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Diversity and floristic patterns of epiphytic macrolichens on white oak in the Klamath-Siskiyou region

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ABSTRACT. – White oak (*Quercus garryana*) plant communities are one of the most threatened habitat types in the Pacific Northwest, and often host diverse and characteristic epiphyte communities. In order to better understand the diversity and floristic patterns of epiphytic macrolichens of these habitats in the Klamath-Siskiyou region we studied lichen communities in 52 plots within the Cascade-Siskiyou National Monument (CSNM). We report a rich flora of 96 species of epiphytes on *Quercus garryana*. Macrolichen species richness in the plots ranged between 12 and 49 species with an average of 24.7 species per plot. The most species-rich genera in descending order were: *Usnea, Physconia, Physcia, Hypogymnia, Melanohalea, Peltigera, Bryoria, Lobaria* and *Scytinium*. We found three rare species that are listed by the Oregon Biodiversity Information Center: *Hypotrachyna revoluta* (S3-vulnerable), *Collema curtisporum* (S1-critically imperiled), and *Rostania quadrifida* (S2-imperiled). *Placidium fingens* was recorded for the first time as an epiphyte in Oregon. We observed floristic patterns that indicate a mix of lichens from six distinct geographic floristic groups. Of these, the California Madrean floristic group had the fewest representative species but nonetheless included a number of species rare in Oregon such as *Melanelixia californica*, *Physconia californica* and *P. fallax*. We discuss how these new findings influence our current knowledge of oak lichen communities and dispersal corridors within the Klamath-Siskiyou region.

KEYWORDS. – California flora, biogeography, biodiversity, Siskiyou crest, woodlands, land bridge, Klamath River

INTRODUCTION

Oaks are a globally significant substrate for lichens, often hosting diverse communities and locally rare species (e.g. Kappelle & Sipman 1992; Upreti & Chatterjee 2000; Oran & Öztürk 2012; Villella et al. 2013b; Pérez-Pérez et al. 2015; Marmor et al. 2017; El Mokni et al. 2018). Oak-dominated habitats are often subject to intense anthropogenic influences that have substantial effects on lichen communities, such as burning, urbanization, and conversion to agriculture (van Herk 2001; Insarov et al. 2010; Aguillaume et al 2017; Güvenç & Öztürk 2017). In the Pacific Northwest humans have recently repressed wildfires in oak-dominated habitats leading to invasion by other tree species, such as conifers (Sugihara and Reed 1987; Engber et al. 2011). This region has seen a significant loss of white oak habitats; Washington State currently retains just nine percent of the oak savannah it contained before Euro-American settlement

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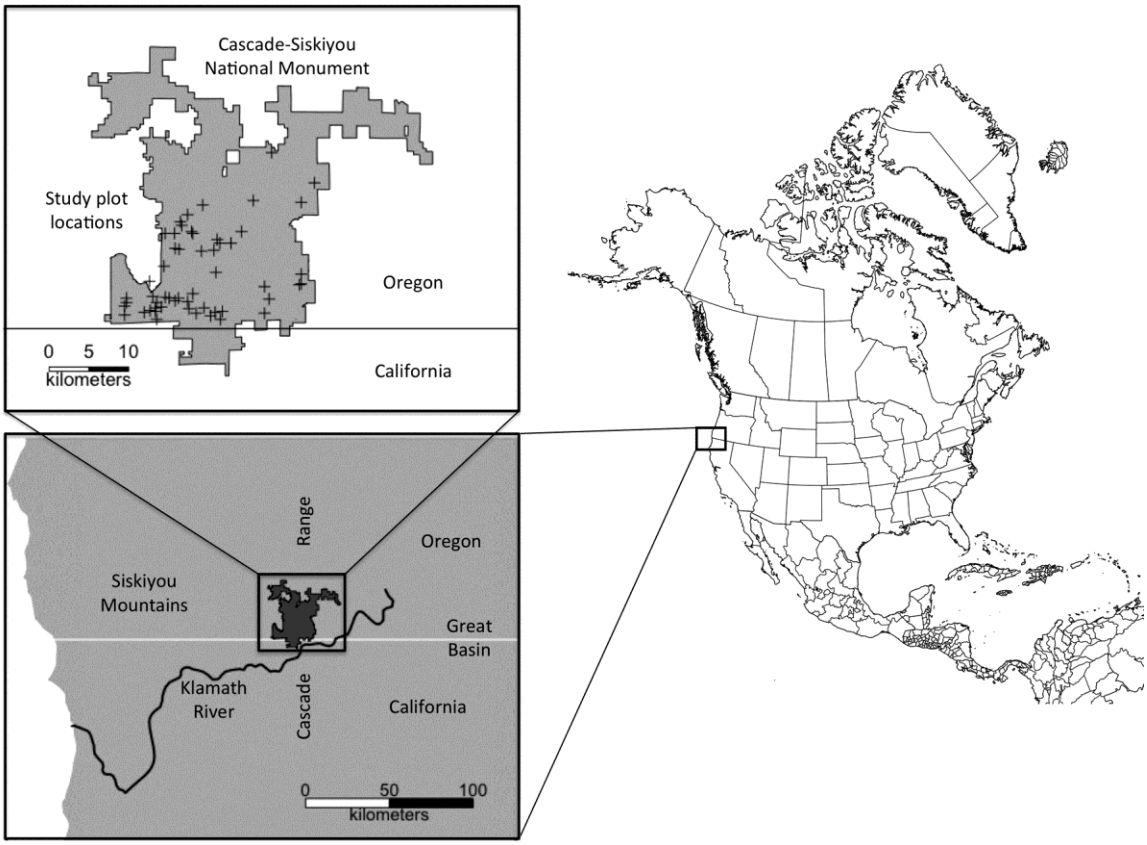

