Conservation Assessments
for
11 species of Coastal Lichens

Bryoria pseudocapillaris Brodo & D. Hawksw.
Bryoria spiralifera Brodo & D. Hawksw.
Bryoria subcana (Nyl. ex Stizenb.) Brodo & D. Hawksw.
Erioderma sorediatum D.J. Galloway & P.M. Jørg.
Heterodermia leucomelos Hedw.
Kaernefeltia californica (Tuck.) Thell & Goward
Leioderma sorediatum D.J. Galloway & P.M. Jørg.
Leptogium brebissonii Mont.
Niebla cephalota (Tuck.) Rundel & Bowler
Pyrrhospora quernea (Dickson) Körber
Teloschistes flavicans (Sw.) Norman

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Preface

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

Assumptions about Site Management
In the Final Supplemental Environmental Impact Statement (FSEIS) and Record of Decision (ROD) to Remove or Modify the Survey and Manage Standards and Guidelines, assumptions were made as to how former Survey and Manage species would be managed under Agency Special Status/Sensitive Species policies. Under the assumptions in the FSEIS, the ROD stated "The assumption used in the final SEIS for managing known sites under the Special Status Species Programs was that sites needed to prevent a listing under the Endangered Species Act would be managed. For species currently included in Survey and Manage Categories A, B, and E (which require management of all known sites), it is anticipated that only in rare cases would a site not be needed to prevent a listing…. Authority to disturb special status species sites lies with the agency official who is responsible for authorizing the proposed habitat-disturbing activity" (USDA and USDI 2004). Five of the species covered in these Conservation Assessments were listed as Category A or B at the time of the signing of the ROD, and the above assumptions apply to these species' management under the agencies' SSSSP. Those species are: *Bryoria pseudocapillaris, Bryoria spiralifera, Bryoria subcana, Niebla cephalota*, and *Teloschistes flavicans*.

The remaining six species included in this document were removed from Survey and Manage prior to the ROD, when it was determined that they were not dependent upon or associated with late-successional/old-growth stands. Known sites continued to be managed for these species while their inclusion within the SSSSP was being evaluated. Now that these six species have been added to one or more agency SSSSP, sites are to be managed consistent with SSSSP policies. The assumptions listed in the ROD regarding site management do not apply to these six species.

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. These considerations are not required and are intended as general information that field level personnel could utilize and apply to site-specific situations. Management of all of the species covered in these Conservation Assessments follows Forest Service 2670 Manual policy and BLM 6840 Manual direction. (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
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Linda Geiser, Author

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M. Stein

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SUMMARY

Preface: Since the transmittal of the Management Recommendations in 2000, 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
Other Management Status: Forest Service Region 6 Sensitive Species; Bureau of Land Management (BLM) Bureau Sensitive for Washington, Oregon, and California. From NatureServe, the species is ranked with a Global Heritage Rank of G1/G2, described as critically imperiled (G1) to imperiled (G2) with fewer than 20 known sites. The State Heritage Rank of S1 for Washington and Oregon identifies the species as critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation in the State. The Oregon Natural Heritage Information Center (ORNHIC) ranks the species Heritage List 1, described as species threatened or endangered throughout their range or presumed extinct.

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 in Lane County, 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 500 meters (1600 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, ect., 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 Nomenclature[1]

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 Chemistry[1]

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+ red reactions of the cortex, and the extremely long (up to 4 mm), spiraling pseudocyphellae. The unique deep, longitudinal sulcae (grooves or

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

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 has short, inconspicuous (as opposed to long, white, conspicuous) pseudocyphellae. *Bryoria capillaris* also tends to darken in exposed locations, but *B. pseudocapillaris* is always very pale (McCune *et al.* 1997). The two species also differ in habitat: *B. capillaris* is primarily a lichen of sheltered forests, but *B. pseudocapillaris* grows in exposed sites along the immediate coast (McCune *et al.* 1997).
- *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* has abundant, conspicuous, white soralia but soralia are never present in *B. pseudocapillaris*.
- *Bryoria friabilis* has long, spiraling pseudocyphellae and a KC+ pinkish-orange reaction, but it's K- and P- reactions, and uneven, wrinkled branches, readily distinguish it.
- *Bryoria pseudofuscescens* has short, inconspicuous pseudocyphellae and is KC-.

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 Samoa Peninsula, Humboldt County California, is home to the largest population of *B. pseudocapillaris*. 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 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, *Mikulin 1227* (OSC); Cape Arago State Park, *Mikulin 1292* (OSC); Oregon Dunes National Recreation Area, North Eel Campground vicinity, *Mikulin 1217* (OSC). Douglas Co. Umpqua Lighthouse State Park, Lake Marie, *Geiser 7098* (OSC); Oregon Dunes National Recreation Area, Takenitch Ck trail, *Mikulin 1310* (OSC). Lane Co. Siuslaw National Forest: Sutton Creek, *Mikulin 1141* (OSC); Heceta Beach *Mikulin 1149* (OSC); Oregon Dunes National Recreation Area, Goose Pasture, *Mikulin 1152* (OSC). Clatsop Co. Saddle Mountain State Park, *Mikulin 1180* (OSC). WASHINGTON. Clallam Co. Olympic National Park, Sand Point vicinity, *Mikulin 1291* (OSC). Island Co. Deception Pass State Park, *Mikulin 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 500 meters (1650 feet) elevation. *B. pseudocapillaris* is found predominantly on shore pine (*Pinus contorta*) and Sitka spruce (*Picea sitchensis*). It shares the same habitat with a closely related California-Oregon endemic, *B. spiralifera*. On the Samoa Peninsula, it is frequently mixed with the epiphytic lichen, *Ramalina menziesii* (Brodo and Hawksworth 1977).

The largest population of *Bryoria pseudocapillaris* occurs on the Samoa Peninsula where it grows intermixed with the more abundant *B. spiralifera*. At Humboldt Lagoons State Park, it was found on Sitka spruce on the edge of Stone Lagoon. At Patrick's Point State Park and College Cove State Beach, it was found at the edge of Sitka spruce forests on marine terrace cliffs (Glavich, pers. comm.). At Sutton Creek, just north of the Oregon Dunes in Lane County, *B. pseudocapillaris* was found densely overgrowing a small, moribund conifer located in an exposed site between an old-growth Sitka spruce forest and open dunes (McCune *et al.* 1997).

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 2000 SEIS, 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.

Bryoria pseudocapillaris has a Global Heritage Rank of G1/G2, described as critically imperiled (G1) or imperiled (G2) with fewer than 20 known sites. The species has a State Heritage Rank of S1 in Washington and Oregon, considered critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation (ORNHIC 2004). The species is now on the ORNHIC List 1, described as species threatened or endangered throughout their range or presumed extinct.

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 speices, 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. Timber harvest, expansion of the area open to recreational activities, or additional development could further restrict its habitat on the Samoa Peninsula, and elsewhere along the coast.

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). Destabilization of the foredunes by recreationists or removal of European beachgrass (*Ammophila arenaria*) can destabilize tree island habitats of *Bryoria pseudocapillaris* by increasing the amount of sand drift into them and burying trees on the perimeter (Christy *et al.* 1998). 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 vicinity, and elsewhere, including Asia, might threaten this species in the future.

Climate change affecting 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.

D. Distribution Relative to Land Allocations

Sites of *Bryoria pseudocapillaris* on federal land include the Sutton Creek Recreation Area, Siuslaw National Forest which is administratively withdrawn, with a management emphasis on recreation, as are sites within the Oregon Dunes National Recreation Area. All other Oregon sites occur within the State Park system. In Washington, the site in Olympic National Park is Congressionally reserved. 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 Area of Critical Environmental Concern (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.

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. Conservation is defined as the use of all methods and procedures that are necessary to improve the condition of SSS and their habitats to a point where their Special Status recognitions no longer warranted. 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

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. comm.). At the Lanphere Dunes Unit, even hiking has been documented to damage fragile shore pine/bearberry (*Arctostaphylos uva-ursi*) communities (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 verify the status of the species, determine the extent of local populations, and better characterize habitat conditions.
- Determine whether additional populations exist in areas identified as potentially suitable habitat, such as Gwynn Creek; Eel Creek on the Siuslaw National Forest; and inter-dune tree islands and scrub forests of the Oregon Dunes National Recreation Area; BLM parcels adjacent to Cape Lookout; and other coastal BLM parcels.
- Report documented sites to Oregon Natural Heritage 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/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?

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.

REFERENCES

Bailey, R.H. 1976. Ecological aspects of dispersal and establishment in lichens. pp. 215-247. *In*: Brown, D.H., D.L. Hawksworth, and R.H. Bailey (eds.). Lichenology: Progress and Problems. Systematics Association Special Volume No. 8. Academic Press, London and New York.

Brodo, I.M. and D.L. Hawksworth. 1977. *Alectoria* and allied genera in North America. Opera Botanica 42:1-164.

Brown, D.R. 1990. Disturbance and recovery of trampled vegetation at the Lanphere-Christensen Dunes Preserve, Humboldt County, California. M.S. Thesis. Humboldt State University, Arcata, CA. 45 p.

Christy, J.A., J.S. Kagan, and A.M. Wiedemann. 1998. Plant Associations of the Oregon Dunes National Recreation Area, Siuslaw National Forest, Oregon. Technical Paper R6-NR-ECOL-TP-09-98. USDA Forest Service, Pacific Northwest Region, Portland, OR. 183 p.

Denison, W.C. and S.M. Carpenter. 1973. A Guide to Air Quality Monitoring with Lichens. Lichen Technology, Inc., Corvallis, OR. 39 p.

Dettki, H. 1998. Dispersal of fragments of two pendulous lichen species. Sauteria 9:123-132.

Esseen, P.-A., L. Ericson, H. Lindström, and O. Zackrisson. 1981. Occurrence and ecology *of Usnea longissima* in central Sweden. Lichenologist 13(2):177-190.

Glavich, D. 1998. Personal communication. Humboldt State University, Arcata, CA.

Glavich, D., L.H. Geiser, and A.G. Mikulin. 2004. Distribution of some rare coastal lichens in Washington, Oregon and northern California, USA and their association with late-seral federally protected forests. Manuscript submitted for publication in Evansia.

Hawksworth, D.L. and F. Rose. 1976. Lichens as Pollution Monitors. The Institute of Biology's Studies in Biology 66. Edward Arnold, London.

Insarova, I.D., G.E. Insarov, S. Brakenhielm, S. Hultengren, P.O. Martinsson, and S.M. Semenov. 1992. Lichen Sensitivity and Air Pollution - A Review of Literature Data. 150 Report 4007, Swedish Environmental Protection Agency, Uppsala.

McCune, B., J. Dey, J. Peck, K. Heiman, and S. Will-Wolf. 1996. Lichen communities. *In*: Lewis, T.E., and B.L. Conkling (eds.). Forest health monitoring, Southeast Loblolly/Shortleaf Pine Demonstration Final Report. US Environmental Protection Agency EPA/620/R-64/006.

McCune, B. and L. Geiser. 1997. Macrolichens of the Pacific Northwest. Oregon State University Press, Corvallis, OR. 386 p.

McCune, B., R. Rosentreter, and A. DeBolt. 1997. Biogeography of rare lichens from the coast of Oregon. pp. 234-241. *In*: T.N. Kaye, A. Liston, R.M. Love, D.L. Luoma, R.J. Meinke, and M.V. Wilson (eds.). Conservation and Management of Native Plants and Fungi. Native Plant Society of Oregon, Corvallis, OR . 296 p.

ORNHIC 2004. Oregon Natural Heritage Information Center. http://oregonstate.edu.ornhic/

Peterson, J., D. Schmoldt, D. Peterson, J. Eilers, R. Fisher, and R. Bachman. 1992. Guidelines for evaluating air pollution impacts on class 1 wilderness areas in the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-299. USDA Forest Service, Pacific Northwest Research Station. Portland, OR. 83 p.

Seaward, M.R.D. 1977. Lichen Ecology. Academic Press, London. 550 p.

Stevenson, S.K. 1988. Dispersal and colonization of arboreal forage lichens in young forests. IWIFR-38. BC Ministry of Environment and BC Ministry of Forests, Victoria, British Columbia.

Taylor, R.J. and M.A. Bell. 1983. Effects of sulfur dioxide on the lichen flora in an industrial area, northwest Whatcom County, Washington. Northwest Science 57:157-166.

USDA Forest Service. 1998. See website for lichens and air quality in the Pacific Northwest Region: www.fs.fed.us/r6/aq.

USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Portland, OR.

USDA Forest Service and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl, Appendix J2: Results of Additional Species Analysis. Portland, OR. 476 p.

USDA Forest Service and USDI Bureau of Land Management. 1994c. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents and Standards and Guidelines for Management of Habitat for Late-successional and Old-growth Forest Related Species within the Range of the Northern Spotted Owl. Portland, OR.

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

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

USDI Bureau of Land Management. 1998. Bureau Special Status Species Policy (6840) and Oregon/Washington Special Status Species List, Internal Memorandum OR-98-342, August 28, 1998, including attachments.

USDI Fish and Wildlife Service. 1997. Environmental assessment and land protection plan: Lanphere Dunes Unit, Humboldt Bay National Wildlife Refuge, Humboldt County, California. Portland, OR.

Wetmore, C.M. 1983. Lichens of the air quality Class 1 National Parks. Final Report, National Park Service Contract CX 0001-2-0034. Denver, CO.

Wiedemann, A.M. 1984. The ecology of Pacific Northwest coastal sand dunes: a community profile. FWS/OBS-84/04. US Fish and Wildlife Service. 130 p.

Wiedemann, A.M. 1990. The coastal parabola dune system at Sand Lake, Tillamook County, Oregon, USA. pp. 171-194. *In*: Proceedings of the Canadian Symposium on Coastal Sand Dunes.

Conservation Assessment

for

Bryoria spiralifera Brodo & D. Hawksw.

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SUMMARY

Preface: Since the transmittal of the Management Recommendations in 2000, new site information has been collected regarding *Bryoria spiralifera* and is presented herein.

Species: *Bryoria spiralifera* Brodo & D. Hawksw.
Taxonomic Group: Lichen
Other Management Status: Forest Service Region 6 Sensitive Species in Oregon; Bureau of Land Management (BLM) Bureau Sensitive in Oregon and California. From NatureServe the species has a Global Heritage Rank of G1, described as critically imperiled, with fewer than 6 known sites, or 1000 individuals or 2000 acres of occupied habitat. 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. The Oregon Natural Heritage Information Center (ORNHIC) ranks the species Heritage List 1, described as species threatened or endangered throughout its range or presumed extinct.

Range: Global distribution is restricted to coastal northwest United States from Umpqua County, Oregon to San Luis Obispo County, California. Distribution is uneven with sites in Humboldt, Sonoma, Monterey, and San Luis Obispo Counties, California and Coos and Umpqua Counties, Oregon. Four sites occur on federal lands managed by the Siuslaw National Forest, Humboldt Bay National Wildlife Refuge, and Arcata Field Office of the BLM.

Specific Habitat: *Bryoria spiralifera* grows on exposed trees (especially Sitka spruce and shore pine) and shrubs on forested, coastal, windswept dunes and headlands at or near sea level within 3 km (2 miles) of the ocean. 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+ red, 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).

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. It also has somewhat shorter (up to 3 mm) pseudocyphellae than does *B. spiralifera*, and they are mainly straight rather than spiraling. The unique deep, longitudinal sulcae (grooves or fissures) of *Sulcaria badia* easily distinguish it from *B. spiralifera*. *Nodobryoria oregana* is the most common reddish-colored *Bryoria* of the Coast Range and has short perpendicular side branches, but it lacks pseudocyphellae, usually has apothecia, and--because it contains no lichen substances—is 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. 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. spiralifera* and has short, inconspicuous (as opposed to long, white, conspicuous) pseudocyphellae. The two species also differ in habitat: *B. capillaris* is primarily a lichen of sheltered forests, but *B. spiralifera* grows in exposed sites along the immediate coast (McCune *et al.* 1997).
- *Bryoria trichodes* ssp. *trichodes* is easily distinguished from *B. spiralifera* 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* has abundant, conspicuous, white soralia but soralia are never present in *B. spiralifera*.
- *Bryoria friabilis* has long, spiraling pseudocyphellae, but it's K-, P-, and KC+ pinkish-orange reactions and uneven, wrinkled branches, readily distinguish it.
- *Bryoria pseudofuscescens* has short, inconspicuous pseudocyphellae and is KC-.
- *Bryoria pseudocapillaris* (see discussion above).

2. Reproductive Biology

Bryoria spiralifera 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 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*. 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. Current information suggests that this lichen is both rare and limited to the immediate coast as extensive surveys conducted by the Forest Service on seven national forests, in over 1200 locations, located only one site near Spin Reel Campground (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.

Other selected records (Glavich *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 (< 50 m (165 ft) elevation) and within 3 km (2 miles) of the ocean. *B. spiralifera* 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, pers. comm.). On the Samoa Peninsula, Humboldt County, California it is frequently mixed with the draping, epiphytic lichen, *Ramalina menziesii* (Brodo and Hawksworth 1977). It is known to be scattered but locally abundant near Blue Gill Lake and on the Samoa Peninsula.

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. The largest population of *B. spiralifera* occurs on the Samoa Peninsula, where 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. Some of the old snags of shore pine and Sitka spruce, partially buried at the apex of a moving dune, support the largest, most well-established thalli (Glavich, pers. comm.). It also occurs in the canopy and edges of Sitka spruce-shore pine forests with thick to impenetrable understories of evergreen huckleberry, typical of dry stabilized dunes, tree islands, and deflation planes. It is also found in open shore pine woodlands with an understory of bearberry and mats of the reindeer lichen *Cladina*.

Although many of the habitat areas are not climax communities, *Bryoria spiralifera* typically occupies older substrates within those communities. At the Lanphere Dunes Unit (Humboldt Bay National Wildlife Refuge, USFWS) on the Samoa Peninsula, the oldest shore pine are approximately 150 years old (Glavich, pers. comm.). Mature shore pine in shore pine/bearberry woodlands at the Oregon Dunes National Recreation Area average between 80 to 130 years old. Sitka Spruce/Evergreen Huckleberry forests are mid-seral to climax communities and can contain Sitka spruce that are many centuries old (Christy *et al*. 1998).

II. CURRENT SPECIES SITUATION

A. Status History

Bryoria spiralifea 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 (USDI Bureau of Land Management 1998). With the completion of the 2000 SEIS, 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.

From NatureServe, *Bryoria spiralifera* has a Global Heritage Rank of G1, described as critically imperiled, at high risk of extinction due to extreme rarity, very steep declines or other factors. The species has a State Heritage Rank of S1 in California and Oregon, considered critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation (ONHIC 2004). 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 ORNHIC List 1, described as species threatened or endangered throughout their range or presumed extinct.

