Management Recommendations for

Bryoria pseudocapillaris Brodo & D. Hawksw.

version 2.0

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SUMMARY

Species: *Bryoria pseudocapillaris* Brodo & D. Hawksw
Taxonomic Group: Lichens (Rare Oceanic Influenced)
ROD Components: 1,3

Other Management Status: Oregon Natural Heritage Program: List 2 (taxa that are threatened with extirpation or presumed to be extirpated from the state of Oregon); Natural Heritage Networks Rank: Global Rank G2? (rank of G2 is uncertain, but is defined as imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction (extirpation), typically with 6-20 occurrences), State Rank S1 (critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences) (Oregon Natural Heritage Program 1998), and BLM Assessment Status (USDI Bureau of Land Management 1998).

Range: The world-wide distribution of this endemic lichen consists of seven coastal populations from California to Oregon. The largest population is at Samoa Peninsula, California. Three other Humboldt County populations are nearby at Patricks Point State Park, Humboldt Lagoons State Park, and College Cove State Beach. The two known sites in Oregon are Sutton Creek Recreation Area, Siuslaw National Forest and Cape Blanco State Park. Only one population is on federal land (Siuslaw National Forest). One population is outside the range of the Northwest Forest Plan, in San Luis Obispo County, California.

Specific Habitat: *Bryoria pseudocapillaris* grows on exposed trees (especially Sitka spruce and shore pine) and shrubs on coastal windswept dunes and rocky headlands at or near sea level within 3 km (1-2 mi) of the ocean in areas of frequent fog.

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 Recommendations:
- Manage known sites to maintain local populations and their habitat.
- Develop practices to route human use away from known sites.
- Manage fire in the habitat areas, with emphasis on prevention.
- Restrict removal of trees, shrubs, or other vegetation from known sites except when removal will not harm habitat integrity.

Information Needs:
- Visit known sites to determine the extent of local populations and improve habitat descriptions.
- Determine if species is closely associated with late-successional and old-growth forests.
- Determine if additional populations exist in areas identified as potential suitable habitat.

Management Recommendations for *Bryoria pseudocapillaris*

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 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).