Figure 1. Location of Cascade-Siskiyou National Monument with plot locations depicted by a plus (+).

(Dunwiddie & Bakker 2011) and the reintroduction of prescribed fire has potential to threaten ground layer lichen and bryophyte communities in the remaining patches of oak prairie (Calabria et al. 2015). The Willamette Valley in northwest Oregon historically contained sixty-four percent white oak habitat (Christy & Alverson 2011), but now only one percent of the area remains in this vegetation type (Noss & Peters 1995). In California, oak lichens are threatened by air pollution, where estimates show that at least one third of the area occupied by these habitats exceed critical loads of airborne toxins (Fenn et al. 2014). These trends contribute to making white oak-dominated plant communities one of the most threatened habitat types in the Pacific Northwest (Dunwiddie & Bakker 2011).

White oak habitats in the Klamath-Siskiyou area of southwestern Oregon seem to have fared better, despite experiencing some anthropogenic alteration including shrub removal and grazing (DiPaolo & Hosten 2015). The oak habitats of the valley bottoms have been significantly impacted by urbanization and agriculture and have been identified as in need of conservation (Duren et al. 2012). This region sits at the intersection of several distinct ecoregions and is one of the most biodiverse regions in North America (DellaSala et al. 1999), in part because of its high geologic and topographic diversity and numerous vegetation types (Copeland & Harrison 2014). Major landscape features such as the Klamath River, that cuts across the Cascade Mountains from the desert-like communities to the east, and the Siskiyou crest, that connects the region to the wetter exterior coast ranges to the west, act as dispersal corridors and contribute to the rich variety of species found in the area (Parks et al. 2005). High levels of plant and animal endemism are found here because the area escaped recent glaciation and the rugged topography and geological diversity foster the survival of relict, often disjunct populations (Whittaker 1961; Stebbins & Major 1965; Bury & Pearl 1999; Coleman & Krukeburg 1999; Briles et al. 2005).

The Cascade-Siskiyou National Monument (CSNM) is a 134,774-acre (210 sq. mi.) public land reserve in southwest Oregon and Northwest California administered by the Bureau of Land Management (BLM) that has been designated to preserve the biodiversity of the area (Figure 1). Several studies within the CSNM have noted rare or disjunct populations of lichens, hinting at the significance of the Monument for lichen diversity (Wright 1998, Villella et al. 2010, McCune & Rosentreter 2014, Villella & Sheehy

2016). In this study, we explore white oak-dwelling epiphytic macrolichen species diversity in the CSNM and report new species records. Our findings will help managers develop conservation practices, including strategies for protecting rare species and small populations that occur in oak woodlands.