B. Major Habitat and Viability Considerations

Major concerns for *Bryoria spiralifera* are the small number of known populations globally, the limited range of the species which is restricted to coastal habitat in Oregon and California, the limited amount of suitable habitat for this species on federal land, and the potential loss of populations from management or recreational activities that damage the populations or the remaining habitat. 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. Timber harvest, expansion of the area open to recreational activities, or additional development could further restrict its habitat on the Samoa Peninsula, 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). Destabilization of the foredunes by recreationists or removal of European beachgrass (*Ammophila arenaria*) can destabilize tree island habitats of *Bryoria spiralifera* by increasing the amount of sand drift into them and burying trees on the perimeter (Christy *et al.* 1998). 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 vicinity, and elsewhere along the coast, might threaten this species in the future.

Climate change affecting 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.

D. Distribution Relative to Land Allocations

Four sites for *Bryoria spiralifera* occur on federal lands including Humboldt Bay National Wildlife Refuge, Lanphere Dunes Unit, of unknown land use allocation; a Bureau of Land Management Arcata Field Office parcel on the Samoa Peninsula, Humboldt County, administratively withdrawn; Siuslaw National Forest in the vicinity of Bluebill Lake in Coos County, Oregon (*McCune 23696, 23700)*; and the Oregon Dunes National Recreation Area in the vicinity of Spin Reel Campground, Coos County. The population at Bluebill Lake is on a parcel of land administered by the Siuslaw National Forest, bordering the southern edge of the Oregon Dunes National Recreation Area. Although not administratively withdrawn, part of the area occupied by the population is managed for wildlife and plant viewing and part is an undeveloped area off-limits to motor vehicles. The population near Spin Reel Campground may be inside the

Oregon Dunes National Recreation area, and administratively withdrawn, or just outside. Non-federal sites occur within the Oregon and California States Park systems.

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. Conservation is defined as the use of all methods and procedures that are necessary to improve the condition of SSS and their habitats to a point where their Special Status recognitions no longer warranted. 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

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. comm.). At the Lanphere Dunes Unit, even hiking has been documented to damage fragile shore pine/bearberry (*Arctostaphylos uva-ursi*) communities (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 the status of the species, determine the extent of local populations, and better characterize habitat conditions.
- Determine whether additional populations exist in areas identified as potentially suitable habitat, such as Gwynn Creek and Eel Creek on the Siuslaw National Forest; and inter-dune tree islands and scrub forests of the Oregon Dunes National Recreation Area; BLM parcels adjacent to Cape Lookout and other coastal BLM parcels.
- Report documented sites to ORNHIC 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/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?

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.

REFERENCES

Bailey, R.H. 1976. Ecological aspects of dispersal and establishment in lichens. pp. 215-247. *In*: Brown, D.H., D.L. Hawksworth, and R.H. Bailey (eds.). Lichenology: Progress and Problems. Systematics Association Special Volume No. 8. Academic Press, London and New York.

Brodo, I.M. and D.L. Hawksworth. 1977. *Alectoria* and allied genera in North America. Opera Botanica 42:1-164.

Brown, D.R. 1990. Disturbance and recovery of trampled vegetation at the Lanphere-Christensen Dunes Preserve, Humboldt County, California. M.S. Thesis. Humboldt State University, Arcata, CA. 45 p.

Christy, J.A., J.S. Kagan, and A.M. Wiedemann. 1998. Plant Associations of the Oregon Dunes National Recreation Area, Siuslaw National Forest, Oregon. Technical Paper R6-NR-ECOL-TP-09-98. USDA Forest Service, Pacific Northwest Region, Portland, OR. 183 p.

Denison, W.C. and S.M. Carpenter. 1973. A Guide to Air Quality Monitoring with Lichens. Lichen Technology, Inc., Corvallis, OR. 39 p.

Dettki, H. 1998. Dispersal of fragments of two pendulous lichen species. Sauteria 9: 123-132.

Esseen, P.-A., L. Ericson, H. Lindström, and O. Zackrisson. 1981. Occurrence and ecology *of Usnea longissima* in central Sweden. Lichenologist 13(2):177-190.

Glavich, D. 1998. Personal communication. Humboldt State University, Arcata, CA.

Glavich, D., L.H. Geiser, and A.G. Mikulin. 2004. Distribution of some rare coastal lichens in Washington, Oregon and northern California, USA and their association with late-seral federally protected forests. Manuscript submitted for publication in Evansia.

Hawksworth, D.L. and F. Rose. 1976. Lichens as pollution monitors. The Institute of Biology's Studies in Biology 66. Edward Arnold, London.

Insarova, I.D., G.E. Insarov, S. Brakenhielm, S. Hultengren, P.O. Martinsson, and S.M. Semenov. 1992. Lichen Sensitivity and Air Pollution - A Review of Literature Data. 150 Report 4007, Swedish Environmental Protection Agency, Uppsala.

McCune, B., J. Dey, J. Peck, K. Heiman, and S. Will-Wolf. 1996. Lichen communities. *In*: Lewis, T.E., and B.L. Conkling (eds.). Forest health monitoring, Southeast Loblolly/Shortleaf Pine Demonstration Final Report. US Environmental Protection Agency EPA/620/R-64/006.

McCune, B. and L. Geiser. 1997. Macrolichens of the Pacific Northwest. Oregon State University Press, Corvallis, OR. 386 p.

McCune, B., R. Rosentreter, and A. DeBolt. 1997. Biogeography of rare lichens from the coast of Oregon. pp. 234-241. *In*: T.N. Kaye, A. Liston, R.M. Love, D.L. Luoma, R.J. Meinke and M.V. Wilson (eds.). Conservation and Management of Native Plants and Fungi. Native Plant Society of Oregon, Corvallis, OR . 296 p.

ORNHIC. 2004. Oregon Natural Heritage Information Center. http://oregonstate.edu.ornhic/

Peterson, J., D. Schmoldt, D. Peterson, J. Eilers, R. Fisher, and R. Bachman. 1992. Guidelines for evaluating air pollution impacts on class 1 wilderness areas in the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-299. USDA Forest Service, Pacific Northwest Research Station. Portland, OR. 83 p.

Riefner, R.E., Jr., P.A. Bowler, and B.D. Ryan. 1995. New and interesting records of lichens from California. Bulletin of the California Lichen Society 2(2).

Seaward, M.R.D. 1977. Lichen Ecology. Academic Press, London. 550 p.

Stevenson, S.K. 1988. Dispersal and colonization of arboreal forage lichens in young forests. IWIFR-38. BC Ministry of Environment and BC Ministry of Forests, Victoria, British Columbia.

Taylor, R.J. and M.A. Bell. 1983. Effects of sulfur dioxide on the lichen flora in an industrial area, northwest Whatcom County, Washington. Northwest Science 57:157-166.

USDA Forest Service. 1998. See website for lichens and air quality in the Pacific Northwest Region: www.fs.fed.us/r6/aq.

USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Portland, OR.

USDA Forest Service and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl, Appendix J2: Results of Additional Species Analysis. Portland, OR. 476 p.

USDA Forest Service and USDI Bureau of Land Management. 1994c. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents and Standards and Guidelines for Management of Habitat for Late-successional and Old-growth Forest Related Species within the Range of the Northern Spotted Owl. Portland, OR.

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

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

USDI Bureau of Land Management. 1998. Bureau Special Status Species Policy (6840) and Oregon/Washington Special Status Species List, Internal Memorandum OR-98-342, August 28, 1998, including attachments.

USDI Fish and Wildlife Service. 1997. Environmental assessment and land protection plan: Lanphere Dunes Unit, Humboldt Bay National Wildlife Refuge, Humboldt County, California. Portland, OR.

Wetmore, C.M. 1983. Lichens of the air quality Class 1 National Parks. Final Report, National Park Service Contract CX 0001-2-0034. Denver, CO.

Wiedemann, A.M. 1984. The ecology of Pacific Northwest coastal sand dunes: a community profile. FWS/OBS-84/04. US Fish and Wildlife Service. 130 p.

Wiedemann, A.M. 1990. The coastal parabola dune system at Sand Lake, Tillamook County, Oregon, USA. pp. 171-194. *In*: Proceedings of the Canadian Symposium on Coastal Sand Dunes.

Conservation Assessment

for

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

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SUMMARY

Preface: Since the transmittal of the Management Recommendations in 2000, 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
Other Management Status: Bureau of Land Management Bureau (BLM) Assessment Species for Washington and Oregon. From NatureServe the species is ranked with a Global Heritage Rank of G2/G4, described as imperiled (G2) at high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors, to apparently secure (G4), uncommon but not rare, some cause for long-term concerns due to declines or other factors. The species also has a State Heritage Rank of S2 for Oregon, considered imperiled in the State because of rarity due to a very restricted range, very few populations (20 or fewer), steep declines, or other factors making it very vulnerable to extirpation in the State, and S1 in Washington and California, described as critically imperiled because of extreme rarity or some other factor such as very steep declines making it especially vulnerable to extirpation from the State. The Oregon Natural Heritage Information Center ranks the species Heritage List 2, described as taxa that are threatened, endangered or possibly extirpated from the State but more secure or common elsewhere.

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 is an unverified site near Eel Creek in the Oregon Dunes National Recreation Area.

Specific Habitat: *Bryoria subcana* grows on the bark and wood of conifers in forests of coastal bays, streams, dune forests, and high precipitation ridges and summits within 50 km (30 mi) of the ocean.

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., Viznachik Lishainikiv 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 the spot chemical, p-phenylenediamine, differentiate it from very pale forms of *B. trichodes* ssp. *trichodes* that also grow near the coast (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). *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 *Bryoria 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 seven sites, all within 50 km (30 mi) of the coast. There are two sites (USDA 1998) on the Hebo Ranger District, Siuslaw National Forest. One is south of the Little Nestucca River about 5 km (3 mi) west of Dolph, and the other is north of Cedar Lake. Other Oregon sites are the summit of Saddle Mountain State Park (Clatsop County) (Pike 3818 in OSC Herbarium), and the summit of Grass Mountain (McCune *et al.* 1997), in Grass Mountain Area of Critical Environmental Concern (ACEC) on Salem District BLM (Benton County). In Washington, sites are known from Walker Mountain on the Olympic National Forest and Moran State Park on Orcas Island Glavich *et al*. 2004). In California, *B. subcana* is known from the Bolema Trail, Inverness Ridge area (Brodo and Hawksworth 1977) (Marin County); ownership of this site is unknown. An eighth site, near Eel Creek (USDA 1998) in the Oregon Dunes National Recreation Area (Coos County) has been tentatively identified. The voucher specimen from this site is pale brown, with protocetraric acid and many soralia, but it is very small. There have been a number of reports of this species from the Cascade Range in Oregon and Washington. A confident identification involves using thin layer chromatography (TLC) to isolate fumarprotocetraric acid. To date, TLC results using voucher material collected from the Cascades have been inconclusive, possibly due to an insufficient amount of voucher material (Glew 2004).

Selected specimen record (Glavich *et al.* 2004) includes Oregon. Coos Co. Oregon Dunes National Recreation Area, Eel Creek, *Ingersoll 957* (OSC). Douglas Co. Umpqua National Forest, Tiller Ranger District, near Black Butte, *Bonilla 970804-1* (OSC). 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 along coastal bays and streams, dune forests (tentative), coastal mountain ridges, and high precipitation summits. High humidity, either as coastal fog or high precipitation, appears to be an important habitat requirement. At the sites where stand age was noted, the host plant is old or the stand age is late-seral to old-growth. Requirements for light are not well understood. The lichen tolerates shade at two sites but canopy cover is low at other sites. In western North America, *B. subcana* has always been found within 50 km (30 mi) of the ocean.

At Inverness ridge, *Bryoria subcana* was found on the lower trunk of a Douglas-fir. At the Little Nestucca site, it was found mid-slope on a steep ridge, among red alders (*Alnus rubra*) and large, old western hemlocks. Exposure to light at this site was also low. At the Cedar Lake site, the lichen was found on Douglas-fir in an open, even-aged Sitka spruce/swordfern (*Polytrichum munitum*) forest of about 85 years. At the summits of Grass Mountain and Saddle Mountain it was found in wet noble fir forests, but the exposure is not known. (The tentative site at Eel creek was an open canopy, mature western hemlock/rhododendron (*Rhododendron macrophyllum*) dune forest with mats of the lichen *Stereocaulon* on the forest floor.)

Little information is available about species abundance. The species was noted as rare at two sites. No large populations have been identified.

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 2000 SEIS, it was assigned to Management Category B (USDA USDI 2001). In 2004, *B. subcana* was designated as a Bureau Assessment species for the OR.WA Bureau of Land Management (BLM).

From NatureServe the species is ranked with a Global Heritage Rank of G2/G4, described as imperiled (G2) at high risk of extinction due to very restricted range, very few populations (often 20 or fewer) steep declines, or other factors to apparently secure (G4), uncommon but not rare, some cause for long-term concerns due to declines or other factors (ORHHIC 2004). The species has a State Heritage Rank of S2 for Oregon, considered imperiled in the State because of rarity due to a very restricted range, very few populations (20 or fewer) steep declines, or other factors making it very vulnerable to extirpation in the State. The Oregon Natural Heritage Information Center (ORNHIC) ranks the species Heritage List 2, described as taxa that are threatened, endangered or possibly extirpated from the State but more secure or common elsewhere

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 nonfederal ownership, generally managed on short harvest rotations. 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 Sitka spruce, Douglas-fir, and noble fir, or other colonized bark or wood substrates; 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). Destabilization of the foredunes by recreationists or removal of European beachgrass (*Ammophila arenaria*) can destabilize tree island habitats of *Bryoria subcana* by increasing the amount of sand drift into them and burying trees on the perimeter (Christy *et al.* 1998). 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) along the coast, might threaten this species in the future.

Climate change affecting 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.

D. Distribution Relative to Land Allocations

Sites of *Bryoria subcana* occurring on federal land include the Little Nestucca River site in the North Coast Adaptive Management Area, Hebo Ranger District, Siuslaw National Forest, the Cedar Lake site in Unit 93, block III of the Hebo long term restoration project, of unknown allocation and the Grass Mountain site, managed by the BLM as an Area of Critical Environmental Concern and administratively withdrawn. The site at Walker Mountain on the Olympic National Forest is in an unknown allocation.

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. Conservation is defined as the use of all methods and procedures that are necessary to improve the condition of SSS and their habitats to a point where their Special Status recognitions no longer warranted. 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

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 affec*t 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

- Determine the range of *Bryoria subcana* in Oregon and Washington by collecting voucher material from suspected Cascade Range sites on the Willamette, Mt. Hood, and Gifford Pinchot National Forests and make identifications using the thin layer chromatography method to isolate fumarprotocetraric acid.
- Revisit the site near Eel Creek in the Oregon Dunes to verify the presence of *Bryoria subcana*.
- Report documented sites to ORNHIC 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/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*?

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.

REFERENCES

Brodo, I.M. and D.L. Hawksworth. 1977. *Alectoria* and allied genera in North America. Opera Botanica 42:1-164.

Christy, J.A., J.S. Kagan, and A.M. Wiedemann. 1998. Plant Associations of the Oregon Dunes National Recreation Area, Siuslaw National Forest, Oregon. Technical Paper R6-NR-ECOL-TP-09-98. USDA Forest Service, Pacific Northwest Region, Portland, OR. 183 p.

Denison, W.C. and S.M. Carpenter. 1973. A Guide to Air Quality Monitoring with Lichens. Lichen Technology, Inc., Corvallis, OR. 39 p.

Glavich, D., L.H. Geiser and A.G. Mikulin. 2004. Distribution of some rare coastal lichens in Washington, Oregon and northern California, USA and their association with late-seral federally protected forests. Manuscript submitted for publication in Evansia.

Glew, Katherine. 2004. Results of Thin-layer Chromatography for *Cladonia norvegica* and *Bryoria subcana* collections. Unpublished report.

Hawksworth, D.L. 1972. Regional studies in *Alectoria* (Lichenes) II. The British species. Lichenologist 5:181-261.

Hawksworth, D.L. and F. Rose. 1976. Lichens as Pollution Monitors. The Institute of Biology's Studies in Biology 66. Edward Arnold, London.

Insarova, I.D., G.E. Insarov, S. Brakenhielm, S. Hultengren, P.O. Martinsson, and S.M. Semenov. 1992. Lichen Sensitivity and Air Pollution - A Review of Literature Data. 150 Report 4007, Swedish Environmental Protection Agency, Uppsala.

Maser, C., Z. Maser, and J.M. Trappe. 1985. Food habits of the northern flying squirrel (*Glaucomys sabrinus*) in Oregon. Canadian Journal of Zoology 63: 1085-1088.

Maser, C., Z. Maser, J.W. Witt, and G. Hunt. 1986. The northern flying squirrel; a mycophagist in southwestern Oregon. Canadian Journal of Zoology 64: 2086-2089.

McCune, B., J. Dey, J. Peck, K. Heiman, and S. Will-Wolf. 1996. Lichen communities. *In*: Lewis, T.E., and B.L. Conkling (eds.). Forest health monitoring, Southeast Loblolly/Shortleaf Pine Demonstration Final Report. US Environmental Protection Agency EPA/620/R-64/006.

McCune, B. and L. Geiser. 1997. Macrolichens of the Pacific Northwest. Oregon State University Press, Corvallis, OR. 386 p.

McCune, B., R. Rosentreter, and A. DeBolt. 1997. Biogeography of rare lichens from the coast of Oregon. pp. 234-241. *In*: T.N. Kaye, A. Liston, R.M. Love, D.L. Luoma, R.J. Meinke and M.V. Wilson (eds.). Conservation and Management of Native Plants and Fungi. Native Plant Society of Oregon, Corvallis, OR . 296 p.

Neitlich, P. 1996. Lichen diversity in old-growth and managed stands in western Oregon. Master's Thesis. Oregon State University. Corvallis, OR.

ORNHIC. 2004. Oregon Natural Heritage Information Center. http://oregonstate.edu.ornhic/

Rosentreter, R. and L. Eslick. 1993. Notes on the Bryorias used by flying squirrels for nest construction. Evansia 10(2):61-63.

Seaward, M.R.D. 1977. Lichen Ecology. Academic Press, London. 550 p.

Stevenson, S.K. and J.A. Rochelle. 1984. Lichen litterfall--its availability and utilization by lack-tailed deer. pp. 391-96. *In*: Meehan, W.R. *et al.*, (eds.). Proceedings: Symposium on Fish and Wildlife Relationships in Old-Growth Forests.

Taylor, R.J. and M.A. Bell. 1983. Effects of sulfur dioxide on the lichen flora in an industrial area, northwest Whatcom County, Washington. Northwest Science 57:157-166.

