Management Recommendations for

Pyrrhospora quernea (Dickson) Körber

version 2.0

CONTENTS

SUMMARY 1

I. Natural History 2
- A. Taxonomy and Nomenclature 2
- B. Species Description 2
  - 1. Morphology and Chemistry 2
  - 2. Reproductive Biology 2
  - 3. Ecological Roles 4
- C. Range and Known Sites 4
- D. Habitat Characteristics and Species Abundance 4

II. Current Species Situation 4
- A. Why Species Is Listed Under Survey and Manage Standard and Guideline 4
- B. Major Habitat and Viability Considerations 5
- C. Threats to the Species 5
- D. Distribution Relative to Land Allocations 6

III. Management Goal and Objectives 6
- A. Management Goal for the Species 6
- B. Objectives 6

IV. Habitat Management 6
- A. Lessons From History 6
- B. Identifying Habitat Areas for Management 7
- C. Managing in Habitat Areas 7
- D. Other Management Issues and Considerations 8

V. Research, Inventory, and Monitoring Needs 8
- A. Data Gaps and Information Needs 8
- B. Research Questions 8
- C. Monitoring Needs and Recommendations 9

REFERENCES 9

version 2.0

SUMMARY

Species: *Pyrrhospora quernea* (Dickson) Körber
Taxonomic Group: Lichens (Oceanic Influenced)
ROD Components: 1, 3
Other Management Status: None

Range: In the range of the Northwest Forest Plan, *P. quernea* is known from only four sites on federal land, two administered by the Siuslaw National Forest at the mouth of Gwynn Creek in the Cape Perpetua Special Interest Area, and at Horsefall Campground, Oregon Dunes National Recreation Area; BLM land on the southern end of Lopez Island in Washington, and Lanphere Dunes Unit (Humboldt Bay National Wildlife Refuge, USFWS). Other Oregon sites are Cape Blanco State Park, and private land near the Newport Beach Nelson Wayside. In Washington, it is also found at the Sequim Cemetery, and on San Juan Island and Fidalgo Island. The other California sites are Hookton Road, and Patricks Point State Park. In more southerly coastal areas of California, especially the Channel Islands, *P. quernea* is considered common.

Specific Habitat: In the Pacific Northwest, *P. 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 *P. quernea* is loss of populations from activities that adversely affect the habitat or the population, such as altering microclimate and removing colonized substrate. Because *P. quernea* is known from three sites on federal lands in the range of the Northwest Forest Plan, altering them could result in local extirpation of the species. 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 Recommendations:
- Manage known sites to maintain local populations and their habitat areas.
- Develop practices to route human use away from known sites.
- Manage fire in habitat areas, with emphasis on prevention near occupied substrates.
- Restrict removal of trees, shrubs, or other vegetation from known sites and habitat areas, except when removal will not harm habitat integrity.

Information Needs:
- Visit known sites to describe the geographical extent of local populations, and improve habitat descriptions.
- Determine if *P. quernea* is closely associated with late-successional and old-growth forest.
- Determine whether additional populations exist in areas identified as potential suitable habitat.

Management Recommendations for *Pyrrhospora quernea*

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.* 1992:523).

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.