MATERIALS AND METHODS

We aimed to sample epiphytic lichen communities of *Quercus garryana* across the geographic range of the species within the CSNM. We delineated white oak-dominated habitats using aerial photographs in Google Earth. Within these habitats, we randomly selected approximately four points within each section (square mile) of CSNM. Of these points, 52 locations were selected for sampling because they represented the full spectrum of white oak habitats within CSNM and were deemed accessible by foot. We sampled macrolichens using a study plot design based on the Forest Inventory and Analysis (FIA) lichen plot method (FIA 2011). We used the FIA plot size (3,793 m^2), but we only sampled lichens from white oak within these plots.

At each plot a voucher specimen and an abundance estimate were collected for every macrolichen species occurring on white oak. Basic environmental data were recorded including: location, aspect, slope, and elevation. Voucher specimens for all rare or listed sensitive species have been deposited with the Forest Service's Interagency Special Status/Sensitive Species Program (ISSSSP) in the herbarium of Oregon State University (OSC), and at least one representative voucher for all other species encountered has been deposited in the herbarium of The Evergreen State College (EVE).

We queried two online lichen distribution databases, the Consortium of North American Lichen Herbaria (CNALH), and USFS Lichen and Air Quality Database (LAQD) (http://gis.nacse.org/lichenair/) along with regional lichen field guides (McCune & Geiser 2009; Sharnoff 2014) to construct distribution maps for each species. We then assigned a geographic floristic group that fit best for every species based on "floristic element" maps for western North America presented by Brodo et al. (2001).

RESULTS

A total of 96 macrolichens were identified from 1,841 collections across 52 plots (Appendix 1). Species richness at the plot level ranged from 12 to 49 species, with an average of 24.7 species per plot (Standard deviation = 7.1). Species found in 80% (41) or more of the plots were *Evernia prunastri*, *Melanohalea elegantula*, *Candelaria pacifica*, *Letharia vulpina*, *Parmelia barrenoae*, *Physconia americana* and *Usnea scabrata*. *Evernia prunastri* was the most frequent lichen occurring in 85% (44) of the plots. The genus with the most species was *Usnea,* making up roughly 10% (10) of the total species diversity. Other diverse genera included *Physconia* 6% (6), *Physcia* 6% (6), *Hypogymnia* 5% (5), *Melanohalea* 5% (5), *Bryoria* (5%), *Peltigera* 5% (5), *Lobaria* 4% (4) and *Scytinium* 4% (4). Forty-two percent (40) of the species were found in 5% (3) or fewer of the plots. Fourteen percent (13) of the species occurred in only one plot. Seventy-nine percent (76) of species were chlorolichens and 21% (20) were cyanolichens.

Macrolichen species that occurred on white oak in the CSNM had distribution patterns from six geographic floristic groups as delimited by Brodo et al. (2001). The breakdown of species per floristic group was as follows: 24% (23) were oceanic, 19% (18) were pan-temperate, 19% (18) were Pacific Northwest temperate, 15% (14) were west temperate, 13% (13) were Cascades-Northern Rockies western montane, and 5% (5) were California Madrean. Three species were listed with the Oregon Biodiversity Information Center and six species were range extensions based on CNALH records (detailed below).

DISCUSSION

The Klamath-Siskiyou region has been identified as a regional diversity hotspot for epiphytic lichens (Jovan 2008). Floristic studies from the region show distinct lichen communities with various dominant floristic affinities ranging from Oceanic in the Illinois River watershed to the west (Villella et al. 2013a), California Madrean in California's Central Valley to the south (Carlberg et al. 2017) and Cascades-Northern Rockies Western Montane in Lava Beds National Monument to the east (Sheehy 2017). The macrolichens found on oaks within CSNM exhibit a mix of these floristic influences along with the more widespread temperate elements characteristic of the broader Pacific Northwest.

Regionally noteworthy species such as *Collema curtisporum*, *Dendriscocaulon intricatulum* and

Hypotrachyna revoluta exhibit abundance and distribution patterns that point to the importance of dispersal corridors for rare lichen occurrences within the region. The proximity of the Siskiyou Crest and the Klamath River canyon provide dispersal corridors from the coastal ranges and the great basin. Species such as *Melanelixia californica*, *Physconia californica* and *Physconia fallax* that are at the northern edge of their range here represent rare occurrences for Oregon.

REPORTS OF NOTEWORTHY SPECIES

The following section gives details of species representing range extentions or rare species listed by Oregon Biodiversity Information Center. Voucher data are listed at the end of each entry; all cited specimens are deposited in the herbarium of Oregon State University (OSC).