USDA Forest Service. 1998. See website for lichens and air quality in the Pacific Northwest Region: www.fs.fed.us/r6/aq.

USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Portland, OR.

USDA Forest Service and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl, Appendix J2: Results of Additional Species Analysis. Portland, OR. 476 p.

USDA Forest Service and USDI Bureau of Land Management. 1994c. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents and Standards and Guidelines for Management of Habitat for Late-successional and Old-growth Forest Related Species within the Range of the Northern Spotted Owl. Portland, OR.

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

Wetmore, C.M. 1983. Lichens of the air quality Class 1 National Parks. Final Report, National Park Service Contract CX 0001-2-0034. Denver, CO.

Wiedemann, A.M. 1984. The ecology of Pacific Northwest coastal sand dunes: a community profile. FWS/OBS-84/04. US Fish and Wildlife Service. 130 p.

Wiedemann, A.M. 1990. The coastal parabola dune system at Sand Lake, Tillamook County, Oregon, USA. pp. 171-194. *In*: Proceedings of the Canadian Symposium on Coastal Sand Dunes.

Conservation Assessment

for

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

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

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M. Stein

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SUMMARY

Preface: Since the transmittal of the Management Recommendations in 2000, new information has been collected regarding the range and habitat of *Erioderma sorediatum* and is presented herein.

Species: *Erioderma sorediatum* D.J. Galloway & P.M. Jørg.
Taxonomic Group: Lichen
Other Management Status: Forest Service Region 6 Sensitive Species. 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, considered imperiled in the State because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation. The Oregon Natural Heritage Information Center (ORNHIC) ranks the species as Heritage List 2, described as threatened, endangered or presumed extinct from Oregon but more common or stable elsewhere.

Range: *Erioderma sorediatum* is paleotropical in distribution, also occurring in New Zealand and North America, where it is known from southeast Alaska through British Columbia, Washington, and Oregon. *E.sorediatum* is rare in the Pacific Northwest, known from five sites in Washington and nine in Oregon.

Specific Habitat: *Erioderma sorediatum* occurs in the coastal fog zone, and one site in a young, riparian red alder stand about ten miles from the coast. In Oregon, it is most typically found in coastal stabilized dune forests of Sitka spruce and shore pine and interspersed willow/wax myrtle or ericaceous shrub thickets. It is epiphytic on huckleberry, rhododendron, *Arctostaphylos*, and western hemlock.

Threats: The major threat to *Erioderma sorediatum* 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.

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 sorediatum 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 sorediatum*, another rare oceanic Survey and Manage lichen, but *Erioderma sorediatum* can be distinguished by the erect tomentum on its upper surface and its PD+ orange reaction (eriodermin) (Tønsberg pers. comm.). It can also be superficially confused with diminutive *Peltigera collina*, but *E. sorediatum* lacks veins below (McCune and Geiser 1997).

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 sorediatum 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 sorediatum*. *E. sorediatum* is a nitrogen-fixing species, providing a small amount of usable nitrogen to the ecosystems it inhabits. Like other nitrogen-fixing species it is likely to be sensitive to air quality, though its specific sensitivity is unknown.

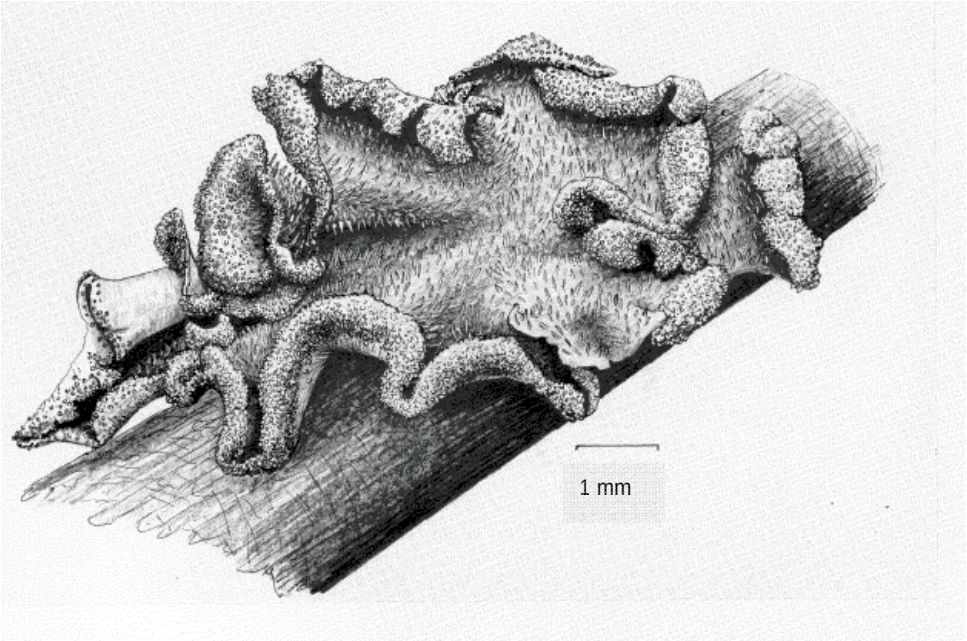

Figure 4. Line drawing of *Erioderma sorediatum* by Alexander Mikulin.

C. Range and Sites

Erioderma sorediatum 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 (Glavich *et al.* 2004). In Washington, *E. sorediatum* it is known from three sites on the Olympic Peninsula in Clallam and Jefferson Counties as well as two sites at Leadbetter Point in Pacific County. The nine known Oregon sites occur along the coast from Tillamook County south to Coos County and include Sutton Creek Recreation Area, Siuslaw National Forest; Clear Lake (McCune *et al.* 1997); BLM Heceta Dunes Area of Critical Environmental Concern; and a site at T.18 R.12 Section 35 on land of unknown ownership in Lane County; Lower Canal Creek, Siuslaw National Forest; T13S R11E Section 2, Siuslaw National Forest in Lincoln County; Coos Bay north of North Bend, Siuslaw National Forest in Coos County; and Eel Creek Recreation Area, Siuslaw National Forest in Douglas County (McCune *et al.* 1997).

Selected specimen records (Glavich *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

In Oregon, *Erioderma sorediatum* is found in the coastal fog zone, in broken shore pine (*Pinus contorta*) and Sitka spruce (*Picea sitchensis*) forests interspersed with willow/wax myrtle (*Salix/Myrica gale*) or ericaceous shrub thickets covering an old system of dune ridges and swales (McCune *et al.* 1997). It is epiphytic on huckleberry (*Vaccinium spp.*), rhododendron (*Rhododendron macrophyllum*), manzanita (*Arctostaphylos spp.)*, and western hemlock (*Tsuga heterophylla*). In Washington, the one inland site in the Hoh River Valley occurs on the bark of young red alder (*Alnus rubra*) in a riparian area, about 16 km (10 mi) from the coast. This site had an abundance of the cyanolichen *Lobaria oregana*, which is uncommon in young alder stands. The alder stand was next to a large clear-cut, a bridge and a road, and was probably disturbed during road and bridge building (Tønsberg, pers. comm.).

II. CURRENT SPECIES SITUATION

A. Status History

Erioderma sorediatum 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 2000 SEIS, it was removed from Survey and Manage because information indicated it was not closely associated with late-successional and old growth forest (USDA and USDI 2001). 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 species programs: in 2004, *E. sorediatum* was designated a Sensitive Species for the Forest Service Region 6.

From NatureServe, *Erioderma sorediatum* 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 S2 in Oregon, considered imperiled in the State because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the State (ORNHIC 2004). The species is on the ORNHIC List 2, described as threatened, endangered or presumed extinct from Oregon but more common or stable elsewhere.

B. Major Habitat and Viability Considerations

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

C. Threats to the Species

Threats to *Erioderma sorediatum* 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 from vehicle exhaust and burning. 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.

D. Distribution Relative to Land Allocations

Erioderma sorediatum occurs at two sites within Olympic National Park that are Congressionally reserved, in an Area of Critical Environmental Concern on Salem District, BLM that is administratively withdrawn and on the Siuslaw National Forest within the Oregon Dunes National Recreation Area, also administratively withdrawn. The remainder of the sites located in Washington and Oregon are within the State Parks system with a single site on private land.

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. Conservation is defined as the use of all methods and procedures that are necessary to improve the condition of SSS and their habitats to a point where their Special Status recognitions no longer warranted. 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

- Revisit sites to verify the status of the species, determine the extent of the populations and abundance, and better characterize ecological conditions.
- Determine if *Erioderma sorediatum* occurs in areas identified as potentially suitable habitat. Potentially suitable habitat is identified as foggy coastal deflation dune systems with scattered old Sitka spruce and lodgepole pine forests and ericaceous shrub thickets. Areas with potential suitable habitat include Gwynn Creek Recreation Area and Sand Lake, Siuslaw National Forest; and BLM parcels adjacent to Cape Lookout, and other coastal BLM parcels. Coastally influenced riparian alder stands could also be potentially suitable habitat.
- Report documented sites to ORNHIC 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 Forest Service Region 6 Sensitive Species Specialist in the Regional Office.
- Report sitings and survey work in NRIS.

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?

C. Monitoring Opportunities and Recommendations

Monitor the effects of recreational activities on populations of *Erioderma sorediatum* in species habitat areas.

REFERENCES

Geiser, L.H., K.L. Dillman, C.C. Derr, and M.C. Stensvold. 1998. Lichens and allied fungi of southeast Alaska. pp. 201-243. *In*: M.G. Glenn, R.C. Harris, T. Dirig and M.S. Cole (eds.). *Lichenographia Thomsoniana:* North American Lichenology in Honor of John W. Thomson. Mycotaxon Ltd., Ithaca, NY. 445 p.

Geiser, L., C.C. Derr, and K.L. Dillman. 1994. Air quality monitoring on the Tongass National Forest: Methods and baselines using lichens. R10-TB-46. USDA Forest Service, Alaska Region. 84 p.

Glavich, D., L.H. Geiser and A.G. Mikulin. 2004. Distribution of some rare coastal lichens in Washington, Oregon and northern California, USA and their association with late-seral federally protected forests. Manuscript submitted for publication in Evansia.

Galloway, D.J. and P.M. Jørgensen. 1975. *Erioderma sorediatum*, a new lichen from New Zealand. Lichenologist 7:139-142.

McCune, B. and L. Geiser. 1997. Macrolichens of the Pacific Northwest. Oregon State University Press, Corvallis, OR. 386 p.

McCune, B., R. Rosentreter, and A. DeBolt. 1997. Biogeography of rare lichens from the coast of Oregon. pp. 234-241. *In*: T.N. Kaye, A. Liston, R.M. Love, D.L. Luoma, R.J. Meinke and M.V. Wilson (eds.). Conservation and Management of Native Plants and Fungi. Native Plant Society of Oregon, Corvallis, OR . 296 p.

ORNHIC. 2004. Oregon Natural Heritage Information Center. http://oregonstate.edu.ornhic/

Rhoades, F.M. 1988. Re-examination of baseline plots to determine effects of air quality on lichens and bryophytes in Olympic National Park. Northrop Environmental Sciences NPS Contract CX-0001-4-0057. National Park Service Air Quality Division.

Ryan, B. and F. Rhoades. 1992. Lichens, bryophytes and air quality in Pacific Northwest wilderness areas. *In*: J. Peterson, D. Schmoldt, D. Peterson, J. Eilers, R. Fisher, and R. Bachman. Guidelines for Evaluating Air Pollution Impacts on Class 1 Wilderness Areas in the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-299. USDA Forest Service, Pacific Northwest Research Station. Portland, OR. 83 p.

Seaward, M.R.D. 1977. Lichen Ecology. Academic Press, London. 550 p.

Tønsberg, T. 1997. Personal communication. Botanical Institute, University of Bergen, Norway.

USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Portland, OR.

USDA Forest Service and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl, Appendix J2: Results of Additional Species Analysis. Portland, OR. 476 p.

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

USDI Bureau of Land Management. 1998. Bureau Special Status Species Policy (6840) and Oregon/Washington Special Status Species List, Internal Memorandum OR-98-342, August 28, 1998, including attachments.

Conservation Assessment

for

Heterodermia leucomelos Hedw.

Originally issued
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SUMMARY

Preface: Since the transmittal of the Management Recommendations in 1996, new site information has been collected for *Heterodermia leucomelos* and is presented herein.

Species: *Heterodermia leucomelos* Hedw**.**
Taxonomic Group: Lichen
Other Management Status: Forest Service Region 6 Sensitive Species; Bureau of Land Management (BLM) Bureau Sensitive for California. From NatureServe, the species has a Global Heritage Rank of G2/G3, described as imperiled (G2) at high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors or vulnerable (G3), at moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors. The State Heritage Rank is S2 in Oregon, considered imperiled in the State because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the State. The Oregon Natural Heritage Information Center (ORNHIC) ranks the species Heritage List 2, described as threatened, endangered or presumed extinct from Oregon but more common or stable elsewhere

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 (Goward *et al.* 1994), Washington (Glavich *et al.* 2004) Oregon, and California. In Washington, there is one site in Pacific County. Eight Oregon sites occur in Tillamook, Lane, Coos, and Curry counties. The eight California sites occur in Humboldt, Sonoma and Marin counties.

Specific Habitat: *Heterodermia leucomelos* appears to be strictly coastal in Washington, Oregon, and California. In Oregon, it occurs on windswept, forested headlands on large Sitka spruce and possibly shore pine. In California, it grows from sea level to 480 m (1575 ft) in moist coastal redwood forests, in open, low coastal scrub, and in dry, open, savanna-like oak woodlands. Some of these woodlands may be influenced by coastal fog. The species is typically epiphytic but occasionally grows on rocks. In hyper-maritime localities of British Columbia, it is infrequent over conifers.

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 parks 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. 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 is often apotheciate.

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*. This species is used as nesting material by bushtits.

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 (Goward *et al.* 1994), Washington, Oregon, and California. In Washington, this species is known from one site in Pacific County (Glavich *et al.* 2004). Eight Oregon sites occur in Tillamook, Lane, Coos, and Curry counties. California sites are known from eight locations in Humboldt, Sonoma, and Marin counties.

Selected specimen records (Glavich *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).

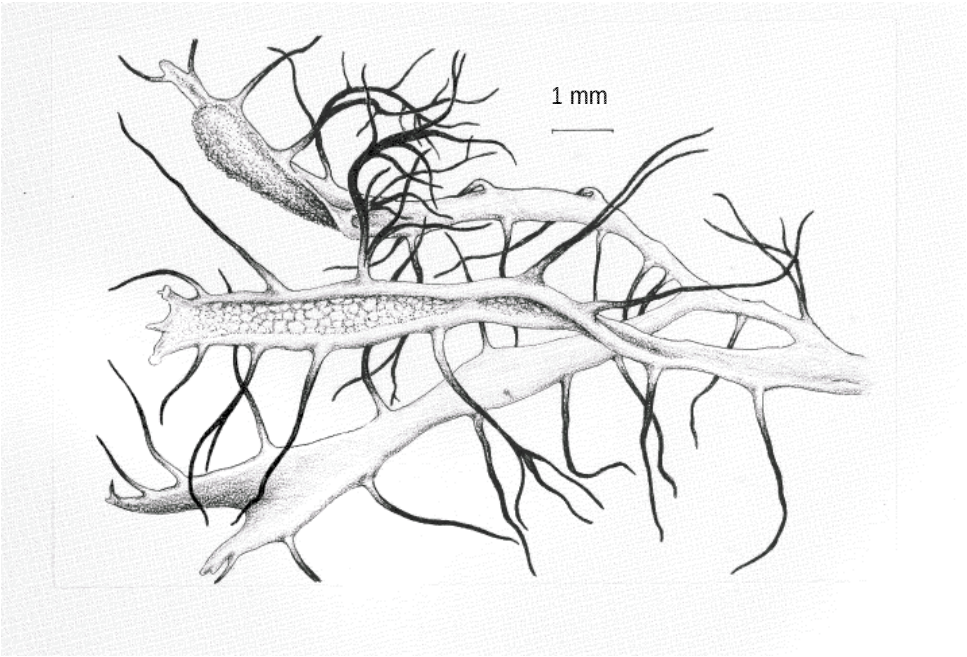

Figure 5. Line drawing of *Heterodermia leucomelos* by Alexander Mikulin.

D. Habitat Characteristics and Species Abundance

In Oregon, *Heterodermia leucomelos* grows on small branches of Sitka spruce (*Picea sitchensis*) on forested headlands in the coastal fog zone, and it may grow on shore pine (*Pinus contorta*) in this habitat. In California, it grows on the trunks and branches of Sitka spruce, on oaks (*Quercus* spp.) and other broad-leaved trees and shrubs, and occasionally on rocks, from sea level to 480 meters (1575 ft.). It was also found incorporated into a bushtit nest. The species is found in several California habitats, including moist, coastal redwood forests; open, low coastal scrub; and dry, open, savanna-like valley and foothill woodlands dominated by California oak species (Hale and Cole 1988). In British Columbia, it is infrequent on conifers in open hyper-maritime localities (Goward *et al.* 1994). In Europe, where it is rare, local, and declining, *H. leucomelos* is found on mossy rocks or moss-lichen turf on sunny, exposed, coastal cliffs, and rarely on trunks and branches of wayside, broad-leaved trees (Purvis *et al.* 1992). Species abundance is unknown.

In northwest North America, *Heterodermia leucomelos* appears to be rare and confined to coastal habitat. This species might also be found at inland sites with coastal influences or conditions, such as riparian areas, moist valleys, and fog-intercept ridges.

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 2000 SEIS, it was removed from Survey and Manage because information indicated it was not closely associated with late-successional and old growth forest (USDA and USDI 2001). In 2004, *H. leucomelos* was designated a Sensitive Species for Forest Service Region 6 and Bureau Sensitive for the BLM in California.

From NatureServe, *Heterodermia leucomelos* has a Global Heritage Rank of G2/G3, described as imperiled (G2) at high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors or vulnerable (G3), at moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors. The State Heritage Rank for Oregon is S2, considered imperiled in the State because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the State (ORNHIC 2004). The species is on the ORNHIC List 2, described as threatened, endangered or presumed extinct from Oregon but more common or stable elsewhere.

B. Major Habitat and Viability Considerations

The major viability consideration for *Heterodermia leucomelos* is loss of populations resulting from management 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.

