) Tuck.

Teloschistes exilis (Michx.) Vainio

Teloschistes flavicans (Swartz) Norman is a lichenized fungus in the family Teloschistaceae, order Lecanorales, class Ascomycetes (Tehler 1996). The photobiont is a species of *Trebouxia*, a green alga (Murray 1960).

B. Species Description

1. Morphology and Chemistry

Teloschistes flavicans is a conspicuous, small to medium sized, fruticose lichen (Figure 1). The thallus is tufted, erect and spreading or, rarely, pendent, and yellow to orange colored. It is occasionally greenish-yellow, or even pale greenish, when grown in the shade (McCune and Geiser 1997). It is composed of many elongated, entangled, somewhat compressed, more or less twisted, pitted or channeled, sorediate branches (Fink 1935). The branches have pointed tips and short pointed side branches, also called cilia (Sanders 1993). The soredia are yellowish in roundish soralia. Apothecia are unknown. The cortex is K+ purple-red, the medulla is K-, KC-, C-, P- (McCune and Geiser 1997).

A similar but smaller non-sorediate species with apothecia, *Teloschistes exilis* (Michx.) Vain., has been collected in the Santa Cruz Mountains and the Channel Islands but is now very rare (Hale and Cole 1988).

2. Reproductive Biology

Asexual reproduction occurs via soredia and thallus fragmentation. Sexual reproductive structures are unknown. The genus as a whole is considered, by some, to be extremely ancient and very slow evolutionary rates have left many species little changed over millions of years (Kärnefelt 1991). In Britain (Gilbert and Purvis 1996), *Teloschistes flavicans* can spread locally on an individual tree or boulder but disperses only very slowly to adjacent rocks or tree boles.



Figure 11. Line drawing of *Teloschistes flavicans* by Alexander Mikulin.

3. Ecological Roles

Little is known about the ecological roles of *Teloschistes flavicans* in the Pacific Northwest. In general, lichens are able to use not only rain, but also fog, dew or atmospheric water vapor as a source of water for positive net photosynthesis. The genus *Teloschistes* is particularly well adapted to low annual rainfall, frequent overcast and fogs with associated high humidity. The ability to reactivate under low thallus moisture content (as low as 15 percent for *T. capensis*) enables them to grow in areas with low or no rain but with high amounts of atmospheric moisture, most of which is unavailable to vascular plants. Where terricolous (ground-dwelling) species of *Teloschistes* form the predominant component of the perennial plant biomass (Lange *et al.* 1990, Gilbert and Purvis 1996), they are very important in stabilizing soil and protecting it from wind erosion.

C. Range and Sites

Teloschistes flavicans is a widespread tropical and subtropical species that occurs in the Cape Verde and Canary Islands, Great Britain, Australia, South Africa, the Hawaiian Islands, and sporadically along the Pacific coast of the Americas from Chile to northern Oregon (Arizona State University 2004, McCune and Geiser 1997). Although Fink (1935) reported *T. flavicans* along the Atlantic coast from Massachusetts to Florida, and from Texas, Oregon, and Nevada, he considered *T. flavicans* and *T. exilis* to be conspecific. Hale's (1979) maps show the latter species only from southern California and southern Texas, Louisiana and Mississippi. However, a current search and re-examination of collections at Duke University and the US National Museum at the Smithsonian Institute conducted by Dr. Irwin Brodo of the Canadian National

Museum (pers. comm. 1997), revealed that *T. flavicans* does indeed occur on the Atlantic coast in Georgia, North Carolina, Massachusetts, and Nova Scotia

In the western United States, *Teloschistes flavicans* is currently known from northern Oregon to southern California (ASU 2012; Glavich et al. 2005a; USDI 2012; USDA 2012). In Tillamook County, Oregon, it is known from, Cape Meares State Park, Cape Lookout State Park, near Sand Lake, Cascade Head Experimental Forest (Siuslaw National Forest), and Salem BLM land just north of Pacific City. In Curry County, Oregon, it is known from the New River Area of Critical Environmental Concern (Coos Bay District BLM), Cape Blanco State Park, and Harris Beach State Park. In California, sites are known from Point Reyes National Seashore in Marin County, and in Monterey, San Mateo, San Luis Obispo, Santa Barbara, Los Angeles, and San Diego counties.