Collema curtisporum Degel. – ONHP S1 – Critically Imperiled

This species is distinguished from the sympatric *Collema nigrescens* (Hudson) DC. by its shorter, 4-celled spores. It is thought of as being more common on the east side of the Cascade crest growing on cottonwood, being replaced on the west side by *C. nigrescens* commonly growing on oaks (McCune & Geiser 2009). This pattern seems to hold true for the broader Pacific Northwest (Exeter et al. 2016), but in the case of the CSNM *C. curtisporum* is the more common species. It was found in 26% (14) of the plots as opposed to *C. nigrescens* that occurred in only 2% (1) of plots. This species is from the Cascades-Northern Rockies Western Montane group and highlights the east side montane influence on this area. The local abundance within CSNM may be linked to the proximity of the Klamath River canyon that provides a dispersal corridor where cottonwood and white oak grow in close proximity.

Specimens examined. – **U.S.A. OREGON.** JACKSON CO: Cascade-Siskiyou National Monument, oak-pine-fescue habitat, 04.iv.2016, on trunk of *Quercus garryana, L. Kyan & S. Pierce 6-27* (OSC); 05.iv.2016, *T. Carlberg 10-6* (OSC); Cascade-Siskiyou National Monument, in oak-conifer mosaic, 08.iv.2016, *D. Stone 29-18* (OSC); Cascade-Siskiyou National Monument, in oak-juniper-fescue habitat type, 21.iv.2016, *A. Hardman 212-2* (OSC).

Dendriscocaulon intricatulum (Nyl.) Henssen (oak form)

The genus "*Dendriscocaulon*" is actually the fruticose cyanomorphs of foliose species of *Ricasolia*, *Lobaria* or *Sticta*. There are two distinct forms of dendricocauloid lichens known in the Pacific Northwest, the oak-dwelling form and the conifer-dwelling form (McCune & Geiser 2009). It has been speculated that our oak-dwelling form may correspond to *R. amplissima* (Scop.) De Not. (Cornejo et al. 2017) based on one small composite specimen from oak in Northern California (Tonsberg & Goward 2001) but this has not been confirmed with molecular data. This lichen is somewhat common in the Klamath ranges where it occurs on a variety of different oak species. It occurred in four plots in CSNM.

Specimens examined. **U.S.A. OREGON.** JACKSON CO: Cascade-Siskiyou National Monument, in oak-pine habitat, 04.iv.2016, *T. Carlberg 13-20* (OSC); Cascade-Siskiyou National Monument, in oak-pine-fescue habitat, 21.iv.2016, *A. Hardman 209-33* (OSC), 08.iv.2016, *D. Stone 8B-38* (OSC); Cascade-Siskiyou National Monument, in oak-big leaf maple habitat, 21.iv.2016, *A. Hardman 219-25* (OSC).

Hypotrachyna revoluta (Flörke) Hale – ONHP S3 –Vulnerable

This species is currently known from coastal California north to British Columbia where it is locally common. In Oregon it is rare, found on the coast and in the foothills of the Cascades (Exeter et al. 2016). It is tolerant of elevated nitrogen at some coastal sites (McCune 2003). The single record from CSNM is the first for Jackson County, and an eastern outlier population. *Hypotrachyna revoluta* is from the oceanic floristic group and occurs in the CSNM as a rare inland disjunct from the Coast Ranges of Coos and Curry Counties. The occurrence here may be facilitated by the land bridge provided by the Siskiyou crest. Although this species is not yet reported from Josephine County, we predict that targeted searches in the Klamath and Coast Ranges there could turn up new populations of this rare lichen.

Specimen examined. – **U.S.A. OREGON.** JACKSON CO: Cascade-Siskiyou National Monument, in a closed canopy creekside oak woodland, 06.x.2016, on *Quercus garryana*, *J. Villella JNL12-38* (OSC).