D. Distribution Relative to Land Allocations

Heterodermia leucomelos occurs on federal lands in Oregon and California. Oregon sites include an administratively withdrawn site at Oregon Dunes National Recreation Area, a Salem District BLM site at the Yaquina Head Outstanding Natural Area, in a Congressionally reserved allocation, a site at Sutton Creek on the Suislaw National Forest that is administratively withdrawn, as well as two other sites on the Suislaw National Forest of unknown land use allocation. In California, a single site each occurs in the Humboldt Lagoons National Wildlife Refuge in an unknown allocation, a BLM parcel on the Samoa Peninsula in Humboldt County that is administratively withdrawn, a site in Golden Gate National Recreation Area in Marin County of unknown allocation and a Congressionally reserved site in Redwood National Park. The majority of the remaining sites in Washington, Oregon and California are located 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. Conservation is defined as the use of all methods and procedures that are necessary to improve the condition of SSS and their habitats to a point where their Special Status recognitions no longer warranted. 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.

- Revisit sites to verify the status of known populations, determine the extent of the populations and abundance, and to characterize habitat conditions.
- Determine the land ownership of the population on the Samoa Peninsula.
- Report documented sites to ORNHIC 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/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?

C. Monitoring Opportunities and Recommendations

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

REFERENCES

Esseen, P. 1996. Epiphytic lichen biomass in managed and old-growth boreal forests: effects of branch quality. Ecological Applications 6:228-238.

Glavich, D., L.H. Geiser, and A.G. Mikulin. 2004. Distribution of some rare coastal lichens in Washington, Oregon and northern California, USA and their association with late-seral federally protected forests. Manuscript submitted for publication in Evansia.

Goward, T., B. McCune, and D. Meidinger. 1994. The lichens of British Columbia. Part 1. Foliose and Squamulose Species. Ministry of Forests Research Program, Victoria, BC 181 p.

Hale, M.E. Jr. and M. Cole. 1988. Lichens of California. California Natural History Guides: 54. University of California Press, Berkeley. 254 p.

ORNHIC. 2004. Oregon Natural Heritage Information Center. http://oregonstate.edu.ornhic/

Purvis, O.W., B.J. Coppins, D.L. Hawksworth, P.W. James, and D.M. Moore (eds.). 1992. The Lichen Flora of Great Britain and Ireland. Natural History Museum Publications and The British Lichen Society, London. 710 p.

USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Portland, OR.

USDA Forest Service, and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl, Appendix J2, Results of Additional Species Analysis. Portland, OR.

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

Conservation Assessment

for

Kaernefeltia californica (Tuck.) Thell & Goward

[formerly *Cetraria californica* Tuck.]

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

Reconfigured June, 2004
M. Stein

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SUMMARY

Preface: Since the transmittal of the Management Recommendations in 200, additional range information has been collected for *Kaernefeltia californica* and is included in this document.

Species: *Kaernefeltia californica* (Tuck.) Thell & Goward [formerly *Cetraria californica* Tuck.]
Taxonomic Group: Lichen
Other Management Status: Bureau of Land Management (BLM) Bureau Sensitive for California. From NatureServe, *Kaernefeltia californica* has a Global Heritage Rank of G3, described as vulnerable, at moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors. The State Heritage Rank for Oregon is S3, considered vulnerable in the State (ORNHIC 2004). The species is not on any Oregon Natural Heritage Information Center (ORNHIC) List.

Range: *Kaernefeltia californica* is endemic to the Pacific coast of North America. It occurs in a scattered distribution along a narrow coastal band from southeast Alaska to Baja California, Mexico.

Specific Habitat: *Kaernefeltia californica* appears to be strictly coastal in most of its range. *K. californica* grows on the bark, twigs, or cones of open grown conifers, especially bishop and shore pine, and on rock outcrops, wooden fence posts, and other wooden structures. Although it is found mostly at sea level or very low elevations, it has been reported from 1524 m (5000 ft) on the Hurricane Ridge Trail, Olympic National Park, and 40 miles inland near Selma, Oregon. These populations are probably *K. merrillii*, but need to be confirmed.

Threats: The major threat to *Kaernefeltia californica* is loss of populations resulting from activities that impact the population or its habitat, including altering the microclimate and removing colonized substrate. These activities would most likely be recreation-related (ex. building trails and shelters); collecting firewood; and bicycle, off-road vehicle, and foot traffic. The species is vulnerable to loss of habitat resulting from increasing building and clearing along the coast.

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.

Data and Information Gaps:

- Verify the status of known populations and characterize the habitat.
- Check collections of *Kaernefeltia californica* and *K. merrillii* to confirm identification of these often confused species.
- Locate additional populations of *Kaernefeltia californica* in potentially suitable habitat on federal land along the immediate coast in Washington, Oregon and California.

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Kaernefeltia californica (Tuck.) Thell & Goward (Thell and Goward 1996) was originally described as *Cetraria californica* Tuck., and was referred to by this name in the Forest Ecosystem Management Assessment Team report (USDA and USDI 1994a) and subsequent documents (USDA and USDI 1994b, 1994c).

Synonyms: *Cetraria californica*
Tuckermannopsis californica
Cornicularia californica
Coelocaulon californicum
C. cetrariza
Alectoria californica
A. cetrariza

B. Species Description

1. Morphology and Chemistry

This small (generally <2 (3) cm diameter) tufted, fruticose lichen is roundish to irregular in cross-section and varies from pale olive brown to olive black. Soredia and isidia are lacking but it has some short pointed branches that may appear isidia-like (Figure 1). Apothecia are fairly common. This species is frequently confused with *Kaernefeltia merrillii* (formerly *Cetraria merrillii*) and *Nodobryoria abbreviata* (formerly *Bryoria abbreviata*), but is easily distinguished from these species in both habitat and form because neither of them are reported from oceanside forests (McCune and Geiser 1997; Thell and Goward 1996). *K. californica* is typically richly fertile, usually pale brownish, and has rather knobby branches often lightly covered with whitish pruina, while *K. merrillii* usually is sparsely fertile, has flatter, darker (greenish black) moderately smooth lobes lacking any trace of pruina (Thell and Goward 1996). Also, a sectioned epithecium of *K. californica* stains K+ purple and *K. merrillii* is K- (McCune, pers. comm.). *Nodobryoria abbreviata* is reddish brown and usually has terminal apothecia that are often marginally ciliate (McCune and Geiser 1997).

Technical Description: Thallus fruticose, up to 1.5 cm high, tufted or decumbent, gray or grayish- brown or pale to dark olive-brown, always paler in central parts; lobes rounded-angular to flattened in transverse section, to 1.0 (1.5) mm wide, frequently ridged and knobby, in part covered in whitish pruina; pseudocyphellae occasional, more or less distinct, immersed; cilia occasionally present, barely separate from smaller side lobes; isidia absent; rhizines absent; cortex usually 2-layered. Apothecia frequent, terminal, subterminal, or lateral, disc to 3 mm in diameter, dark brown or blackish, at first concave, later becoming convex. Photobiont is a green alga (Thell and Goward 1996).

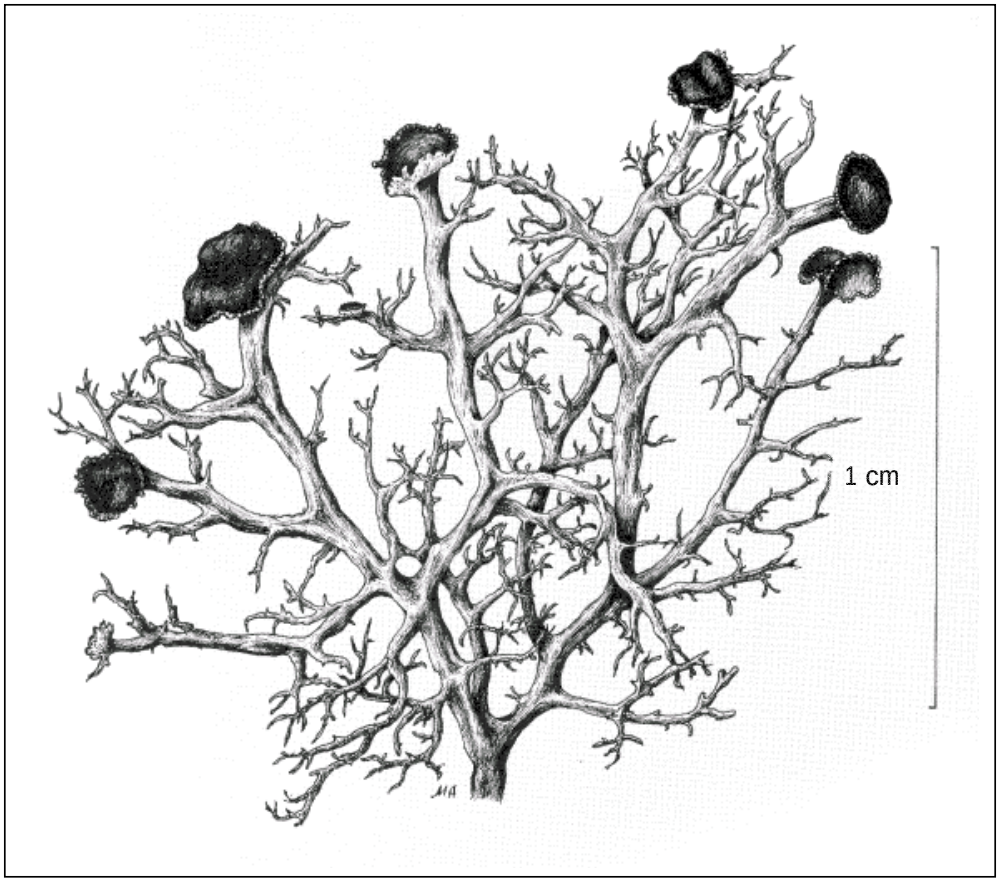

Figure 6. Line drawing of *Kaernfeltia californica* by Alexander Mikulin.

2. Reproductive Biology

Kaernfeltia californica reproduces sexually by producing fungal spores in apothecia. True vegetative reproductive structures (i.e., soredia and isidia) are unknown, but given the brittle nature of the thallus and its tiny branches, this species may also reproduce through fragmentation.

3. Ecological Roles

This uncommon hyper-maritime species is apparently confined to western North America at low elevations along the Pacific Ocean (Thell and Goward 1996), suggesting a narrow ecological amplitude. Specific ecological roles and interactions are unknown, although it occurs with other rare Survey and Manage lichen species.

C. Range and Sites

The global range of *Kaernfeltia californica* is restricted to the Pacific coast of North America, from southeast Alaska (Geiser *et al.* 1998) to Baja California (Thell and Goward 1996, Arizona State University 2004). It is known from 43 sites: four in Washington, 28 in Oregon, and 11 in California. In Washington, it is known from Clallam and Grays Harbor counties; in Oregon, from Tillamook, Lane, Linn, Lincoln, Douglas, Josephine, Curry, and Coos counties; and in California from Humboldt, Mendocino, Lake, San Mateo, Monterey, San Luis Obispo, Ventura, Santa Barbara and Los Angeles Counties.

In California, *Kaernfeltia californica* occurs at Patrick's Point State Park, Humboldt Bay National Wildlife Refuge, Lanphere Dunes Unit, at several sites in the pygmy forest habitat near Mendocino, and a number of islands including Santa Rosa, Santa Catalina, Santa Cruz, San Nicolas, San Miguel and Anacapa. In Oregon, it occurs near Lincoln City; near Cape Lookout and Cape Sebastian State Parks; in or near South Beach State Park; in the BLM Heceta Dunes Area of Critical Environmental Concern (ACEC), North Fork Hunters Creek ACEC, and New River ACEC; on the Siuslaw National Forest at Heceta Beach, Sutton Creek, Bluebird Campground, near North Bend, at Horsefall Dunes, Clear Lake; and at several sites in the Oregon Dunes National Recreation Area. Two inland collections near Cave Junction and Selma, Oregon, should be verified, as they may be *K. merrillii*. About 10 of these sites are on federally managed lands, mainly on the Siuslaw National Forest and Heceta Dunes BLM land. Most of these sites need to have land ownership determined or verified. In Washington, it is found in Olympic National Park, Westport Lighthouse State Park, and land near Grays Harbor of unknown ownership

D. Habitat Characteristics and Species Abundance

Kaernfeltia californica appears to be strictly coastal over most of its range (Thell and Goward 1996), mostly at sea level or very low elevations. *K. californica* tends to grow on bark, twigs, or cones, of open grown conifers especially bishop pine (*Pinus muricata*) and shore pine (*Pinus contorta*), and on rock outcrops, wooden fence posts and other structures. Although it has been reported from 1524 m (5000 ft) on the Hurricane Ridge Trail, Olympic National Park, and at 365 m (1200 ft) about 40 miles inland on the Siskiyou National Forest near Selma, vouchers from these two inland sites should be reexamined to confirm they are not .K. *merrillii*. *K. californica* can be locally abundant at some sites, although it is considered rare throughout its range (Thell and Goward 1996).

II. CURRENT SPECIES SITUATION

A. Status History

Kaernfeltia californica was considered at risk under the Northwest Forest Plan because of its rarity and limited distribution in the range of the northern spotted owl (USDA and USDI 1994a, 1994b). With the completion of the 2000 SEIS, it was removed from Survey and Manage because information indicated it was not closely associated with late-successional and old growth

forest (USDA and USDI 2001). In 2004, *K. californica* was designated as Bureau Sensitive for the BLM in California.

From NatureServe, *Kaernfeltia californica* has a Global Heritage Rank of G3, described as vulnerable, at moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors. The State Heritage Rank for Oregon is S3, considered vulnerable in the State (ORNHIC 2004). The species is not on any ORNHIC list.

B. Major Habitat and Viability Considerations

The major viability consideration for *Kaernfeltia californica* is the loss of populations resulting from management activities that impact the habitat or the populations.

C. Threats to the Species

Threats to *Kaernfeltia californica* 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 would most likely be activities related to recreation (ex. building trails and shelters); collecting firewood; and off-trail bicycle, off-road vehicle and foot traffic. It is vulnerable to loss of habitat due to increasing construction and clearing along the coast.

D. Distribution Relative to Land Allocations

In California, one site from Humboldt Bay National Wildlife Refuge occurs on federal land in an unknown land allocation. Other California sites need to have land ownership and land allocations verified. Several Oregon populations are in BLM Areas of Critical Environmental Concern and in the Oregon Dunes National Recreation Area in administratively withdrawn allocations.

III. MANAGEMENT GOALS AND OBJECTIVES

Management for this species follows BLM California Special Status Species (SSS) policy (6840).

IV. HABITAT MANAGEMENT

A. Lessons From History

No specific lessons from history about *Kaernfeltia californica* have been identified.

B. Identifying Species Habitat Areas

All sites of *Kaernfeltia californica* on federal lands administered by the the BLM in California 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:

- Maintain ecological conditions associated with *Kaernfeltia californica* including forest structure, substrate, and microclimatic conditions.
- Restrict firewood collection in the species habitat area.
- Restrict collecting voucher specimens unless they are found in litterfall.
- Restrict off-road vehicle and bicycle traffic in coastal ericaceous shrub habitats without trails.
- Minimize the 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 of 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

- Reexamine inland collections of *Kaernfeltia californica* to confirm identifications
- Determine distribution of *Kaernfeltia californica* in areas identified as potentially suitable habitat. There are several other federally managed parcels of coastal fog zone habitat with populations of other rare oceanic lichens with similar habitat requirements. They are Gwynn Creek, Sand Lake, and Eel Creek (Siuslaw National Forest, Oregon Dunes National Recreation Area); BLM Heceta Dunes ACEC; a small BLM parcel near Cape Lookout State Park; and other coastal BLM parcels.
- Identify which areas provide the most optimal *Kaernfeltia californica* habitat, as suggested by an abundance of the species.

- Report changes in documented and suspected status as quickly as possible to the BLM California Special Status Species Specialist in the State Office.

B. Research Questions

- What are the dispersal rates and mechanisms of *Kaernfeltia californica*?
- Which habitat characteristics and ecological conditions are necessary for survival of *Kaernfeltia californica* propagules?
- What limits dispersal and establishment of propagules and colonization of suitable *Kaernfeltia californica* habitat?
- Is *Kaernfeltia californica* sensitive to air pollution?
- Which other rare lichens occur with *Kaernfeltia californica*?
- Do refugial populations disperse into managed stands?

C. Monitoring Opportunities and Recommendations

No monitoring opportunities are identified at this time.

REFERENCES

Arizona State University. 2004. Database search of the lichen herbarium records. http://seinet.asu.edu/collections/selection.jsp

Geiser, L.H., K.L. Dillman, C.C. Derr, and M.C. Stensvold. 1998. Lichens and allied fungi of southeast Alaska. pp. 201-243. *In*: M.G. Glenn, R.C. Harris, T. Dirig and M.S. Cole (eds). *Lichenographia Thomsoniana*: North American Lichenology in Honor of John W. Thomson. Mycotaxon Ltd., Ithaca, NY. 445 p.

McCune, B. Personal communication. Oregon State University, Corvallis.

McCune, B. and L. Geiser. 1997. Macrolichens of the Pacific Northwest. Oregon State University Press. Corvallis, OR. 386 p.

ORNHIC. 2004. Oregon Natural Heritage Information Center. http://oregonstate.edu.ornhic/

Thell, A. and T. Goward. 1996. The new Cetrarioid genus *Kaernefeltia* and related groups in the Parmeliaceae (Lichenized Ascomycotina). The Bryologist 99(2):125-136.

USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Impact Statement on Management of Habitat for Late-successional and Old-growth forest Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecologic, Economic, and Social Assessment. Portland, OR.

USDA Forest Service and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl, Appendix J2, Results of Additional Species Analysis. Portland, OR.

USDA Forest Service and USDI Bureau of Land Management. 1994c. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents and Standards and Guidelines for Management of Habitat for Late-successional and Old-growth Forest Related Species within the Range of the Northern Spotted Owl. Portland, OR.

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

Conservation Assessment

for

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

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as Management Recommendations
March, 2000
Chiska Derr, Author

Reconfigured June, 2004
M. Stein

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SUMMARY

Preface: Since the transmittal of the Management Recommendations in 2000, additional sites have been recorded for *Leioderma sorediatum* and are included in this Assessment.

Species: *Leioderma sorediatum* D.J. Galloway & P.M. Jørg.
Taxonomic Group: Lichen
Other Management Status: Forest Service Region 6 Sensitive Species. 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 Natural Heritage Information Center (ORNHIC) ranks the species Heritage List 2, described as threatened, endangered or presumed extinct from Oregon but more common or stable elsewhere.

Range: *Leioderma sorediatum* is distributed from the Pacific coast of North and South America to Asia, Australia, and New Zealand. In North America, it is known from ten sites, five in Washington, four in Oregon and a single location on Vancouver Island, B.C., all within close proximity to the coast.

Specific Habitat: In northwest North America, *Leioderma sorediatum* is found in semi-open coastal thickets, most often in dune woodlands, deflation plains, and ericaceous shrub thickets. *L. sorediatum* 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 sorediatum* is a loss of populations resulting from activities that harm the population or impact its 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. 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.