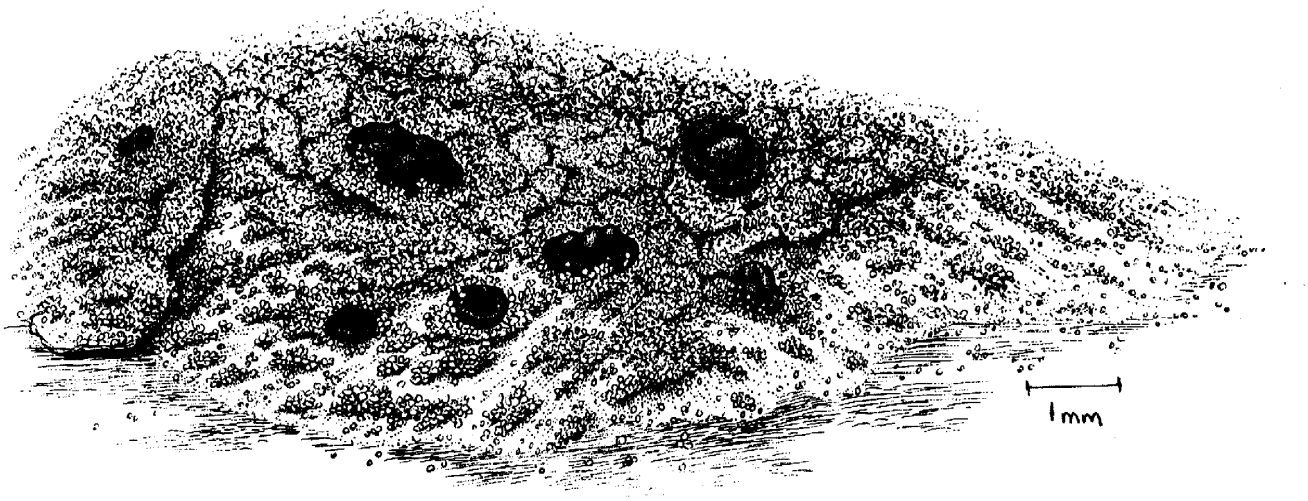

Figure 1. Line drawing of *Pyrrhospora quernea* by Alexander Mikulin.

3. Ecological Roles

Little to nothing is known of the ecological roles of *P. 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 Known 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. In the range of the Northwest Forest Plan, *P. quernea* is found at four sites on federal land, two administered by the Siuslaw National Forest, one by US Fish and Wildlife Service, and one by the BLM. The Siuslaw National Forest sites are at the mouth of Gwynn Creek in the Cape Perpetua Special Interest Area (Lincoln County), and Horsefall Campground parking lot, 1 km (0.6 mi) north of North Bend, in the Oregon Dunes National Recreation Area (Coos County). The USFWS site is Lanphere Dunes Unit (Humboldt Bay National Wildlife Refuge, Humboldt County) on the Samoa Peninsula. The BLM site is on the southern end of Lopez Island in San Juan County, Washington, where it is considered very common (Rhoades, pers. comm.). Two other Oregon sites are at Cape Blanco State Park (Curry County) and a parcel of private land near the Newport Beach Nelson Wayside. In Washington, it is also found at the Sequim Cemetery (Clallam County), on San Juan Island (San Juan County), and Fidalgo Island (Skagit County). Other California sites in the range of the Northwest Forest Plan Hookton Road (Humboldt County), and Patricks Point State Park (Humboldt County). In more southerly coastal areas of California, especially the Channel Islands, *P. quernea* is considered common.

D. Habitat Characteristics and Species Abundance

In the Pacific Northwest, *P. quernea* occurs in hypermaritime 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*) in old-growth stands. It also grows on 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. Why Species Is Listed Under Survey and Manage Standard and Guideline

Pyrrhospora quernea 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 four populations in the range of the northern spotted owl (USDA and USDI 1994b).

Because of persistence concerns, 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

Frequent fog along the coast, combined with moderate temperatures, create a suitable environment for ocean-influenced lichens like *P. 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 *P. 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 low elevation coastal forest land in the Pacific Northwest is under nonfederal ownership and, along the immediate coast, development pressures are increasing. Outside of urban areas, privately owned forests are generally managed on short harvest rotations. Given that lichens are slow to establish in rapidly growing stands and do not become abundant until late in successional development (USDA and USDI 1994a), most of these stands are harvested before lichens have a chance to re-establish significant populations.

C. Threats to the Species

Threats to *P. 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 *P. 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 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).

The air-pollution sensitivity of *P. 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

Two populations of *P. quernea* on federal land are administered by the Siuslaw National Forest. The population at Horsefall Creek is in part of the Oregon Dunes National Recreation Area, which is Congressionally withdrawn. The population at Gywnn Creek is inside the Cape Perpetua Special Interest Area, also congressionally withdrawn. Lanphere Dunes Unit is part of the Humboldt Bay National Wildlife Refuge (USDI 1997). The land allocation of the BLM site on Lopez Island needs to be determined.

III. Management Goal And Objectives

A. Management Goal for the Species

The goal for managing *P. quernea* 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 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 and 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 regional guidelines (Peterson *et al.* 1992).

B. Identifying Habitat Areas for Management

All known sites of *P. quernea* on federal land administered by the Forest Service or BLM in the range of the Northwest Forest Plan are identified as areas where these management recommendations should be implemented. 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 habitat conditions for *P. quernea*. Specific conditions for *P. quernea* are the foggy coastal headlands with old-growth Sitka spruce, shore pine, oak, elderberry, and old wood (such as wooden fence posts and old buildings).

- 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, 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 *P. quernea* (for example, by preventing deeply shaded conditions or by removing invasive exotics).
- Prevent fire in the population but 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.

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 *P. quernea.*

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

- Visit known sites to determine the extent of local populations, and improve habitat descriptions.
- Determine if *P. quernea* meets the criteria for being closely associated with late-successional and old-growth forests.
- Determine whether additional populations exist in areas identified as potential suitable habitat.

B. Research Questions

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

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.

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.

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.

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.

Rhoades, F. 1997. Personal communication. Western Washington University, Bellingham, WA.

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 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.