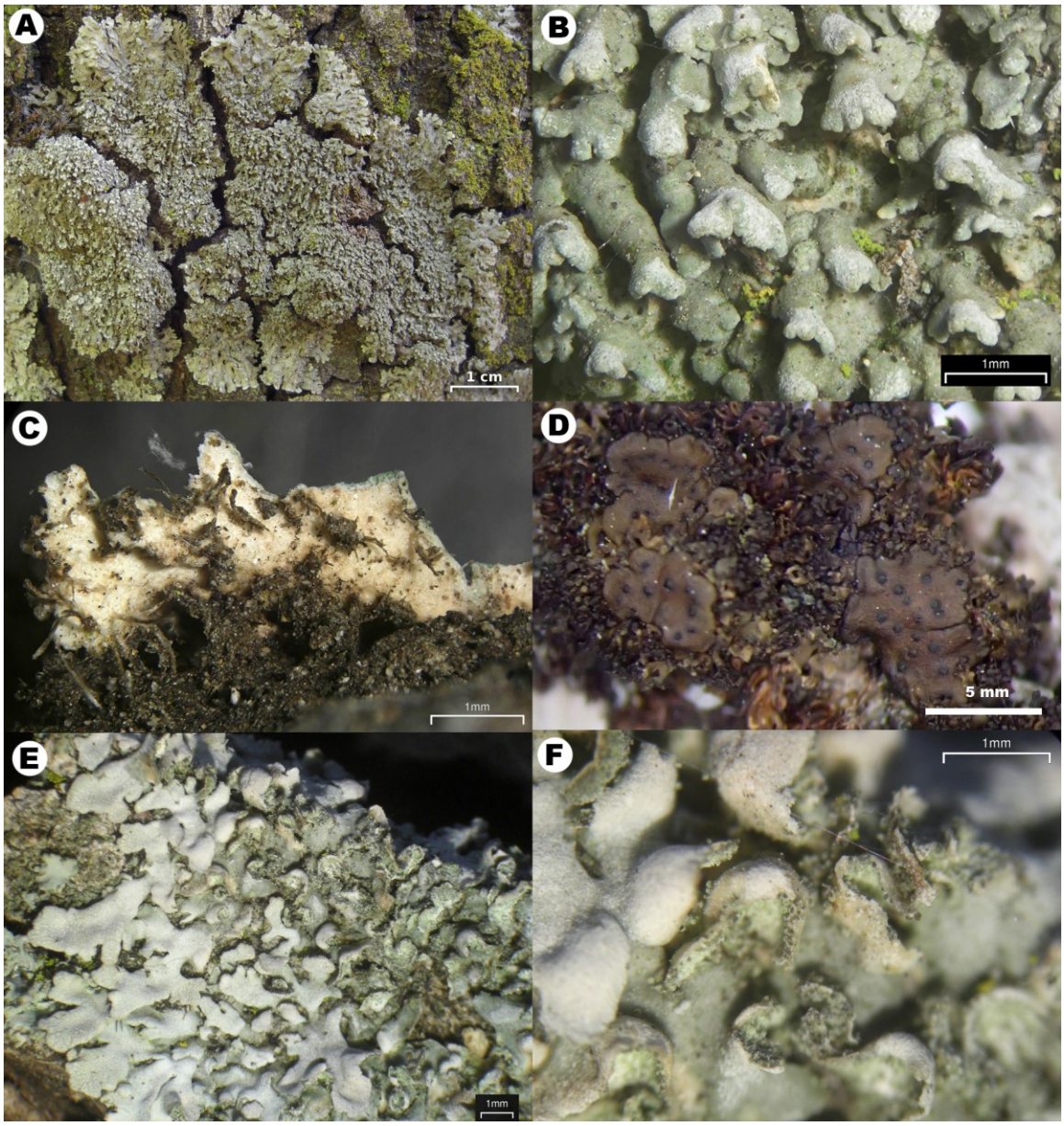

Figure 2. *Physconia californica* (A-C, all from *Hollinger 4524*), *Physconia fallax* (E-F, from *Hollinger 1151*) and *Placidium fingens* (D, from *Stone 9268*). A, habit of *P. californica*. B, detail of upper surface of *P. californica*. C, detail of light colored lower surface of *P. californica*. D, thallus of *P. fingens* growing over *Scytinium* on oak branch. E, habit of *P. fallax*. F, detail of hooded soralia in *P. fallax*. Photographs of *P. californica* and *P. fallax* by Jason Hollinger, photograph of *P. fingens* by Daphne Stone. Scale bars as indicated.

Melanelixia californica A. Crespo & Divakar

A species that is mostly restricted to California, it is most frequent in the Sierra Nevada and the southern mountains (Sharnoff 2014). In CSNM this is a representative of the California Madrean floristic group. The specimens cited represent a new species occurence for Oregon.