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) (Tønsberg, pers. comm.). *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 1997).

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 1987:390).

2. Reproductive Biology

This species reproduces asexually by producing soredia that are distributed by wind, gravity, animals, or birds (McCune and Geiser 1997). Apothecia are very rare in *Leioderma sorediatum* (Galloway and Jørgensen 1987), so 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. *L.sorediatum* is a nitrogen-fixing species, providing a small amount of usable nitrogen to the ecosystems it inhabits.

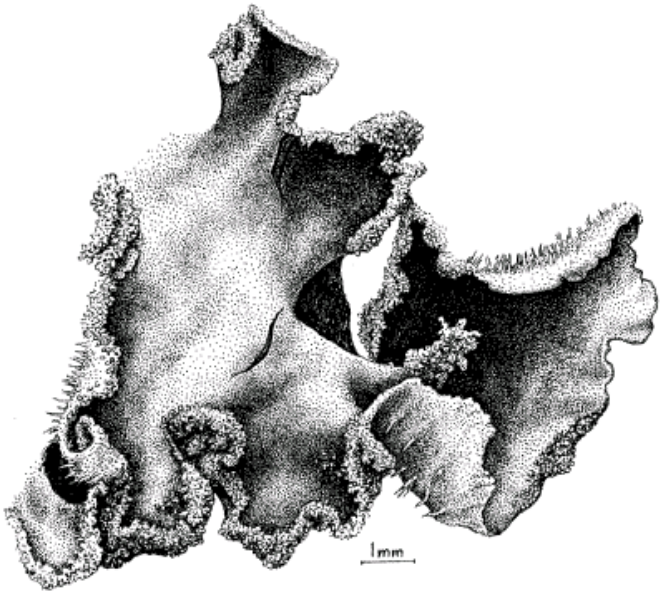

Figure 7. Line drawing of *Leioderma sorediatum* by Alexander Mikulin.

C. Range and Sites

Leioderma sorediatum 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). *L. sorediatum* is known from ten localities in North America. Oregon sites include Sutton Creek Recreation Area in Lane County; Eel Creek Recreation Area and Clear Lake in Douglas County; and South Beach State Park in Lincoln County. Washington sites include Hoh River Road, Olympic Peninsula in Jefferson County (Tønsberg, pers. comm.); Point of Arches, Dungeness National Wildlife Refuge and James Lake, Clallam County; and Leadbetter State Park in Pacific County. There is one site on Vancouver Island, British Columbia (Goward *et al.* 1994).

Selected specimen records (Glavich 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. Dungeness National Wildlife Refuge, *Mikulin 1300* (OSC), Olympic National Seashore: James Lake, *Mikulin 1157* (OSC), Point of Arches vicinity, *Mikulin 1192* (OSC).

D. Habitat Characteristics and Species Abundance

Leioderma sorediatum is rare in North America. In Oregon, *L. sorediatum* is found in semi-open ericaceous shrub thickets of shore pine (*Pinus contorta*) and ericaceous shrubs (*Vaccinium* spp. and *Rhododendron macrophyllum*) on stabilized dunes and deflation plains (McCune *et al.* 1997). The Sutton Creek Recreation Area site is an open, old shore pine-shrub forest with little or no Sitka spruce (*Picea sitchensis*) in the canopy. *L. sorediatum* is epiphytic over thin bryophyte mats on the stems of the ericaceous shrubs. In Washington, it is found in a young riparian stand of red alder (*Alnus rubra*) surrounded by clearcuts, and was on the bole of a 10-cm-dbh alder. This site was unusual in that the cyanolichen *Lobaria oregana* was abundant in a young stand (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. sorediatum* 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). In parts of its range, it is best developed on disturbed sites, such as edges of secondary forests and road margins (McCune *et al.* 1997)

II. CURRENT SPECIES SITUATION

A. Status History

Leioderma sorediatum 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 2000 SEIS, it was removed from Survey and Manage because information indicated it was not closely associated with late-successional and old growth forest (USDA and USDI 2001). In 2004, *L. sorediatum* was designated a Sensitive species for Forest Service Region 6 in Washington and Oregon.

From NatureServe, *Leioderma sorediatum* 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). ORNHIC has put this species on List 2, described as threatened, endangered or presumed extinct from Oregon but more common or stable elsewhere.

B. Major Habitat and Viability Considerations

The major viability consideration for *Leioderma sorediatum* in Oregon and Washington is the loss of populations due to management activities that harm populations or their habitat. Because of the limited extent of Oregon coastal dune habitat, the tendency of other rare oceanic lichens to be found in this habitat, the rarity of this species in North America, and land 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 sorediatum* 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. sorediatum* 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.

D. Distribution Relative to Land Allocations

Leioderma sorediatum occurs on federal lands in Washington and Oregon. Oregon sites include three locations on the Oregon Dunes National Recreation Area that are administratively withdrawn. Sites on federal land in Washington include two in Olympic National Park, that are Congressionally reserved and one in the Dungeness National Wildlife Refuge in an unknown land allocation.

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. Conservation is defined as the use of all methods and procedures that are necessary to improve the condition of SSS and their habitats to a point where their Special Status recognitions no longer warranted. 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 sorediatum*. 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). *L .sorediatum* habitat is at risk because of coastal development along the Oregon dunes.

B. Identifying Species Habitat Areas

All sites of *Leioderma 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:

- 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 sorediatum* 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 ORNHIC 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 sorediatum*?
- Which habitat characteristics and ecological conditions are necessary for survival of *Leioderma sorediatum* propagules?
- What limits dispersal and establishment of propagules and colonization of suitable *Leioderma sorediatum* habitat?
- Is *Leioderma sorediatum* sensitive to air pollution?
- Which suites of other rare lichens occur with *Leioderma sorediatum*?
- How do populations of *Leioderma sorediatum* respond to successional changes and associated changes in microclimate?
-

C. Monitoring Opportunities and Recommendations

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

REFERENCES

Galloway, D.J. and P.M. Jørgensen. 1987. Studies in the lichen family Pannariaceae II. The genus *Leioderma* Nyl. Lichenologist 19:345-400.

Geiser, L.H., C.C. Derr, and K.L. Dillman. 1994. Air quality monitoring on the Tongass National Forest: Methods and baselines using lichens. R10-TB-46. USDA Forest Service, Alaska Region. 84 p.

Glavich, D., L.H. Geiser, and A.G. Mikulin. 2004. Distribution of some rare coastal lichens in Washington, Oregon and northern California, USA and their association with late-seral federally protected forests. Manuscript submitted for publication in Evansia.

Goward, T., B. McCune, and D. Meidinger. 1994. Lichens of British Columbia. Part 1. Foliose and Squamulose Species. Ministry of Forests Research Program. Victoria, BC. 181 p.

McCune, B. and L. Geiser. 1997. Macrolichens of the Pacific Northwest. Oregon State University, Corvallis, OR. 386 p.

McCune, B., R. Rosentreter, and A. DeBolt. 1997. Biogeography of rare lichens from the coast of Oregon. pp. 234-241. *In*: T.N. Kaye, A. Liston, R.M. Love. D.L. Luoma, R.J. Meinke and M.V. Wilson (eds.). Conservation and Management of Native Plants and Fungi. Native Plant Society of Oregon, Corvallis, OR. 296 p.

ORNHIC. 2004. Oregon Natural Heritage Information Center. http://oregonstate.edu.ornhic/

Rhoades, F.M. 1988. Re-examination of baseline plots to determine effects of air quality on lichens and bryophytes in Olympic National Park. Northrop Environmental Sciences, NPS Contract CX-0001-4-0057. National Park Service Air Quality Division.

Ryan, B. and F. Rhoades. 1992. Lichens, bryophytes and air quality in Pacific Northwest wilderness areas. *In*: J. Peterson, D. Schmoldt, D. Peterson, J. Eilers, R. Fisher, and R. Bachman. Guidelines for Evaluating Air Pollution Impacts on Class 1 Wilderness Areas in the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-299. USDA Forest Service, Pacific Northwest Research Station, Portland, OR.

Seaward, M.R.D. 1977. Lichen Ecology. Academic Press, London. 550 p.

Tønsberg, T. 1997. Personal communication. Botanical Institute, University of Bergen, Bergen, Norway.

USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Portland, OR.

USDA Forest Service and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl, Appendix J2, Results of Additional Species Analysis. Portland, OR.

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

USDI Bureau of Land Management. 1998. Bureau Special Status Species Policy (6840) and Oregon/Washington Special Status Species List, Internal Memorandum OR-98-342, August 28, 1998, including attachments.

Conservation Assessment

for

Leptogium brebissonii Mont.

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

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M. Stein

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SUMMARY

Preface: Since the transmittal of the Management Recommendations in 2000, new site information has been collected for *Leptogium brebissonii* and is presented herein.

Species: *Leptogium brebissonii* Mont.
Taxonomic Group: Lichen
Other Management Status: Forest Service Region 6 Sensitive Species. From NatureServe, the species is ranked with a Global Heritage Rank of G5, described as common, widespread and abundant and Oregon State Heritage Rank of S2, described as imperiled in the State because of rarity due to very restricted range, very few population (often less than 20), steep declines in population, or other factors making it very vulnerable to extirpation from the State. The Oregon Natural Heritage Information Center (ORNHIC) ranks the species Heritage List 2, considered threatened, endangered or presumed extinct from Oregon but more common or stable elsewhere.

Range: *Leptogium brebissonii* has a broad global distribution; it is known from the western British Isles, western Ireland, western Europe, Macronesia, east Africa, New Zealand and northwest North America (Purvis *et al.* 1992). In the Pacific Northwest, *L. brebissonii* is known from nine sites in Washington along the coast in Clallam, Jefferson and Pacific Counties. The sixteen sites in Oregon are also restricted to the coast in Tillamook, Lincoln, Lane, Douglas and Coos Counties.

Specific Habitat: *Leptogium brebissonii* in Oregon and Washington is a strictly coastal species occurring on trees and woody shrubs from sea level to 600 m (2000 ft) elevation, within 16 km (10 mi) of the Pacific Coast. Known habitat conditions for *L. brebissonii* are coniferous and deciduous trees and shrubs in semi-exposed sites such as tree pockets on stabilized dunes, trees on the edge of dune forests, dune woodlands, wetland shrub mosaics, deciduous trees in riparian zones, and open forested stands on ridgetops. Known substrates are Sitka spruce, red alder, rhododendron, evergreen huckleberry, and Hooker's willow.

Threats: The main threats are activities that directly harm the populations, their habitat, or the habitat area 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.

Mangement 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 substrates.
- Restrict removal of trees, shrubs, or other vegetation from the species habitat area, 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 Nomenclature

Leptogium brebissonii Mont. was described in 1840. It is a lichenized fungus in the family Collemataceae, order Lecanorales, class Ascomycetes (Tehler 1996). Sierk (1964) included some material of *L. brebissonii* in *L. platynum* (Tuck.) Herre, but the latter species grows on soil and rock and does not occur in Washington or Oregon.

B. Species Description

1. Morphology and Chemistry

Leptogium brebissonii (Figure 1) belongs to a group of cyanobacteria-containing lichens known as gelatinous lichens. The cyanobacterial photobiont, *Nostoc*, is scattered throughout the heavily gelatinized thallus rather than in a distinct layer close to the upper surface (Sierk 1964). The medullary area is dark because little or no internal differentiation is present. When wet, *L. brebissonii* can easily be identified by the dark, swollen thallus and the indistinct, ridged lobes with marginal and laminal isidia. When dry, the lichen shrinks to an irregular, tufted, markedly ridged or wrinkled shape. The upper surface is dark green-black when wet, becoming gray-black when dry. The lower surface is similar but paler. Both surfaces lack tomentum. The lobes are partly fenestrate (having small holes). The isidia are fine granular to cylindrical and often arranged in lines along the ridges and lobe margins (Purvis *et al.* 1992, Goward *et al.* 1994b). Apothecia have not been observed in North American material (McCune *et al.* 1997b). This species is anomalous among the species of *Leptogium* found in the coastal Pacific Northwest in having a very thick, gelatinous thallus more reminiscent of *Collema* than of *Leptogium* (Goward *et al.* 1994a).

2. Reproductive Biology

Sexual reproductive structures are unknown for North American material. Instead, *Leptogium brebissonii* reproduces by the production and dispersal of isidia. Isidia are thalloid protrusions less than 1 mm in length, that break off at the base and have the potential to be dispersed long distances by wind or animals. Birds in particular can be important vectors, dispersing lichen propagules along the coastal migratory routes (McCune *et al.* 1997b).

3. Ecological Roles

Because the photobiont of *Leptogium brebissonii* is a cyanobacterium, this lichen is grouped functionally with other epiphytic nitrogen-fixing lichens. Containing up to 4 percent nitrogen dry weight, this group provides especially nutritious forage. Cyanolichens can also make significant contributions of fixed nitrogen to forest soils through leaching and decomposition of the thalli.

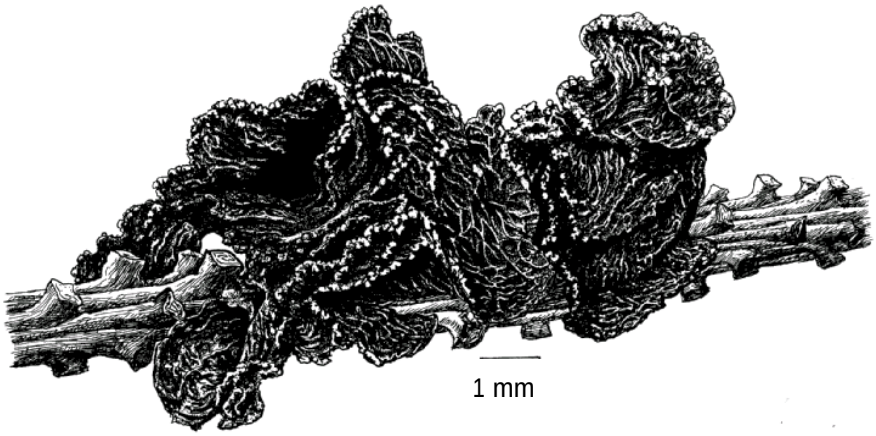

Figure 8. Line drawing of *Leptogium brebissonii* by Alexander Mikulin.

C. Range and Sites

Leptogium brebissonii has a broad global distribution; it is known from the western British Islands, western Ireland, western Europe, Macronesia, east Africa, and New Zealand (Purvis *et al.* 1992). The presence of *L. brebissonii* in North America was only recently recognized (Goward *et al.* 1994a). The known North American distribution consists of a single site in southeastern Alaska at Wrangell (Geiser *et al.* 1998), a few sites in coastal British Columbia in the Queen Charlotte Islands, and near Ucelot (Goward 1996), and scattered sites in Washington and Oregon.

In the Pacific Northwest, *Leptogium brebissonii* is known from nine sites from Washington along the coast in Clallam, Jefferson and Pacific Counties. The sixteen sites in Oregon are also restricted to the coast in Tillamook, Lincoln, Lane, Douglas and Coos Counties.

Selected specimen records (Glavich *et al.* 2004*)* – OREGON. Coos Co. Tugman State Park, *Mikulin 1058* (OSC). Douglas Co. Oregon Dunes National Recreation Area, Three mile Creek vicinity, *Mikulin 1066* (OSC); Umpqua Lighthouse State Park, *Mikulin 1013* (OSC). Lane Co. Siuslaw National Forest: Sutton Ck., *Mikulin 1143* (OSC), Heceta Head, *Mikulin 1075* (OSC), ridge above Cummins Ck., *Mikulin 1186* (OSC), Ten Mile Ck., *Ingersoll 955* (OSC). Lincoln Co. South Beach State Park, *Mikulin 1303*, Yaquina Head Natural Area, *Mikulin 1164* (OSC), Siuslaw National Forest, ridge above Cedar Ck, *Mikulin 1293* (OSC). Tillamook Co. Cape Lookout State Park, *Mikulin 1121* (OSC); Siuslaw National Forest: 1.6 km n of Cape Kiwanda.,

Mikulin 1083 (OSC), Neskowin Crest Research Natural Area, 1.3 km se of the mouth of Cliff Ck., *Mikulin 070696-1* (OSC), 2.5 km e of Neskowin, *Mikulin 1212* (OSC), Sand Lake vicinity, *Mikulin 1109* (OSC); Tillamook State Forest, se of Garibaldi, *Mikulin 1239* (OSC). WASHINGTON. Pacific Co. Fort Canby State Park, Cape Disappointment, *Mikulin 1158* (OSC); Leadbetter Point State Park, Leadbetter south trailhead, *Mikulin 1232* (OSC). Jefferson Co. Olympic National Park: Hoh Rainforest Campground, Hoh River valley, *Mikulin 1288* (OSC). Clallam Co. Olympic National Park: James Lake, *Mikulin 1193* (OSC), Point of Arches vicinity, *Mikulin 1202* (OSC), Rialto Beach, *Mikulin 1168* (OSC) Sand Point vicinity, *Mikulin 1302,* La Push, *Mikulin 1304* (OSC).

D. Habitat Characteristics and Species Abundance

This lichen is typically found in moist, semi-exposed habitats, close to the ocean, on trees or shrubs. Outside North America, it has also been found on mossy rocks. In British Columbia, it is thought to be closely associated with old-growth (Goward 1996). In the range of Northwest Forest Plan, because of sparse distribution and the diverse nature of known habitats, the degree to which it is associated with late-successional and old-growth forests is undetermined.

All known sites of *Leptogium brebissonii* are within 16 km (10 mi) of the coast, from sea-level to 600 m (2000 ft) elevation. Coastal fog may be an important habitat condition. It grows in semi-exposed conditions such as tree pockets on stabilized dunes, wetland shrubs, deciduous trees in riparian zones, and open-grown trees and partially thinned stands on ridgetops. Known substrates in the Pacific Northwest are Sitka spruce (*Picea sitchensis*), red alder (*Alnus rubra*), Pacific rhododendron (*Rhododendron macrophyllum*), huckleberry (*Vaccinium* spp.), and Hooker's willow (*Salix hookeriana*). In British Columbia and southeastern Alaska, *L. brebissonii* has been found on cascara (*Rhamnus purshiana*) and red alder in open, low elevation hypermaritime forests, and beach edges (Goward *et al.* 1994b, Geiser *et al.* 1998). In western Europe, it also occurs on mossy rocks (Purvis *et al.* 1992).