Selected specimen records (Geiser et al. 2004)—California. Marine Co. Pt. Reyes national Seashore: Mt. Vision, *Glavich* 508, Inverness Ridge, *McCune* 25884 (McCune). Oregon. Curry Co. New River ACEC, *Morgan s.n.* (BLM-Coos Bay herbarium). Tillamook Co., Cape Lookout SP, *Mikulín* 1124, *McCune* 17184 (McCune).

D. Habitat Characteristics and Species Abundance

Teloschistes flavicans is rare throughout its Northwest Forest Plan range along the Pacific coast of Oregon and northern California. Within this area, it appears to be confined to exposed headlands and dunes of the immediate coast. All known sites are under 440 m (1452 ft) elevation. The largest Northwest population is at Cape Lookout State Park, and there it was found on the twigs of Sitka spruce (*Picea sitchensis*) and is common in the litterfall of an old Sitka spruce forest on the long, forested headland of the peninsula (Glavich et al. 2005a, 2005b). At Cape Blanco, *T. flavicans* grows on the boles and limbs of exposed Sitka spruce and Hooker's willow (*Salix hookeriana*) in an open Sitka spruce forest. At New River ACEC, where it is rare, it is found on shore pine (*Pinus contorta*) in a mature shorepine forest at the edge of a pasture. At Sand Lake it occurs on Sitka spruce. Just 1 km (0.6 mi) north of Pacific City, it occurs in the twig litterfall of a small, old, mixed shore pine and Sitka spruce forest on a knoll east of the dune. In California, *T. flavicans* has been found on conifers, coyote brush (*Baccharus pilularis*) and scrub oak (*Quercus berberidifolia*) (Glavich et al. 2005b). One collection from San Mateo County is on sandstone.

In Great Britain, *Teloschistes flavicans* displays a habitat range that encompasses epiphytic, saxicolous (rock-dwelling), and terricolous communities. All the terricolous and saxicolous sites are coastal; inland it occurs only as an epiphyte. Host plants include ash (*Fraxinus*), maple (*Acer*), oak (*Quercus*), cherry (*Prunus*), alder (*Alnus*), and rhododendron (*Rhododendron*). The typical host tree is large, free-standing and with a well-illuminated trunk exposed to the wind, typically at a height of 1-4 m (3-12 ft) on the trunk, but, if the canopy is open, it may extend high into the upper branches. The largest colonies are on coastal granite, and encompass many thousands of plants. Around 1 percent of the British population is terricolous, growing up to 15 cm (6 in) deep between wind-clipped heaths or on soil with *Armeria* (sea-pink), fescue (*Festuca*), plantain (*Plantago*), and stonecrop (*Sedum*). In windswept locations where the higher

plant cover is very open, it can be attached to other lichens, the soil, or to fescue culms (Gilbert and Purvis 1996).

II. CURRENT SPECIES SITUATION

A. Status History

Teloschistes flavicans 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 (S&M) strategy 1 and 3 species (USDA and USDI 1994c). In 1998, the species was given BLM Assessment Status based on ORNHIC ranking of List 2 (USDI Bureau of Land Management 1998). With the completion of the 2001 Survey and Manage Record of Decision, it was assigned to Management Category A (USDA and USDI 2001). In 2004, *T. flavicans* was designated a Sensitive species for Forest Service Region 6 and a BLM Bureau Assessment species in Washington, Oregon, and California; the Survey and Manage Standards and Guidelines were also removed at this time. After a legal hiatus, the Survey and Manage (S&M) Standards and Guidelines were re-instated in 2009, with a settlement agreement in 2011 (USDA-USDI 2011). The settlement agreement maintains *T. flavicans* as S&M management category A, manage all known sites and conduct pre-disturbance and strategic surveys (USDA and USDI 2001; USDA-USDI 2011b). In 2011, this lichen is also a sensitive species for both the BLM and Forest Service in Oregon (USDA-USDI 2011a).

As of 2004, *Teloschistes flavicans* has a Global Heritage Rank of G4/G5, described as apparently secure (G4), uncommon but not rare; some cause for long-term concern due to declines or other factors or secure (G5), common, widespread and abundant. The species has a State Heritage Rank of S1 in Oregon and California, considered critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation (ORNHIC 2004). The species is on the ORNHIC List 2, described as taxa that are threatened, endangered, or possibly extirpation from the state of Oregon but more stable or common elsewhere. No changes to Heritage Program ranking in 2010 (ORBIC 2012).