Specimens examined. – ***U*.S.A. OREGON.** JACKSON CO: Cascade-Siskiyou National Monument, in oak-juniper-fescue habitat, 19.iv.2016, *A. Hardman 201-9* (OSC); Cascade-Siskiyou National Monument, in open oak savannah grassland, 06.x.2016, on *Quercus garyanna J. Villella JNL 11-01* (OSC).

Physcia aipolia (Ehrh. ex Humb.) Fürnr.

Recently North American material traditionally identified as *Physcia aipolia* has been critically examined, resulting in most of the material from the Pacific Northwest being recognized as *Physcia alnophila* (Vain.) Loht., Moberg, Myllys & Tehler, with *P. aipolia s. str.* being much rarer in the region (Brodo et al. 2013). *Physcia alnophila* is distinguished as having narrower lobes and apothecia near the margin as opposed to *P. aipolia* that has more central apothecia and wider lobes. *Physcia aipolia* contains several triterpines in addition to atranorin and zeorin that are lacking in *P. alnophila*. Spores on average are smaller in *P. alnophila* although there is a significant area of overlap in this character among individual specimens (Brodo et al. 2013). Of the oak dwelling specimens in CSNM most material is clearly assignable to *P. alnophila*, but four specimens conform morphologically to the species concept for *P. aipolia* in the strict sense.

Specimens examined. – **U.S.A. OREGON.** JACKSON CO: Cascade-Siskiyou National Monument, in juniper-oak-fescue habitat, 22.iv.2016, *A. Hardman 225-25* (OSC); Cascade-Siskiyou National Monument, in oak-juniper chaparral, 04.ix.2016, *J. Villella JL02-8* (OSC); Cascade-Siskiyou National Monument, in open in oak savannah grassland, 06.x.2016, on *Quercus garryana J. Villella JNL11-8* (OSC); Cascade-Siskiyou National Monument, in pine-oak mosaic, 18.viii.2106, *J. Villella JNL2-09* (OSC).

Physcia subalbinea Nyl.

This species is apparently rare in Oregon, known to grow on rocks in the high desert environments of central Oregon. We found it in two plots as an oak epiphyte. Predominantly rock-dwelling or soil species occurred as oak epiphytes several times during this study (e.g. *Polychidium muscicola* (Sw.) Gray, *Scytinium lichenoides* (L.) Otálora, P. M. Jørg. & Wedin and *Xanthoparmelia* species and this is a pattern seen occasionally in southwestern Oregon.

Specimens examined. – **U.S.A. OREGON.** JACKSON CO: Cascade-Siskiyou National Monument, in mountain mahogany-oak-fescue habitat, 22.iv.2016, *A. Hardman 226-33* (OSC); Cascade-Siskiyou National Monument, in oak-conifer woodland, 18.viii.2016, *J. Villella JNL1-20* (OSC).

Physciella chloantha (Ach.) Essl.

This very widespread species across North America has not been reported from the Pacific Northwest (McCune & Geiser 2009). The occurrence in CSNM is a new report for Oregon. Its presence in the Cascade-Siskiyou region may represent a relict population from an earlier time when climate conditions were different or a more recent arrival.

Specimen examined. – **U.S.A. OREGON.** JACKSON CO: Cascade-Siskiyou National Monument, in oak-juniper-fescue habitat, 18.iv.2018, *A. Hardman 217-19* (OSC).

Physconia californica Essl.

This species is distinguished from the very common species *Physconia americana* Essl. by the lighter underside (Figure 2C). *Physconia californica* has a California Madrean distribution, being common in central to southern California (Jovan 2003, Sharnoff 2014) but it is rare in northern California being known with certainty only from Tehama County (Carlberg et al. 2017). This species was found in two plots in CSNM where it is likely at the northern edge of its range in southwest Oregon.

Specimens examined. – **U.S.A. OREGON.** JACKSON CO: Cascade-Siskiyou National Monument, in oak-juniper chaparral, 19.iv.2016, *A. Hardman 200-16* (OSC); Cascade-Siskiyou National Monument, in oak-pine-fescue habitat, 10.iv.2016, *D. Stone 278-20* (OSC).

Physconia fallax Essl.