At the summit of Neahkahnie Mountain about 1 km (0.6 mi) from the ocean., *Leptogium brebissonii* was found on twigs at the top of a Sitka spruce on an exposed, rocky ridgetop with moss-covered basalt outcrops and pockets of Sitka spruce forest. At Nescowin Creek, it was found on twigs of Sitka spruce in a Sitka spruce/red alder forest. At the mouth of Cliff Creek in Cascade Head Experimental Forest, it was found on the bark of red alder in a young Sitka spruce/western hemlock (*Tsuga heterophylla*) forest. At the ridge crest above Cedar Creek, also on the Hebo District, it was found in a thinned western hemlock/salmonberry-salal (Tsuga heterophylla/*Rubus spectabilis-Gaultheria shallon*) forest of young and mature trees. In Carl Washburne Memorial State Park it was found on Sitka spruce at the forest edge. In Sutton Creek Recreation Area, *L. brebissonii* was found at a semi-exposed site on old rhododendron adjacent to the edge of an old Sitka spruce-shore pine evergreen huckleberry (*P.sitchensis-Pinus contorta/Vaccinium ovatum*) forest on stabilized dunes, and on evergreen huckleberry. At the Heceta Dunes sites it was found on Hooker's willow near vernal pool lowlands; on a willow branch in a shady thicket of the dune and inter-dune wetlands with broken Sitka spruce-shore pine/evergreen huckleberry forest and cyanolichen-rich willow and ericaceous shrub thickets; and in willow/sweet gale (*Salix* spp/*Myrica gale*) wetland thickets and open-grown conifers adjacent to thickets. At Eel Creek, it was found in a shore pine/*Arctostaphylos* woodland.

Physiologically, epiphytic cyanolichens are not considered tolerant of extreme swings in humidity or temperature. They are characteristically found in the wettest microsites: over moss at the bases of trees, or in the canopy on inner, protected branches of trees. Unlike many lichens with a green algal photobiont, cyanolichens must be fully hydrated to photosynthesize (Nash 1996). The availability of moderated microsites is an important factor in the high biomass of cyanolichens in riparian areas and many older forests west of the Cascade crest. Presumably, frequent fog provides favorable moisture conditions for coastal cyanolichens.

II. CURRENT SPECIES SITUATION

A. Status History

Leptogium brebissonii was thought to be 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). At the time of the lichen viability panel, this species was known from only one site in the range of the northern spotted owl (USDA and USDI 1994a, 1994b). With the completion of the 2000 SEIS, it was removed from Survey and Manage because information indicated it was not closely associated with late-successional and old growth forest (USDA and USDI 2001). In 2004, *L. brebissonii* was designated a Sensitive Species for Forest Service Region 6.

From NatureServe, *Leptogium brebissonii* has a Global Heritage Rank of G5; described as common, widespread and abundant and a State Heritage Rank of S2 in Oregon; considered imperiled in the State because of rarity due to very restricted range, very few population (often less than 20), steep declines in population, or other factors making it very vulnerable to extirpation from the State (ORNHIC 2004). The species is on the ORNHIC List 2, described as threatened, endangered or presumed extinct from Oregon but more common or stable elsewhere.

B. Major Habitat and Viability Considerations

Frequent fog and various ocean-influenced climatic, vegetative and soil factors, appear to be important factors influencing the distribution of *Leptogium brebissonii* in Washington and Oregon. Suitable habitats are sparse and are often separated by many miles. Given the limited availability of habitat, the high rate of human and natural disturbance to these habitats, and the slow colonization rates of *L. brebissonii* (no large populations have been recorded), it seems likely that this species will continue to be rare within the Pacific Northwest.

The major concerns for *Leptogium brebissonii* are the small number of sites, the limited amount of suitable habitat for this species on federal land, and potential loss of populations from human activities that directly affect the remaining populations, species habitat areas, or potential habitat. Climate changes, especially if they affect coastal fog regimes, and air pollution, are secondary concerns. Degradation or change in habitat conditions could affect the vigor of this species, possibly resulting in an even more restricted distribution or contributing to local extirpation.

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 *Leptogium brebissonii* 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 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 the foredunes by recreationists or removal of European beachgrass (*Ammophila arenaria*) can destabilize tree island habitats of *Leptogium brebissonii* by increasing the amount of sand drift into them and burying trees on the perimeter (Christy *et al.* 1998). 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 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).

Like other epiphytic cyanolichens, members of the genus *Leptogium* are considered very sensitive to air pollution (Wetmore 1983, Insarova *et al.* 1992, McCune and Geiser 1997). Although air quality is relatively good at known sites, increased pollution emissions from increased traffic and new or expanded industry along the coast may threaten this species. Pollutants of most concern are SO_2, NO_x, and acid deposition containing sulfur and nitrogen compounds.

Climate change affecting 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.

D. Distribution Relative to Land Allocations

Leptogium brebissonii is located on 15 sites on federal land. Administratively withdrawn sites include Sutton Creek Campground on the Mapleton Ranger District, Eugene District BLM Heceta Dunes ACEC. Eel Creek Campground and Three Mile Creek in the Oregon Dunes National Recreation Area. Congressionally reserved sites include Cascade Head Experimental Forest on the Siuslaw National Forest, and six sites within Olympic National Park. The Cedar Creek and Ten Mile Creek sites on the Siuslaw National Forest are within Late-Successional Reserves. A site at Heceta Head is of unknown land allocation. Other sites in Washington and Oregon are in state parks or on private land.

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. Conservation is defined as the use of all methods and procedures that are necessary to improve the condition of SSS and their habitats to a point where their Special Status recognitions no longer warranted. 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

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 *Leptogium brebissonii*, 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). At Sand Lake dunes of Oregon, a hotspot for lichen diversity, 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). At the northern Samoa Peninsula, 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 (Glavich, pers. comm.). At the Lanphere Dunes Unit, even hiking has been documented to damage fragile shore pine/bearberry (*Arctostaphylos uva-ursi*) communities (Brown 1990).

Lichens have been known to be sensitive to air pollution for more than a century. Many species in Europe (Ferry *et al.* 1973, Hawksworth and Rose 1976) and the eastern United States (Brodo 1966, Showman and Long 1992, McCune *et al.* 1997a) are in an active state of decline from sulfur dioxide, nitrogen oxides, and acidic deposition of sulfur- and nitrogen-containing pollutants. 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. In the Pacific Northwest, sensitive species are already declining in some areas (Denison and Carpenter 1973, Taylor and Bell 1983) and lichens have been identified as Air Quality Related Values in USDA Forest Service regional air resource management guidelines (Peterson *et al.* 1992).

B. Identifying Species Habitat Areas

All sites of *Leptogium brebissonii* on federal lands administered by the Forest Service Region 6 and/or OR/WA BLM 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 species habitat area unless these actions would maintain or improve the habitat for *Leptogium brebissonii* (for example, to prevent deeply shaded conditions or remove invasive exotics).
- Restrict commercial collection of moss or fungi or other special forest products if these activities would adversely affect *Leptogium brebissonii*.
- 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 and prescribed fire in coastal plant communities.

- Maintain integrity of the foredunes or other coastal features where they protect species habitat areas.

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 determine the extent of local populations and better describe their habitat.
- Determine whether additional populations exist in areas identified as potential suitable habitat. Habitat conditions for *Leptogium brebissonii* are coniferous and deciduous trees and shrubs in semi-exposed conditions such as tree pockets on stabilized dunes, trees on the edge of dune forests, dune woodlands, wetland shrub mosaics, deciduous trees in riparian zones, and open forested stands on ridgetops from sea level to 600 m (2000 ft) elevation, and within 16 km (10 mi) of the ocean.
- Report documented sites to ORNHIC 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 Region6) 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 *Leptogium brebissonii*?
- Which habitat characteristics are necessary for colonization by *Leptogium brebissonii*? Are conditions unique to late-successional and old-growth forests 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 *Leptogium brebissonii*?

C. Monitoring Opportunities and Recommendations

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

REFERENCES

Brodo, I.M. 1966. Lichen growth and cities: a study on Long Island, New York. The Bryologist 69:427-449.

Brown, D.R. 1990. Disturbance and recovery of trampled vegetation at the Lanphere-Christensen Dunes Preserve, Humboldt County, California. M.S. thesis. Humboldt State University, Arcata, CA. 45 p.

Christy, J.A., J.S. Kagan, and A.M. Wiedemann. 1998. Plant Associations of the Oregon Dunes National Recreation Area, Siuslaw National Forest, Oregon. Technical Paper R6-NR-ECOL-TP-09-98. USDA Forest Service, Pacific Northwest Region, Portland, OR. 183 p.

Denison, W.C. and S.M. Carpenter. 1973. A Guide to Air Quality Monitoring with Lichens. Lichen Technology, Inc., Corvallis, OR. 39 p.

Ferry, B.W., M.S. Baddeley, and D.L. Hawksworth. 1973. Air Pollution and Lichens. University of Toronto Press, Toronto, ON.

Follmann, G. 1995. On the impoverishment of the lichen flora and the retrogression of the lichen vegetation in coastal central and northern Chile during the last decades. Cryptogamic Botany 5:224-231.

Geiser, L.H., K.L. Dillman, C.C. Derr, and M.C. Stensvold. 1998. Lichens and allied fungi of southeast Alaska. pp. 201-243. *In*: M.G. Glenn, R.C. Harris, T. Dirig and M.S. Cole (eds.). *Lichenographia Thomsoniana:* North American Lichenology in Honor of John W. Thomson. Mycotaxon Ltd., Ithaca, NY. 445 p.

Glavich, D. 1998. Personal communication. Humboldt State University, Arcata, CA.

Glavich, D., L.H. Geiser, and A.G. Mikulin. 2004. Distribution of some rare coastal lichens in Washington, Oregon and northern California, USA and their association with late-seral federally protected forests. Manuscript submitted for publication in Evansia.

Goward, T. 1996. Lichens of British Columbia: Rare species and priorities for inventory. Work. Pap. 08/1996. Victoria, BC Research Branch, BC Ministry Forestry and Habitat Protection Branch, BC Ministry of Environment, Lands and Parks, Victoria, BC.

Goward, T., T.P. Diederich, and R. Rosentreter. 1994a. Notes on the lichens and allied fungi of British Columbia. II. The Bryologist 97:56-62.

Goward, T., B. McCune, and D. Meidinger. 1994b. The Lichens of British Columbia. Illustrated Keys. Part 1: Foliose and Squamulose Species. Ministry of Forests Research Program, Victoria, BC. 181 p.

Hawksworth, D.L. and F. Rose. 1976. Lichens as Pollution Monitors. The Institute of Biology's Studies in Biology 66. Edward Arnold, London.

Insarova, I.D., G.E. Insarov, S. Brakenhielm, S. Hultengren, P.O. Martinsson, and S.M. Semenov. 1992. Lichen Sensitivity and Air Pollution - A Review of Literature Data. 150 Report 4007, Swedish Environmental Protection Agency, Uppsala.

McCune, B. and L. Geiser. 1997. Macrolichens of the Pacific Northwest. Oregon State University Press, Corvallis, OR. 386 p.

McCune, B., J. Dey, J. Peck, K. Heiman, and S. Will-Wolf. 1997a. Regional gradients in lichen communities of the southeast United States. The Bryologist 100(2):145-158.

McCune, B., R. Rosentreter, and A. DeBolt. 1997b. Biogeography of rare lichens from the coast of Oregon. pp. 234-241. *In*: T.N. Kaye, A. Liston, R.M. Love, D.L. Luoma, R.J. Meinke and M.V. Wilson (eds.). Conservation and Management of Native Plants and Fungi. Native Plant Society of Oregon, Corvallis, OR . 296 p.

Nash, T. H. III (ed.). 1996. Lichen Biology. Cambridge University Press, Cambridge, UK. 303 p.

ORNHIC. 2004. Oregon Natural Heritage Information Center. http://oregonstate.edu.ornhic/

Peterson, J., D. Schmoldt, D. Peterson, J. Eilers, R. Fisher, and R. Bachman. 1992. Guidelines for evaluating air pollution impacts on class 1 wilderness areas in the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-299. USDA Forest Service, Pacific Northwest Research Station. Portland, OR. 83 p.

Purvis, O.W., B.J. Coppins, D.L. Hawksworth, P.W. James, and D.M. Moore. 1992. The Lichen Flora of Great Britain and Ireland. Natural History Museum Publications and British Lichen Society, London. 710 p.

Seaward, M.R.D. 1977. Lichen Ecology. Academic Press, London. 550 p.

Showman, R.E. and R.P. Long. 1992. Lichen studies along a wet sulfate deposition gradient in Pennsylvania. The Bryologist 95(2):166-170.

Sierk, H.A. 1964. The genus *Leptogium* in North America north of Mexico. The Bryologist 67(3):245-317.

Taylor, R.J. and M.A. Bell. 1983. Effects of sulfur dioxide on the lichen flora in an industrial area, northwest Whatcom County, Washington. Northwest Science 57:157-166.

Tehler, A. 1996. Systematics, phylogeny and classification. pp. 217-239. *In*: Nash, T. H. III, (ed.). Lichen Biology. Cambridge University Press, Cambridge, UK.

USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Portland, OR

USDA Forest Service and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl, Appendix J2: Results of Additional Species Analysis. Portland, OR 476 p.

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

USDI Fish and Wildlife Service. 1997. Environmental assessment and land protection plan: Lanphere Dunes Unit, Humboldt Bay National Wildlife Refuge, Humboldt County, California. Portland, OR.

Wetmore, C.M. 1983. Lichens of the air quality Class 1 National Parks. Final Report, National Park Service Contract CX 0001-2-0034. Denver, CO.

Wiedemann, A.M. 1984. The ecology of Pacific Northwest coastal sand dunes: a community profile. FWS/OBS-84/04. US Fish and Wildlife Service. 130 p.

Wiedemann, A.M. 1990. The coastal parabola dune system at Sand Lake, Tillamook County, Oregon, USA pp. 171-194. *In*: Proceedings of the Canadian Symposium on Coastal Sand Dunes.

Wolseley, P.A. and P.W. James. 1992. Acidification and the Lobarion: a case for biological monitoring. *In*: Wolselely, P. A., and P.W. James (eds.). The Effects of Acidification on Lichens 1986-1990. CSD Report 1247. The Nature Conservancy Council, Peterborough UK.

Conservation Assessment

for

Niebla cephalota (Tuck.) Rundel & Bowler

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Linda Geiser, Author

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SUMMARY

Preface: Since the transmittal of the Management Recommendations in 2000, 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
Other Management Status: Forest Service Region 6 Sensitive s Species; Bureau of Land Management (BLM) Bureau Assessment species for Washington and Oregon, and Bureau Sensitive for California. From NatureServe the species is ranked with a Global Heritage Rank of G1/G3, described as critically imperiled, with fewer than 6 known sites, or 1000 individuals or 2000 acres of occupied habitat (G1) to vulnerable, at moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent widespread declines or other factors). The species has a State Heritage Rank of S1/S2 in Oregon and California, considered critically imperiled (S1) or imperiled (S2) in the State because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation and a S1 Heritage Rank in Washington. The Oregon Natural Heritage Information Center (ORNHIC) ranks the species List 2, described as threatened, endangered or presumed extinct from Oregon but more common or stable elsewhere.

Range: *Niebla cephalota* is endemic to the Pacific coast of North America, ranging from Washington to Baja California. In Washington, it is known from three sites; Roche Harbor on San Juan Island, San Juan County, Deception Pass State Park, Island County and northwest Fidalgo Island, Skagit County. In Oregon, it is known from six locations including: Sutton Creek Recreation Area and Spin Reel Campground, Siuslaw National Forest; Cape Arago State Park, Coos County and Cape Blanco State Park, Curry County. California sites are known from Del Norte, Humboldt, Mendocino, San Luis Obispo, Santa Barbara, Ventura and Los Angeles Counties. A total of four locations are known to occur on federal land.

Specific Habitat: *Niebla cephalota* has been found on exposed Sitka spruce, Hooker's willow, Monterey cypress and shore pine in open forests, forest edges, and scrublands as well as rock outcrops along windswept coastal headlands, sand dunes, stabilized deflation plains, and marshy swales of the immediate coast.

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.

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.

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). Because the morphology is so variable, it can be mistaken for a parasitized *Ramalina*, especially the regionally common species, *R. farinacea*. The black spots are characteristic of the lichen rather than spots of infection, however.

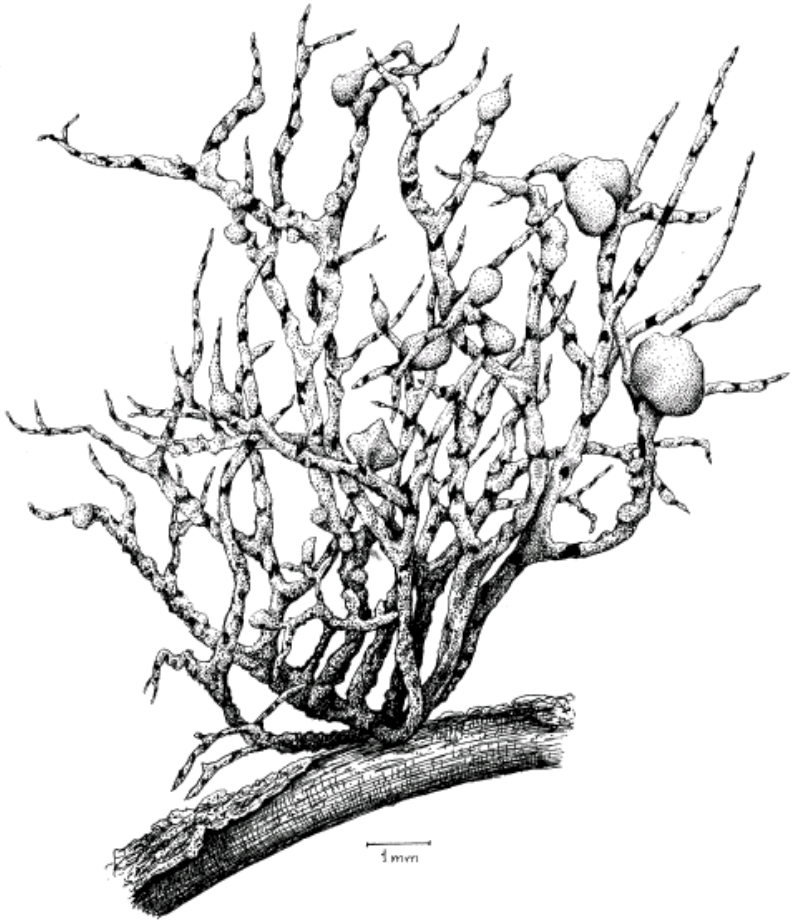

Figure 9. Line drawing of *Niebla cephalota* by Alexander Mikulin.