B. pseudocapillaris can be confused with two other chestnut-colored coastal tree hair lichens;

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

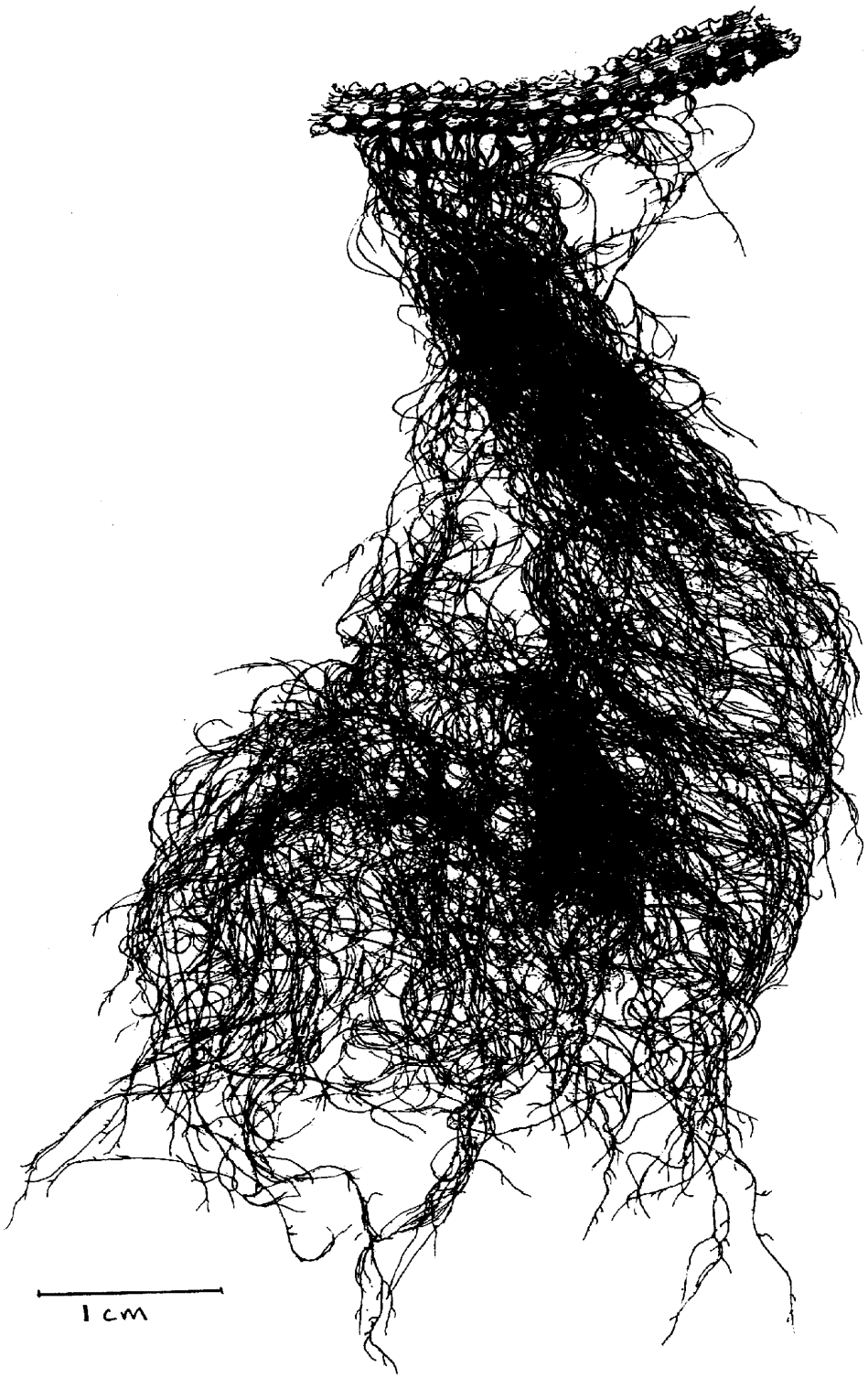

Figure 1. Line drawing of *Bryoria pseudocapillaris* by Alexander Mikulin.

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

Pale individuals of *B. 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), *B. pseudocapillaris* reproduces effectively over short distances (within a few hundred meters) but maybe 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 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 is home to the largest population of *Bryoria 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 Known Sites

The current world-wide distribution of *Bryoria pseudocapillaris* consists of seven known populations, all but one in the range of the Northwest Forest Plan. *Bryoria pseudocapillaris* is limited to a very few widely spaced populations, in exposed sites within 3 km (1-2 mi) of the Oregon and northern California coast. *Bryoria pseudocapillaris* was described by Brodo and Hawksworth in 1977 from two locations: at Cape Blanco (Curry County), Oregon, and from the Samoa Peninsula near Manila (Humboldt County). In almost a quarter century since, only five additional populations have been discovered, one at Sutton Creek, Siuslaw National Forest (Lane County, Oregon) (McCune *et al.* 1997), one near Baywood Park (San Luis Obispo County, California)--outside the range of the Northwest Forest Plan) (Riefner *et al.* 1995), and three more locations in the Arcata-Eureka vicinity of Humboldt County, California: Patricks Point State Park, Humboldt Lagoons State Park, and College Cove State Beach (Glavich, pers. comm.). There is little doubt that this lichen is both rare and also limited to the immediate coast as extensive surveys conducted by the Forest Service on seven national forests, in over 1200 locations, have failed to locate any additional populations (USDA 1998).

D. Habitat Characteristics and Species Abundance

Bryoria pseudocapillaris is a lichen of very narrow ecological amplitude, occurring in sites with moderated temperature 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, at or near sea level (< 50 m (165 ft) elevation). *Bryoria 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, *Bryoria spiralifera*. On the Samoa Peninsula, it is frequently mixed with the draping, epiphytic lichen, *Ramalina menziesii* (Brodo and Hawksworth 1977). This species is rare throughout its narrow range.

The largest population of *B. pseudocapillaris* occurs on the Samoa Peninsula where it grows intermixed with the more abundant *B. spiralifera*. At Sutton Creek, just north of the Oregon Dunes, *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).

The other Humboldt County populations were all in second-growth. At Humboldt Lagoons State Park, it was found on Sitka spruce on the edge of Stone Lagoon. At Patricks 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.).

II. CURRENT SPECIES SITUATION

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

Bryoria pseudocapillaris 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, it was known from two populations world-wide, both in the range of the northern spotted owl (USDA and USDI 1994b). Viability concerns were based on its rarity and restriction to a specialized habitat: the fog zone within 3 km (1-2 mi) of the ocean. The viability ratings reflected a high level of concern for this species. The rare oceanic influenced lichens as a group received the lowest viability ratings among all the lichens considered (USDA and USDI 1994a).

Because of the low viability ratings and high level of concern, this species was identified as a Survey and Manage strategy 1 and 3 species (USDA and USDI 1994c), with the dual objectives of managing known sites and conducting extensive surveys to locate additional populations and identify other high-priority sites for species management.