B. Major Habitat and Viability Considerations

Frequent fog along the coast, combined with moderate temperatures, create suitable habitat for oceanic-influenced lichens such as *Teloschistes flavicans*. The broken topography, natural firebreaks and ocean spray all act to reduce the influence of fire on the immediate coast, thus favoring higher species diversity and successful colonization by rare species such as *T. flavicans* (McCune *et al.* 1997).

The major concerns for this lichen are the small number of populations, the limited amount of suitable habitat for this species on federal land, and loss of populations from management activities that directly impact the remaining habitat or populations. Much of the low elevation coastal forest land in the Pacific Northwest is under nonfederal ownership. This land includes thousands of acres that are generally managed on short harvest rotations. Given that lichens are slow to establish in rapidly growing stands (USDA and USDI 1994a) and do not become

abundant until later in successional development, most of these stands are harvested before lichens have a chance to re-establish significant populations.

Isolation of populations also leads to genetic isolation. Almost nothing is known about the genetics of lichen populations or the effects of gene pool isolation on local extinction rates of populations.

C. Threats to the Species

Threats to *Teloschistes flavicans* are those actions that disrupt stand conditions necessary for its survival. Such actions include treatments that reduce local populations by removing colonized bark or wood substrates; decreasing exposure to light; adversely affecting integrity of habitat areas; reducing or fragmenting potential habitat; or degrading air quality.

Recreational activities and developments may inadvertently alter the habitat of this species. Trampling by recreational vehicles and frequent foot traffic are serious threats, especially in shore pine woodlands and edge communities, as these degrade the habitat by disturbing fragile root systems of trees and shrubs, and the fragile protective mats of ground cryptogams, which stabilize the soil (Christy *et al.* 1998). Destabilization of dunes by off-highway vehicles can increase the amount of sand drift (Christy *et al.* 1998) and, thus, sand burial of trees on dune forest edges that can harbor coastal lichens, such as *T. flavicans*. Buildings, roads, campgrounds and trails along the immediate coast have replaced many natural habitats to improve access, facilitate scenic views, or develop recreational uses.

Other threats to the integrity of habitat and potential habitat areas include logging, grazing, agriculture, and activities that alter local hydrology, or increase fire frequency (Christy *et al.* 1998). Concern about fire varies--many different plant communities and successional stages exist among the coastal dunes and headlands; fire is beneficial to some communities but damaging to others. Invasion or planting of exotics such as Scots broom (*Cytisus scoparium*), European beachgrass, tree lupine (*Lupinus arboreus*), birdsfoot-trefoil (*Lotus corniculatus*), and iceplant (*Mesembryanthemum* spp.) can have profound effects on nitrogen-poor dune soils by increasing nitrogen and soil moisture. These conditions foster invasion of other weeds, which will eventually disrupting native plant communities (Christy *et al.* 1998) and reduce diversity (USDI 1997).

Teloschistes flavicans is considered highly sensitive to air pollution; it cannot tolerate sulfur dioxide concentrations of 20 ppm (Gilbert and Purvis 1996). Because the primary habitat of this lichen is the coastal fog belt, and because fog significantly concentrates pollutants, especially acidic forms of SO_x and NO_x to which lichens are most sensitive, the potential vulnerability of *T. flavicans* to air-quality deterioration is a reasonable concern. Air quality is relatively good at known sites, but emissions from increased traffic (mainly NO_x) or new point sources (SO_x and NO_x), could threaten this species in the future.

Climate change affecting coastal fog and precipitation patterns are likely to affect the vigor of this species, possibly resulting in an even more restricted distribution or contributing to local extirpation.

D. Distribution Relative to Land Allocations

Teloschistes flavicans occurs at four sites on federal land in Oregon and California (Glavich et al. 2005a; USDA 2012). On the Siuslaw National Forest, a site at Cascade Head Experimental Forest is administratively withdrawn. The New River Area ACEC on the Coos Bay District BLM is administratively withdrawn. The Point Reyes National Seashore site is Congressionally reserved. The Salem District BLM parcel just north of Pacific City is Late-Successional Reserve.

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. Policy objectives also state that actions authorized or approved by the BLM do not contribute to the need to list species under the Endangered Species Act.

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.