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* and *Ramalina* 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 western North America, ranging from Baja California north into Washington along the immediate coast. It belongs to a tropical genus with considerable species diversity and biomass along the coasts of southern California, the Channel Islands, and Baja California (Bowler and Riefner 1995). *N. cephalota* is the only species in the genus to range as far north as the Pacific Northwest. In Washington, it is known from three sites; Roche Harbor on San Juan Island, San Juan County; Deception Pass State Park, Island County; and northwest Fidalgo Island, Skagit County. In Oregon, six sites are known including the Siuslaw National Forest's Sutton Creek Recreation Area in Lane County; Spin Reel Campground in the Oregon Dunes National Recreation Area of Coos County; Cape Arago State Park in Coos County; and Cape Blanco State Park in Curry County. California sites include Crescent Beach Overlook in Redwood National Park and Lake Earl State Park, Del Norte County; the Samoa Peninsula and Patrick's Point State Park in Humboldt County; and Van Damme State Park, Manchester State Park, Russian Gulch State Park, Mendocino County; Morro Bay State Park, San Luis Obispo County; Santa Rosa and Santa Cruz Island, Santa Barbara County; Santa Catalina Island, Los Angeles County; and San Miguel, San Nicolas and West Anacapa Island, Ventura County.

Selected specimen records (Glavich *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).

D. Habitat Characteristics and Species Abundance

Throughout its range, this species is found on trees, rocks, and shrubs and is restricted to the coastal fog belt. In the Pacific Northwest and northern California, *Niebla cephalota* has been found most often on exposed boles and branches of Sitka spruce (*Picea sitchensis*), but also on Monterey cypress *(Cupressus macrocarpa)*, shore pine (*Pinus contorta*), and Hooker's willow (*Salix hookeriana*). The species grows on forest edges of windswept headlands and sand dunes; at the edge of tree islands surrounded by moving dunes; as well as in sparsely forested estuaries and willow-dominated marshy areas. In one location, it occurred on an old shore pine on the seaward edge of an old-growth Sitka spruce forest (McCune *et al.* 1997). On the central and southern California coast, it occurs on rocky outcrops, oak (*Quercus* spp.), and shrubs (Arizona State University 2004). All known sites in Washington, Oregon and California are less than 75 meters (250 ft.) elevation and within a few kilometers of the Pacific Ocean. Species abundance at these sites is undetermined.

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 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 2000 SEIS, 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, a Bureau Assessment species for the OR/WA BLM and Bureau Sensitive for the BLM California.

From NatureServe, *Niebla cephalota* has a Global Heritage Rank of G1/G3, described as critically imperiled (G1), with fewer than 6 known sites, or 1000 individuals or 2000 acres of occupied habitat to vulnerable (G3), at moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent widespread declines or other factors (Oregon Natural Heritage Program 2004). The species has a State Heritage Rank of S1/S2 in Oregon and California, considered critically imperiled (S1) or imperiled (S2) in the State because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, and a Heritage Rank of S1 in Washington (ORNHIC 2004). ORNHIC has put this species on List 2, described as threatened, endangered or presumed extinct from Oregon but more common or stable elsewhere. No State Rank has been assigned by the Washington or California Natural Heritage Programs.

B. Major Habitat and Viability Considerations

Frequent fog, and various ocean-influenced climatic, vegetative, and soil factors, create the environment occupied by *Niebla cephalota.* Suitable habitats are sparse and are often separated by many miles. Given the limited availability of habitat, the high rate of human and natural

disturbance to coastal habitats, and the slow colonization rates of *N. cephalota* (no large populations have been recorded), it seems likely that this species will continue to be rare within the range of the Pacific Northwest.

The major concerns for *Niebla cephalota* are the small number of known sites, the limited amount of suitable habitat for this species on federal land, and loss of populations from human activities. Climate changes, especially if they affect coastal fog regimes, and air pollution, are secondary concerns at this time. Degradation or change in habitat conditions could affect the vigor of this species, possibly resulting in an even more restricted distribution or contributing to local extirpation.

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 *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 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 the foredunes by recreationists or removal of European beachgrass (*Ammophila arenaria*) can destabilize tree island habitats of *Niebla cephalota* by increasing the amount of sand drift into them and burying trees on the perimeter (Christy *et al.* 1998). 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).

The air pollution sensitivity of *Niebla cephalota* is unknown. Species in a related genus, *Ramalina,* have a wide range of sensitivity (McCune and Geiser 1997, Boonpragob and Nash

1991). 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 could be expected 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

Niebla cephalota is known from four sites on federal land. In Oregon, there are sites near Spin Reel Campground and Sutton Creek Recreation Area, both administered by the Siuslaw National Forest. It is not clear whether the site near Spin Reel Campground is part of the Oregon Dunes National Recreation Area (administratively withdrawn) or just outside the Recreation Area. Sutton Creek Recreation Area, on the Mapleton Ranger District, is administratively withdrawn. In California, *N. cephalota* occurs at Crescent Beach Overlook in Redwood National Park in a Congressionally withdrawn allocation and at two sites on the Samoa Peninsula in Humboldt County; a BLM parcel in a administratively withdrawn allocation and in Humboldt Bay National Wildlife Refuge in an unknown allocation.

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. Conservation is defined as the use of all methods and procedures that are necessary to improve the condition of SSS and their habitats to a point where their Special Status recognitions no longer warranted. 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

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. comm.). At the Lanphere Dunes, hiking 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* and *Ramalina* 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 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 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 describe the geographical extent of local populations and their habitat.
- Determine whether additional populations exist in areas identified as potentially suitable habitat. Potentially suitable habitat is identified as stabilized deflation plain dunes and swales with Hooker's willow, and foggy, coastal, windswept headlands and dunes with scattered old Sitka spruce and Monterey cypress. Areas with the most potential suitable habitat on federal land include Sutton Creek Recreation Area, Gwynn Creek, Eel Creek Recreation Area, and interdune tree islands and scrub forests of the Oregon Dunes National Recreation Area, all on the Siuslaw National Forest; BLM parcels adjacent to Cape Lookout, and other coastal BLM parcels. Other under-explored federally managed land along the immediate coast include Olympic National Park seashore and the Willapa National Wildlife Refuge.

- Report documented sites to ORNHIC 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*?

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.

REFERENCES

Arizona State University. 2004. Database search of the lichen herbarium records. http://seinet.asu.edu/collections/selection.jsp

Boonpragob, K. and T.H. Nash, III. 1991. Physiological responses of the lichen *Ramalina menziessi* Tayl. to the Los Angeles urban environment. Environmental and Experimental Botany 31(2): 229-238.

Bowler, P.A. and R.E. Riefner, Jr. 1995. Notes on the Ramalinaceae and current related research in California, USA. Bulletin of the California Lichen Society 2(1):1-5.

Bowler, P.A., R.E. Riefner Jr., P.W. Rundel, J. Marsh, and T.H. Nash, III. 1994. New species of *Niebla* (Ramalinaceae) from western North America. Phytologia 77(1):23-37.

Brown, D.R. 1990. Disturbance and recovery of trampled vegetation at the Lanphere-Christensen Dunes Preserve, Humboldt County, California. M.S. Thesis. Humboldt State University, Arcata, CA. 45 p.

Denison, W.C. and S.M. Carpenter. 1973. A Guide to Air Quality Monitoring with Lichens. Lichen Technology, Inc., Corvallis, OR. 39 p.

Christy, J. A., J.S. Kagan, and A.M. Wiedemann. 1998. Plant Associations of the Oregon Dunes National Recreation Area, Siuslaw National Forest, Oregon. Technical Paper R6-NR-ECOL-TP-09-98. USDA Forest Service, Pacific Northwest Region, Portland, OR. 183 p.

Ferry, B. W., M.S. Baddeley, and D.L. Hawksworth. 1973. Air Pollution and Lichens. University of Toronto Press, Toronto, ON.

Follmann, G. 1995. On the impoverishment of the lichen flora and the retrogression of the lichen vegetation in coastal central and northern Chile during the last decades. Cryptogamic Botany 5:224-231.

Glavich, D. 1998. Personal communication. Humboldt State University, Arcata, CA.

Glavich, D., L.H. Geiser and A.G. Mikulin. 2004. Distribution of some rare coastal lichens in Washington, Oregon and northern California, USA and their association with late-seral federally protected forests. Manuscript submitted for publication in Evansia.

Hawksworth, D.L. and F. Rose. 1976. Lichens as Pollution Monitors. The Institute of Biology's Studies in Biology 66. Edward Arnold, London.

McCune, B. and L. Geiser. 1997. Macrolichens of the Pacific Northwest. Oregon State University Press, Corvallis, OR. 386 p.

McCune, B., R. Rosentreter, and A. DeBolt. 1997. Biogeography of rare lichens from the coast of Oregon. pp. 234-241. *In*: T.N. Kaye, A. Liston, R.M. Love, D.L. Luoma, R.J. Meinke and M.V. Wilson (eds.). Conservation and Management of Native Plants and Fungi. Native Plant Society of Oregon, Corvallis, OR . 296 p.

Nash, T. H. III (ed.). 1996. Lichen Biology. Cambridge University Press, Cambridge, UK. 303p.

ORNHIC. 2004. Oregon Natural Heritage Information Center. http://oregonstate.edu.ornhic/

Peterson, J., D. Schmoldt, D. Peterson, J. Eilers, R. Fisher, and R. Bachman. 1992. Guidelines for evaluating air pollution impacts on class 1 wilderness areas in the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-299. USDA Forest Service, Pacific Northwest Research Station. Portland, OR. 83 p.

Riefner, R.E. Jr. and P.A. Bowler. 1995. Cushion-like fruticose lichens as *Dudleya* seed traps and nurseries in coastal communities. Madroño 42: 81-82.

Rundel, P. W. and P.A. Bowler. 1978. *Niebla*, a new generic name for the lichen genus *Desmazieria* (Ramalinaceae). Mycotaxon 6(3):497-499.

Rundel, P. W., P.A. Bowler, and T.W. Mulroy. 1972. A fog-induced lichen community in northwestern Baja California, with two new species of *Desmazieria*. The Bryologist 75:501-508.

Seaward, M.R.D. 1977. Lichen Ecology. Academic Press, London. 550 p.

Taylor, R.J. and M.A. Bell. 1983. Effects of sulfur dioxide on the lichen flora in an industrial area, northwest Whatcom County, Washington. Northwest Science 57:157-166.

Tehler, A. 1996. Systematics, phylogeny and classification. pp. 217-239. *In*: Nash, T.H. III, (ed.). Lichen Biology. Cambridge University Press, Cambridge, UK.

USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Portland, OR.

USDA Forest Service and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl, Appendix J2: Results of Additional Species Analysis. Portland, OR. 476 p.

USDA Forest Service and USDI Bureau of Land Management. 1994c. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents and Standards and Guidelines for Management of Habitat for Late-successional and Old-growth Forest Related Species within the Range of the Northern Spotted Owl. Portland, OR.

USDI, Bureau of Land Management. 1998. Bureau Special Status Species Policy (6840) and Oregon/Washington Special Status Species List, Internal Memorandum OR-98-342, August 28, 1998, including attachments.

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

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

USDI Fish and Wildlife Service. 1997. Environmental assessment and land protection plan: Lanphere Dunes Unit, Humboldt Bay National Wildlife Refuge, Humboldt County, California. Portland, OR.

Wiedemann, A.M. 1984. The ecology of Pacific Northwest coastal sand dunes: a community profile. FWS/OBS-84/04. US Fish and Wildlife Service. 130 p.

Wiedemann, A.M. 1990. The coastal parabola dune system at Sand Lake, Tillamook County, Oregon, USA pp. 171-194. *In*: Proceedings of the Canadian Symposium on Coastal Sand Dunes.

Wolseley, P.A. and P.W. James. 1992. Acidification and the Lobarion: a case for biological monitoring. *In*: Wolselely, P.A., and P.W. James. (eds.). The Effects of Acidification on Lichens 1986-1990. CSD Report 1247. The Nature Conservancy Council, Peterborough, UK.

Conservation Assessment

for

Pyrrhospora quernea (Dickson) Körber

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

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M. Stein

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SUMMARY

Preface: Since the transmittal of the Management Recommendations in 2000, additional sites have been recorded for *Pyrrhospora quernea*. That new information is presented herein.

Species: *Pyrrhospora quernea* (Dickson) Körber
Taxonomic Group: Lichen
Other Management Status: Forest Service Region 6 Sensitive Species. From NatureServe the species is ranked with a Global Heritage Rank of G4, described as apparently secure, uncommon but not rare; some cause for long-term concern due to declines or other factors. The State Heritage Rank has been identified as S2/S3 for Oregon, considered imperiled (S2), because of rarity due to a very restricted range, very few populations (often 20 or fewer), steep declines, or other factors or vulnerable (S3), due to a restricted range, relatively few populations (oftern 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extinction. The State rank for California is S2 and S1/S2 for Washington, considered critically imperiled (S1) because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation in the State to imperiled (S2). The Oregon Natural Heritage Information Center (ORNHIC) ranks the species Heritage List 3, described as taxa for which more information is needed before status can be determined but which may be threatened or endangered in Oregon or throughout their range.

Range: *Pyrrhospora quernea* is found in North America, Europe, and Micronesia. In North America, it is reported from scattered locations in Minnesota, Montana, California, and the Pacific Northwest. Washington and Oregon sites are known from San Juan, Clallam, Jefferson, and Pacific counties in Washington and Clatsop, Lincoln, Coos, Douglas, and Curry counties, Oregon. Sites on federal lands include Olympic National Park, the Bureau of Land Management in San Juan and Coos counties; Oregon Dunes National Recreation Area, Siuslaw National Forest; and the US Fish and Wildlife Service at Dungeness National Wildlife Refuge.

Specific Habitat: In the Pacific Northwest, *Pyrrhospora quernea* grows in hypermaritime habitats within a few kilometers of the Pacific Ocean, including near estuaries, on stabilized dunes, and rocky coastal headlands. Its known substrates are Sitka spruce and shore pine in old-growth stands. It also grows on oaks, alder, elderberry, and other coastal shrubs, and on old board fences and other wood. In Europe, it grows on moderately nutrient-rich rough bark, particularly of oaks, and occasionally, on wood or even sandstone.

Threats: The major threat to *Pyrrhospora quernea* is loss of populations from activities that adversely affect the habitat or the population, such as altering microclimate and removing colonized substrate. Climate change that alters conditions necessary for its survival may result in a decline in vigor of the species, or may be a factor in causing local extirpation.

Management Considerations:

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

Data and Information Gaps:

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

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Pyrrhospora quernea (Dickson) Körber (1855)
Synonyms: *Protoblastenia quernea* (Dickson) Clauzade
Lecidea quernea (Dickson) Acharius

Pyrrhospora quernea is a lichenized Ascomycete in the family Lecanoraceae, order Lecanorales (Tehler 1996). The genus is closely related to *Lecidella*, and is included in the Lecanoraceae on the basis of ascus structure but it lacks a thalline exciple (Purvis *et al.* 1992).

B. Species Description

1. Morphology and Chemistry

Pyrrhospora quernea (Figure 1) is a crustose lichen characterized by a thallus thickly farinose to granular-sorediate, granules to about 150 µm in diameter, arising over the surface of the thallus, even, often indistinctly areolate, yellowish or greenish-fawn; prothallus generally present, forming a delimiting black line to 250 µm wide. Apothecia are 0.4-1(1.5) mm diameter, strongly convex, often irregular in shape, dark reddish-brown; true exciple excluded; epithecium interspersed with reddish brown granules, K+ dissolving, purplish. Ascospores are (7) 8-12 (14) x (5) 6-7 (8) µm. Thallus Pd- or weakly yellowish, K-, KC+ orange, C+ orange, UV- or blackish orange (isoarthothelin, thiophanic acid and ± trihydroxy-2-chloro-6-methylanthraquinone). Apothecia are K+ reddish-purple in section, containing 1,3,8-trihydroxy-2-chloro-6-methylanthraquinone) (Purvis *et al.* 1992).

2. Reproductive Biology

Pyrrhospora quernea reproduces vegetatively by producing soredia, microscopic clusters of algal cells and fungal filaments that can initiate a new thallus if habitat conditions are suitable. The microscopic size of the reproductive propagules should allow them to be carried long distances by wind, animals, or birds. Birds in particular are thought to enhance arrival rates of rare oceanic species by dispersing lichen propagules along coastal migratory routes of the Pacific Northwest (McCune *et al.* 1997).

Pyrrhospora quernea also reproduces sexually by producing fungal ascospores. The fungal spores germinate and presumably reunite with the appropriate green algal photobiont, forming a new lichen thallus. This means of reproduction is generally considered slow compared to asexual propagation.

Figure 10. Line drawing of *Pyrrhospora quernea* by Alexander Mikulin.

3. Ecological Roles

Little to nothing is known of the ecological roles of *Pyrrhospora quernea*. Crustose lichens in the Pacific Northwest commonly show signs of feeding by invertebrates. Various molluscs and insects (for example bristletails, barklice, katydids, grasshoppers, webspinners, butterflies, moths, lacewing larvae, mites, spiders, snails, slugs, and many beetles) live on or mimic lichens, or graze upon the algal rich layer and reproductive structures (Gerson and Seaward 1977).

C. Range and Sites

Pyrrhospora quernea is found in North America, Europe, and Micronesia (Purvis *et al.*1992). In North America, it is reported from scattered locations in Minnesota, Montana, California (Fink 1935), and the Pacific Northwest. Washington and Oregon sites are known from San Juan, Clallam, Jefferson and Pacific counties in Washington and Clatsop, Lincoln, Coos, Douglas, and Curry counties, Oregon. Sites on federal lands include Olympic National Park, the Bureau of Land Management in San Juan and Coos counties; Oregon Dunes National Recreation Area, Siuslaw National Forest; and the US Fish and Wildlife Service at Dungeness National Wildlife Refuge. A site is known from Redwood National Park in Humboldt County, California.