Similar to the very common *Physconia enteroxantha* (Nyl.) Poelt, this species is distinguished by the K-, KC- medulla and the tendency of the soralia to be borne in marginal circular pockets, reminiscent of *Xanthoria fallax* Essl. (Figure 2F). *Physconia fallax* has a California Madrean distribution with herbarium records from California and northern Baja California on oaks and rock (CNALH 2018). It was found in the CSNM in eleven plots. There are some nearby sites from northern California where it is common (Jovan

Figure 4. Habit of *Platismatia wheeleri* (*Hollinger 9225*; photograph by Jason Hollinger).

2003), but this is apparently a new record for Oregon. Jovan (2003) reported that maximum temperature was the best predictor for this species in north-central California. This suggests that increasing temperatures due to climate change could increase the ability of the species to persist in Oregon. This species may be underreported for the Pacific Northwest due to its cryptic nature, as underdeveloped material is difficult to distinguish in the field and it often grows in mixed patches with other *Physconia* species. It is known from one site in Washington on white oak (Esslinger 2000) and is common in southern California where it has an oceanic affinity (Sharnoff 2014).

Specimens examined. – **U.S.A. OREGON.** JACKSON CO: Cascade-Siskiyou National Monument, in oak-pine-fescue habitat, 04.iv.2016, *L. Kyan & S. Pierce 6-11* (OSC), 05.iv.2016, *T. Carlberg 10-23* (OSC), 19.iv.2016, *A. Hardman 201-16* (OSC); Cascade-Siskiyou National Monument, in oak-conifer mosaic, *J. Villella JNL1-16* (OSC).

Placidium fingens (Breuss) Breuss

This inconspicuous peritheciate lichen is rarely found in western North America where it occurs in two distinct habitats: on soil among crust communities and as an oak epiphyte, always growing over *Scytinium* in the Pacific Northwest (Figure 2D). There are two collections on soil from the same site in Arizona (Breuss 2002), collections on bark from four sites California (Breuss & Bratt 2000), and one on oak bark in Washington (Villella et al. 2013b). In Oregon it has been reported on soil among soil crusts (Root et al. 2011). This report is the first occurrence for Oregon as an oak epiphyte; it was found in two plots. Breuss (2002) stated that epiphytic and soil dwelling material from the American west "agree in all important respects". However, Prieto et al. (2010) stated that North American material was distinct from Iberian material in having smaller ascospores and longer conidia, also pointing out that this species does not occur as an epiphyte on the Iberian Peninsula. More work is needed to determine if the North American soil or oak-dwelling material is distinct from *P. fingens s. str*.

Specimens examined. – **U.S.A. OREGON.** JACKSON CO: Cascade-Siskiyou National Monument, in oak-pine-fescue habitat, 04.iv.2016, *L. Kyan & S. Pierce 6-39* (OSC), 10.iv.2016, *L. Kyan & S. Pierce 273-28* (OSC).

Platismatia wheeleri Goward, Altermann & Björk

This species is similar to the widespread *Platismatia glauca* (L.) W.L. Culb. & C. F. Culb. but is distinguished by having marginal, sinuose soralia and no isidia (Figure 3). The distribution of this recently described species is not completely known. In the species description it is characterized as a western montane conifer-dwelling species found in the inland Pacific Northwest (Lumbsch et al. 2011). Allen et al. (2012) reported it from collections in southern California and Slovakia. It has been reported from white oak on the west side of the Cascade crest in the south Puget Sound prairie of Washington State (Villella et al. 2013a). We report it as common on oak in the CSNM, found in equal abundance as *P. glauca*, and in roughly half the plots.

Specimens examined. – **U.S.A. OREGON.** JACKSON CO: Cascade-Siskiyou National Monument, in oak-juniper chaparral, 19.iv.2016, *A. Hardman 200-6* (OSC), Cascade-Siskiyou National Monument, in oak-juniper-fescue habitat, 06.iv.2016, *T. Carlberg 243-26* (OSC). 07.iv.2016, *L. Kyan & S. Pierce 262-5* (OSC), 08.iv.2016, *D. Stone 8B-18* (OSC).