For the Survey and Manage Program, management of *T. flavicans* follows the 2001 Record of Decision, Standards and Guidelines (USDA-USDI 2001).

IV. HABITAT MANAGEMENT

A. Lessons From History

The majority of species in the genus *Teloschistes* are known only from scattered localities in isolated regions (Kärnefelt 1991). Scattered populations may cushion a species against world-wide extinction, but individual populations can be very vulnerable. Giess (1989) documented a dramatic decline in one such isolated population of *T. capensis* in Namibia that resulted from mechanical damage by off-road vehicles. A population of *T. flavicans* in Britain was lost to rabbit grazing (Gilbert and Purvis 1996). In southern California, *T. flavicans* is now quite rare because of urbanization and loss of habitat (Hale and Cole 1988).

One of the best documented declines of *Teloschistes flavicans* was described recently by Gilbert and Purvis (1996). Using accurate historical records, they were able to document the loss of most inland populations of *T. flavicans* in central England and Wales since 1960. The authors believe the gradual contraction of *T. flavicans* is largely from the spread of air pollution in

central and southern England. Although some large saxicolous and terricolous populations remain on the coast, the remaining epiphytic colonies are threatened, even within the clean air area of southwest England. This is because most populations are on single, large mature trees and appear unable to spread onto adjacent trees or bushes. Thus the lifespan of the population is limited by that of its host. Eight sites are known to have been lost from tree mortality or destruction over the last 25 years. General land use changes have also been detrimental, particularly the clearing of old orchards and wayside trees and the death of elms; all were once major habitats.

Lichens have been known to be sensitive to air pollution for over a century. Many species in Europe are in an active state of decline from sulfur dioxide, nitrogen oxides and acidic deposition of sulfur and nitrogen containing pollutants (Ferry *et al.* 1973, Hawksworth and Rose 1976). Fog contains higher levels of dissolved ions and acidity than precipitation, rain or snow (Wolseley and James 1992). Lichens that obtain most of their water from fog and dew, are particularly vulnerable to air quality and weather pattern changes (Nash 1996). Follmann (1995) documented massive impoverishment and retrogression of lichens over much of the northern Chilean coastal fog belt during the past twenty years. Increasing frequency of El Niño events and gradually increasing aridity were postulated as likely, but not exclusive, causal factors in this decline. *Teloschistes flavicans* is a highly sensitive member of the coastal fog belt community of the Americas.

B. Identifying Species Habitat Areas

All sites of *Teloschistes flavicans* 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 the 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 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 habitat areas (for example, divert roads, trails and off-road vehicles). Trampling shrubs or ground vegetation, 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 habitat area unless these actions would maintain or improve the habitat for *Teloschistes flavicans* (for example, by preventing deeply shaded conditions or by removing invasive exotics).

- Utilize or prevent fire in the habitat areas, depending on the role of fire in the plant community. Consider recommendations by Christy *et al.* (1998) for fire management in coastal plant communities.
- Restrict commercial collection of moss or fungi or other special forest products if these activities would adversely affect the integrity of habitat areas.

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

- Visit sites to determine the extent of local populations and improve habitat descriptions.
- Determine whether additional populations exist in areas identified as potential suitable habitat. Potential suitable habitat is foggy coastal windswept headlands and dunes with scattered old Sitka spruce, shore pine, western hemlock, especially on capes and jutting peninsulas.
- 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 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 are the dispersal rates and mechanisms of *Teloschistes flavicans*?
- Which habitat characteristics are necessary for establishment and survival of *Teloschistes flavicans* propagules and colonies?
- What are the minimum and optimum patch sizes of colonized habitat necessary to provide for *Teloschistes flavicans*?
- Can transplants be used to create new populations for *Teloschistes flavicans* to increase its population base on federal land?
- What is the genetic diversity of *Teloschistes flavicans* in local populations and across the region?
- How will forecasted climate change parameters affect *Teloschistes flavicans*?

C. Monitoring Opportunities and Recommendations

- Monitor dispersal and population trends of existing populations.

- Monitor known sites for changes in microclimatic conditions, successional changes, and for inadvertent habitat damage from human activities or wildfire.
- Monitor air-quality effects on *Teloschistes flavicans*. Evaluate point sources and regional or local urban emissions along the coast within the range of the Northwest Forest Plan. Monitor populations at highest risk.

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