Selected specimen records (Glavich *et al*. 2004) – CALIFORNIA. Mendocino Co. Jackson State Forest, Mendocino Woodlands Camp, *Ryan 22268* (ASU). Humboldt Co. Little River State Park, *Glavich 598* (OSC); Redwood National Park, Gold Bluff Beach, *Glavich 587* (OSC). OREGON. Curry Co. Cape Sebastian State Park, *Mikulin 1267* (OSC). Coos Co. New River ACEC, Muddy Lake, *Mikulin 1228* (OSC), Cape Arago State Park, *Mikulin 1306* (OSC), Oregon Dunes National Recreation Area: 2 km nw of North Eel Campground, *Mikulin 1220* (OSC), 1.6 km s of Sandy Way staging area, *Mikulin 1226* (OSC), Bluebill Lake, *Mikulin 1003* (OSC), 6 km n of Bluebill Beach, *Mikulin 1041* (OSC); Tugman State Park, *Mikulin 1059* (OSC). Douglas Co. Oregon Dunes National Recreation Area: 1 km wnw of Carter Lake Campground, *Mikulin 1209* (OSC), 0.3 km s of Brushy Hill, *Mikulin 1199* (OSC), s of 3 Mile Lake, *Mikulin 1068* (OSC),

0.75 km w of Takenitch River and Hwy 101 intersection, *Mikulin 1071* (OSC); Umpqua Lighthouse State Park, *Mikulin 1018* (OSC). Lane Co. Siuslaw National Forest, Sutton Creek, *Mikulin 1145* (OSC), 9.5 km s of Cape Perpetua, *Mikulin 1205* (OSC); Oregon Dunes National Recreation Area, Goose Pasture, *Mikulin 1154* (OSC). Lincoln Co. Cascade Head Experimental Forest, *Mikulin 1269* (OSC); Yaquina Head Natural Area, *Mikulin 1165* (OSC). Clatsop Co. Ecola State Park: Indian Point, *Mikulin 1233* (OSC), Tillamook Head, *Mikulin 1095* (OSC); Fort Stevens State Park, *Mikulin 1236* (OSC). WASHINGTON. Pacific Co. Fort Canby State Park, Cape Disappointment, *Mikulin 1159* (OSC). Clallam Co. Olympic National Park, Sand Point trail, *Mikulin 1307* (OSC), Dept. Natural Resources, 8 km w of Port Angeles, *Mikulin 1196* (OSC), Dungeness National Wildlife Refuge, *Mikulin 1305* (OSC). Jefferson Co. Marrowstone Island, Fort Flagler State Park, *Mikulin 1308* (OSC). Island Co. Whidbey Is., Deception Pass State Park, *Mikulin 1261* (OSC). San Juan Co. Orcas Island, Obstruction Pass NRA, *Mikulin 1245* (OSC); Lopez Island: BLM Point Colville, *Mikulin 1256* (OSC), Shark Reef Sanctuary, *Mikulin 1249* (OSC).

D. Habitat Characteristics and Species Abundance

In the Pacific Northwest, *Pyrrhospora quernea* occurs in hyper-maritime habitats within a few kilometers of the Pacific Ocean, including estuaries, stabilized dunes, and rocky coastal headlands. Its known substrates are Sitka spruce (*Picea sitchensis*), and shore pine (*Pinus contorta*), oaks (*Quercus* spp.), alder (*Alnus*), elderberry (*Sambucus*), and other coastal shrubs, and on old board fences and other wood. In Europe, it grows on moderately nutrient-rich rough bark, particularly on oaks and occasionally on wood or sandstone (Purvis *et al.* 1992).

II. CURRENT SPECIES SITUATION

A. Status History

Pyrrhospora quernea was considered at risk under the Northwest Forest Plan because of its rarity and limited distribution within the range of the northern spotted owl (USDA and USDI 1994a, 1994b). Initially, it was a Survey and Manage strategy 1 and 3 species (USDA and USDI 1994c). With the completion of the 2000 SEIS, it was assigned to Management Category E (USDA and USDI 2001) and subsequently removed from Survey and Manage following the 2002 Annual Species Review, in which a determination was made that the species is not closely associated with late-successional and old growth forests. In 2004, *P. quernea* was designated a Sensitive species for Forest Service Region 6.

From NatureServe, *Pyrrhospora quernea* has a Global Heritage Rank of G4, considered apparently secure, uncommon but not rare; some cause for long-term concern due to declines or other factors (ORNHIC 2004). The species has a State Heritage Rank of S2/S3 in Oregon, described as imperiled (S2), because of rarity due to a very restricted range, very few populations (often 20 or fewer), steep declines, or other factors or vulnerable (S3), due to a restricted range, relatively few populations (oftern 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extinction. It is ranked S2 in California and S1/S2 for Washington, considered critically imperiled (S1) because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation in the State to Imperiled (S2) (ORNHIC 2004).

The ORNHIC ranks the species Heritage List 3, described as taxa for which more information is needed before status can be determined but which may be threatened or endangered in Oregon or throughout their range.

B. Major Habitat and Viability Considerations

Frequent fog, combined with moderate temperatures, creates a suitable environment for ocean-influenced lichens like *Pyrrhospora quernea*. The broken topography, natural firebreaks, and ocean spray all act to reduce the influence of fire on the immediate coast, and migrating birds may enhance arrival rates by spreading lichen propagules. High species diversity, successful colonization by rare oceanic species, and reduced rates of population extirpations are natural features of immediate coastal habitats (McCune *et al.* 1997).

The major habitat and viability concerns for *Pyrrhospora quernea* 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 adversely affect the remaining habitat or populations. Much of the Pacific Northwest's low elevation coastal forest habitat is under non-federal management and, along the immediate coast, development pressures are increasing.

C. Threats to the Species

Threats to *Pyrrhospora quernea* 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 lichens, which stabilize the soil (Christy *et al.* 1998). Destabilization of the foredunes by recreationists or removal of European beachgrass (*Ammophila arenaria*) can destabilize tree island habitats of *Pyrrhospora quernea* by increasing the amount of sand drift into them and burying trees on the perimeter (Christy *et al.* 1998). Buildings, roads, campgrounds and trails along the immediate coast to improve access, facilitate scenic views, or develop recreational uses has removed natural habitat.

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 as 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 exotic plant species such as Scot's 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 1994a).

The air-pollution sensitivity of *Pyrrhospora quernea* is unknown, but crustose species are typically more tolerant of air pollution than other lichen forms. 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 *P. quernea* to air-quality deterioration may be a reasonable concern. Although air quality is relatively good at known sites, rising pollution emissions from increased traffic (mainly NO_x) and new or expanded industry (SO_x and NO_x) along the coast could threaten this species in the future.

Climate change affecting coastal fog patterns could affect the vigor of this species, possibly restricting distribution or contributing to local extirpation.

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.

D. Distribution Relative to Land Allocations

All populations that occur within the Oregon Dunes National Recreation Area are Congressionally reserved. The Siuslaw National Forest sites at Sutton Creek and Cascade Head are administratively withdrawn and the site near Cape Perpetua 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. Conservation is defined as the use of all methods and procedures that are necessary to improve the condition of SSS and their habitats to a point where their Special Status recognitions no longer warranted. 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

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. In coastal Oregon, activities of the past 140 years including increased 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 more than a century. Lichens that obtain most of their water from fog and dew are particularly vulnerable to air quality and weather patterns (Nash 1996). Follmann (1995) documented massive impoverishment and retrogression of lichens over much of the northern Chilean coastal fog belt during the past 20 years. Increasing frequency of El Niño events and gradually increasing aridity were postulated as likely, but not exclusive factors causing this decline. Populations of many species in Europe (Hawksworth and Rose 1976) and eastern United States 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). 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 sites of *Pyrrhospora quernea* 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 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 habitats areas (for example, divert roads, trails, and off-road vehicles). Trampling shrubs or ground lichens, 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 *Pyrrhospora quernea* (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.

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.
- Report documented sites to ORNHIC and Washington Natural Heritage Programs and enter data into agency regional databases.
- Report changes in documented and suspected status as quickly as possible to the interagency Sensitive and Special Status Species Specialist in the Regional/State Office.
- Report sitings and survey work in the appropriate agency database.

B. Research Questions

- What are the dispersal rates and mechanisms of *Pyrrhospora quernea*?
- Which habitat and microclimate characteristics are necessary for establishing *Pyrrhospora quernea* thallus fragments and survival of established thalli?
- What is the genetic diversity of *Pyrrhospora quernea* within local populations and across the region?
- What is the air pollution sensitivity of *Pyrrhospora quernea*?
- What are the minimum and optimum patch sizes of colonized habitat necessary to provide for *Pyrrhospora quernea*?

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.

REFERENCES

Christy, J.A., J.S. Kagan, and A.M. Wiedemann. 1998. Plant Associations of the Oregon Dunes National Recreation Area, Siuslaw National Forest, Oregon. Technical Paper R6-NR-ECOL-TP-09-98. USDA Forest Service, Pacific Northwest Region, Portland, OR. 183 p.

Denison, W.C. and S.M. Carpenter. 1973. A Guide to Air Quality Monitoring with Lichens. Lichen Technology, Inc., Corvallis, OR. 39 p.

Fink, B. 1935. The Lichen Flora of the United States. University of Michigan, Ann Arbor, MI. 426 p.

Follmann, G. 1995. On the impoverishment of the lichen flora and the retrogression of the lichen vegetation in coastal central and northern Chile during the last decades. Cryptogamic Botany 5: 224-231.

Gerson, U. and M.R.D. Seaward. 1977. Lichen-invertebrate associations. pp. 69-119. *In*: Seaward, M.R.D., (ed.). Lichen Ecology, Academic Press, London.

Glavich, D., L.H. Geiser, and A.G. Mikulin. 2004. Distribution of some rare coastal lichens in Washington, Oregon and northern California, USA and their association with late-seral federally protected forests. Manuscript submitted for publication in Evansia.

Hawksworth, D.L. and F. Rose. 1976. Lichens as Pollution Monitors. The Institute of Biology's Studies in Biology 66. Edward Arnold, London.

McCune, B., J. Dey, J. Peck, K. Heiman, and S. Will-Wolf. 1996. Lichen communities. *In*: Lewis, T.E., and B.L. Conkling (eds.). Forest health monitoring, Southeast Loblolly/Shortleaf Pine Demonstration Final Report. US Environmental Protection Agency EPA/620/R-64/006.

McCune, B., R. Rosentreter, and A. DeBolt. 1997. Biogeography of rare lichens from the coast of Oregon. pp. 234-241. *In*: T.N. Kaye, A. Liston, R.M. Love, D.L. Luoma, R.J. Meinke and M.V. Wilson (eds.). Conservation and Management of Native Plants and Fungi. Native Plant Society of Oregon, Corvallis, OR . 296 p.

Nash, T. H. III (ed.). 1996. Lichen Biology. Cambridge University Press, Cambridge, UK. 303 p.

ORNHIC. 2004. Oregon Natural Heritage Information Center. http://oregonstate.edu.ornhic/

Peterson, J., D. Schmoldt, D. Peterson, J. Eilers, R. Fisher, and R. Bachman. 1992. Guidelines for evaluating air pollution impacts on class 1 wilderness areas in the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-299. USDA Forest Service, Pacific Northwest Research Station. Portland, OR. 83 p.

Purvis, O.W., B.J. Coppins, D.L. Hawksworth, P.W. James, and D.M. Moore. 1992. The Lichen Flora of Great Britain and Ireland. Natural History Museum Publications and British Lichen Society, London. 710 p.

Seaward, M.R.D. 1977. Lichen Ecology. Academic Press, London. 550 p.

Taylor, R.J. and M.A. Bell. 1983. Effects of sulfur dioxide on the lichen flora in an industrial area, northwest Whatcom County, Washington. Northwest Science 57:157-166.

Tehler, A. 1996. Systematics, phylogeny and classification. pp. 217-239. *In*: Nash, T.H., III, (ed.). Lichen Biology. Cambridge University Press, Cambridge, UK.

USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Portland, OR.

USDA Forest Service and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl, Appendix J2: Results of Additional Species Analysis. Portland, OR. 476 p.

USDA Forest Service and USDI Bureau of Land Management. 1994c. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents and Standards and Guidelines for Management of Habitat for Late-successional and Old-growth Forest Related Species within the Range of the Northern Spotted Owl. Portland, OR.

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

Wiedemann, A.M. 1984. The ecology of Pacific Northwest coastal sand dunes: a community profile. FWS/OBS-84/04. US Fish and Wildlife Service. 130 p.

Wiedemann, A.M. 1990. The coastal parabola dune system at Sand Lake, Tillamook County, Oregon, USA pp. 171-194. *In*: Proceedings of the Canadian Symposium on Coastal Sand Dunes

Conservation Assessment

for

Teloschistes flavicans (Sw.) Norman

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SUMMARY

Preface: Since the transmittal of the Management Recommendations in 2000, additional sites have been recored for *Teloschistes flavicans* and the new information is presented herein.

Species: *Teloschistes flavicans* (Sw.) Norman
Taxonomic Group: Lichen
Other Management Status: Forest Service Region 6 Sensitive Species; Bureau of Land Management (BLM) Bureau Assessment for Washington, Oregon and California. From NatureServe the species is ranked with a Global Heritage Rank of G4, described as not rare and apparently secure, but with cause for long-term concern, usually with more than 100 occurrences. The State Heritage Rank is S1 for Oregon and California, considered critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation in the State. The Oregon Natural Heritage Information Center (ORNHIC) ranks the species Heritage List 2, described as taxa that are threatened, endangered or possibly extirpated from Oregon but more stable or common elsewhere.

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. It occurs on exposed branches, twigs, and boles of Sitka spruce, shore pine, and stems of Hooker's willow in old Sitka spruce/western hemlock or shore pine stands.

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; 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.

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

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 in Oregon from Tillamook County at Cape Lookout State Park (McCune and Geiser 1997), in the vicinity of Sand Lake, just south of Cape Lookout, a Salem District BLM parcel 1 km (0.6 miles) north of Pacific City, Cascade Head Experimental Forest, and Cape Meares State Park. In Curry County, sites are known from the New River Area of Critical Environmental Concern (ACEC) 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.

D. Habitat Characteristics and Species Abundance

Teloschistes flavicans is rare throughout its range along the Pacific coast of Oregon and 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. At Cape Lookout, where the largest known population is located, *T. flavicans* is 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. 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 southern California, *T. flavicans* grows on conifers and other trees (*e.g*. *Quercus*) in coastal scrub stands. 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 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 2000 SEIS, 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.

Teloschistes flavicans has 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.

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 the foredunes by recreationists or removal of European beachgrass (*Ammophila arenaria*) can destabilize tree island habitats of *Teloschistes flavicans* by increasing the amount of sand drift into them and burying trees on the perimeter (Christy *et al.* 1998). 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).

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 patterns could be expected 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. 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 land allocation for the Salem District BLM parcel just north of Pacific City is unknown at this time.

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. Conservation is defined as the use of all methods and procedures that are necessary to improve the condition of SSS and their habitats to a point where their Special Status recognitions no longer warranted. 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 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 ORNHIC 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?

C. Monitoring Opportunites 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.

REFERENCES

Arizona State University. 2004. Database search of the lichen herbarium records. http://seinet.asu.edu/collections/selection.jsp

Brodo, I.P. 1997. Personal communication. Canadian Museum of Nature, Ottawa, Canada.

Christy, J.A., J.S. Kagan, and A.M. Wiedemann. 1998. Plant Associations of the Oregon Dunes National Recreation Area, Siuslaw National Forest, Oregon. Technical Paper R6-NR-ECOL-TP-09-98. USDA Forest Service, Pacific Northwest Region, Portland, OR. 183 p.

Ferry, B.W., M.S. Baddeley, and D.L. Hawksworth. 1973. Air Pollution and Lichens. University of Toronto Press, Toronto, Ontario.

Fink, B. 1935. The Lichen Flora of the United States. University of Michigan, Ann Arbor, MI. 426 p.

Follmann, G. 1995. On the impoverishment of the lichen flora and the retrogression of the lichen vegetation in coastal central and northern Chile during the last decades. Cryptogamic Botany 5: 224-231.

Giess, W. 1989. Einiges zu unserer Flechtenflora. Dinteria 20:30-32.

Gilbert, O.L and O.W. Purvis. 1996. *Teloschistes flavicans* in Great Britain: distribution and ecology. Lichenologist 28(6):493-506.

Hale, M.E. 1979. How to Know the Lichens. Second edition. William C. Brown Co. Publishers, Dubuque, Iowa. 246 p.

Hale, M.E., Jr. and M. Cole. 1988. Lichens of California. California Natural History Guides: 54. University of California Press, Berkeley, CA. 171 p.

Hawksworth, D.L. and F. Rose. 1976. Lichens as Pollution Monitors. The Institute of Biology's Studies in Biology 66. Edward Arnold, London.

Kärnefelt, I. 1991. Evolutionary rates in the Teloschistaceae. pp: 105-121. *In*: Galloway, D.J. (ed.). Tropical Lichens: Their Systematics, Conservation and Ecology. Systematics Association Special Volume No. 43. Clarendon Press, Oxford, UK.

Lange, O., L. A. Meyer, H. Zellner, I. Ullmann, and D.C.J. Wessels. 1990. Eight days in the life of a desert lichen: water relations and photosynthesis of *Teloschistes capensis* in the coastal fog zone of the Namib Desert. Madoqua 17(1):17-30.

McCune, B. and L. Geiser. 1997. Macrolichens of the Pacific Northwest. Oregon State University Press, Corvallis, OR. 386 p.

McCune, B., R. Rosentreter, and A. DeBolt. 1997. Biogeography of rare lichens from the coast of Oregon. pp. 234-241. *In*: T.N. Kaye, A. Liston, R.M. Love, D.L. Luoma, R.J. Meinke, and M.V. Wilson (eds.). Conservation and Management of Native Plants and Fungi. Native Plant Society of Oregon, Corvallis, OR . 296 p.

Murray, J. 1960. Studies of New Zealand Lichens. II. The Teloschistaceae. Trans. Royal Soc. New Zealand 88(2): 197-210.

Nash, T. H., III (ed.). 1996. Lichen Biology. Cambridge University Press, Cambridge, UK. 303 p.

ORNHIC. 2004. Oregon Natural Heritage Information Center. http://oregonstate.edu.ornhic/

Sanders, W.B. 1993. Apical formation of cilia and associated branching of the axis in the lichen *Teloschistes flavicans*. Int. J. Plant Sci. 154(1):75-79.

Tehler, A. 1996. Systematics, phylogeny and classification. pp: 217-239. *In*: Nash, T.H. III, (ed.). Lichen Biology. Cambridge University Press, Cambridge, UK.

USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Related Species within the Range of the Northern Spotted Owl, Appendix A, Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Portland, OR.

USDA Forest Service and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl, Appendix J2: Results of Additional Species Analysis. Portland, OR. 476 p.

USDA Forest Service and USDI Bureau of Land Management. 1994c. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents and Standards and Guidelines for Management of Habitat for Late-successional and Old-growth Forest Related Species within the Range of the Northern Spotted Owl. Portland, OR.

USDI Bureau of Land Management. 1998. Bureau Special Status Species Policy (6840) and Oregon/Washington Special Status Species List, Internal Memorandum OR-98-342, August 28, 1998, including attachments.

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

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

USDI Fish and Wildlife Service. 1997. Environmental assessment and land protection plan: Lanphere Dunes Unit, Humboldt Bay National Wildlife Refuge, Humboldt County, California. Portland, OR.

Wolseley, P.A. and P.W. James. 1992. Acidification and the Lobarion: a case for biological monitoring. Nature Conservancy Council Newsletter. *In*: Wolseley, P.A. and P.W. James (eds.). The Effects of Acidification on Lichens 1986-1990. CSD Report 1247. Nature Conservancy Council, Peterborough,U