B. Major Habitat and Viability Considerations

The major concerns are the small number of known populations, the limited amount of suitable habitat for this species on federal land, and the loss of populations from management or recreational activities that damage populations or remaining habitat. Climate change or air pollution could also cause a decline in vigor of this species or contribute to extirpation of local populations.

Because of the small number of known sites world-wide, *B. pseudocapillaris* is one of the most threatened species on the survey and manage list of the Northwest Forest Plan. Discovering or establishing additional populations would lower concerns about its viability.

The persistence of this lichen is very uncertain because of the limited potential for federal management along the immediate coast and the very few known sites. The main population stronghold is the Samoa Peninsula, much of which is under 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.

For species with inefficient means for long-distance dispersal, 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 *B. pseudocapillaris* 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 *B. 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 habitat areas include logging, grazing, agriculture, and activities which 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 *B. 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 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

There are sites on federal land of *B. pseudocapillaris* in the range of the Northwest Forest Plan. One is the Sutton Creek Recreation Area, Siuslaw National Forest. The current land allocation designation is "administratively withdrawn", and management emphasis is recreation. The other federally-managed site is the 618 acre Lanphere Dunes Unit on the Samoa Peninsula, part of the Humboldt Bay National Wildlife Refuge (USDI 1997). Most of the Samoa Peninsula habitat is privately owned, 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 *Bryoria pseudocapillaris*. The Cape Blanco site is an Oregon State Park. Patricks Point, Humboldt Lagoons, and College Cove are state parks of California.

III. MANAGEMENT GOAL AND OBJECTIVES

A. Management Goal for the Taxon

The goal for managing *B. pseudocapillaris* is to assist in maintaining species viability.

B. Objectives

Manage populations at all known sites on federal lands by maintaining habitat and potential habitat immediately surrounding known populations.

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, 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 and 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, another hotspot of 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 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 Habitat Areas for Management

All known sites of *B. pseudocapillaris* on federal lands administered by the Forest Service and BLM in the range of the Northwest Forest Plan are identified as areas where these management recommendations should be implemented. Currently, the only known federally managed sites are the Sutton Creek Recreation Area of the Siuslaw National Forest and the USFWS Lanphere Dunes Unit. A habitat area for management is defined as suitable habitat occupied by or near a known population.

C. Managing in Habitat Areas

The objective of managing in habitat areas is to maintain the habitat conditions for *Bryoria pseudocapillaris.* Specific recommendations are to:

- 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 cryptogam mats, compacting roots, damaging trees or branches that serve as substrates, 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 do no harm to, or would improve, the habitat for *B. pseudocapillaris* (for example, by preventing deeply shaded conditions or by removing invasive exotics).
- Prevent fire in the population but utilize or prevent fire in 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 habitat areas.
- Restrict commercial collection of moss or fungi or other special forest products if these activities would adversely affect the integrity of habitat areas.

D. Other Management Issues and Considerations

- Consider opportunities for managing known sites during Forest Plan and Resource Management Plan revisions, such as Botanical Special Interest Areas, Areas of Critical Environmental Concern, or other administratively withdrawn designations, or by prescribing special standards and guidelines.
- Share information with state and private sectors to further activities directed at conserving *B. pseudocapillaris.*
- Continue to work with state and federal regulatory agencies to protect air quality on federally-managed lands from on- or off-site emissions, especially of nitrogen- and sulfur-containing pollutants.
- Provide information about conserving rare lichens at visitor centers or other locations along the coast to build public support of conservation efforts and to discourage collection of specimens.

V. RESEARCH, INVENTORY, AND MONITORING NEEDS

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

A. Data Gaps and Information Needs

- Revisit known sites to verify the status of the species, determine the extent of local populations, and better characterize habitat conditions.
- Determine if *B. pseudocapillaris* meets the criteria for being closely associated with late-successional and old-growth forests.
- 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.

B. Research Questions

- What are the dispersal rates and mechanisms of *B. pseudocapillaris*?
- Which habitat and microclimate characteristics are necessary for establishing *B. pseudocapillaris* thallus fragments and survival of established thalli?
- What is the genetic diversity of *B. 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 *B. pseudocapillaris*?
- Can transplants be used to create local populations of *B. pseudocapillaris* to increase its population base?

C. Monitoring Needs and Recommendations

- Monitor known 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 *B. pseudocapillaris* on federally-managed lands (currently the Lanphere Dunes Unit (Humboldt Bay National Wildlife Refuge, USFWS) and Sutton Creek Recreation Area (Siuslaw NF)) and assess threats to this species from present or projected air-quality trends.

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