Rostania quadrifida (D. F. Stone & McCune) McCune – ONHP S2 – Imperiled

This oak-dwelling cyanolichen species might be confused with a young *Collema curtisporum* or *C. nigrescens* but it is smaller with a thickened margin, abundant apothecia, and cubical ascospores. Our results show that this species is common in the CSNM, occurring in 19% of the plots. Although locally common in the Klamath Mountain ranges this species seems to be rare in the broader Pacific Northwest. This pattern of species being locally abundant in the Klamath-Siskiyou region but otherwise regionally rare is shared by several macrolichens including *Collema curtisporum, Scytinium siskiyouensis* (D. F. Stone & Rutchy) Otálora, P. M. Jørg. & Wedin*, S. teretiusculum* (Wallr.) Otálora, P. M. Jørg. & Wedin and *Umbilicaria phaea* var. *coccinea* Llano.

Specimens examined. – **U.S.A. OREGON.** JACKSON CO: Cascade-Siskiyou National Monument, in oak-juniper-fescue habitat, 04.iv.2016, *L. Kyan & S. Pierce 6-35*(OSC), 08.iv.2016, *D. Stone 27-26* (OSC); Cascade-Siskiyou National Monument, in oak-pine habitat, 04.iv.2016, *T. Carlberg 13-27* (OSC); Cascade-Siskiyou National Monument, in oak savannah, 03.ix.2016, *J. Villella 159-20* (OSC).

Xanthoria parietina (L.) Th. Fr.

Although there are several early reports of this species from Oregon (Lindblom 1997), most collections are from recent times in nitrogen-enriched settings (McCune 2003). In 2000 this species was collected from Lithia Park in Ashland (LAQD 2018) and is currently somewhat common on street trees in the urban areas of the Rogue Valley (J. Villella personal observation). It was found in three plots within CSNM and due to its pollution tolerant nature (McCune & Geiser 2009) it may become more common within the Monument if air quality conditions deteriorate.

Specimens examined. – **U.S.A. OREGON.** JACKSON CO: Cascade-Siskiyou National Monument, in oak-juniper chaparral, 19.iv.2016, *A. Hardman 200-29* (OSC); Cascade-Siskiyou National Monument, in oak-juniper-fescue habitat, 19.iv.2016, *A. Hardman 201-21* (OSC).

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LITERATURE CITED

Aguillaume, L., A. Avila, P. Pinho, P. Matos, E. Llop, and C. Branquinho. 2017. The critical levels of atmospheric ammonia in a Mediterranean holm-oak forest in north-eastern Spain. Water, Air, and Soil Pollution 228: 93.

Allen, J.L., B.P. Hodkinson and C.R. Björk 2012. A major range expansion for *Platismatia wheeleri*. North American Fungi 7: 1–12.

Breuss, O. 2002. *Placidium. In:* Nash III, T.H., B.D. Ryan, C. Gries and F. Bungartz. (eds.): *Lichen Flora of the Greater Sonoran Desert Region, Volume I*. Lichens Unlimited, Tempe, Arizona. Pp. 384-393.

Breuss, O. and C.C. Bratt. 2000. Catapyrenioid lichens in California. Bulletin of the California Lichen Society 7: 36–43.

Briles, C., C. Whitlock and P. Bartlein. 2005. Postglacial vegetation, fire, and climate history of the Siskiyou Mountains, Oregon, USA: Quaternary Research 64: 44–56.

Brodo, I.M., S. Duran Sharnoff and S. Sharnoff. 2001. *Lichens of North America*. Yale University Press, New Haven & London. 795 pp.

Brodo, I.M., C. Freebury and N. Alfonso. 2013. Notes on the lichens *Physcia aipolia* and *Physcia alnophila* in North America. Evansia 30: 110–119.

Bury, R.B. and C. Pearl. 1999. Klamath-Siskiyou herpetofauna: Biogeographic patterns and conservation strategies. Natural Areas Journal 19: 341–350.

Calabria, L., K.M. Petersen, S.T. Hamman and R.J. Smith. 2015. Prescribed fire decreases lichen and bryophyte biomass and alters functional group composition in Pacific Northwest prairies. Northwest Science 90: 470–483.

Carlberg, T., J. Riddell, R. Fischer and A. Craig. 2017. Macrolichen inventory for Dye Creek Preserve, Los Molinos, California. Bulletin of the California Lichen Society 24: 22–35.

Christy, J. and E. Alverson. 2011. Historical vegetation of the Willamette Valley, Oregon, circa 1850. Northwest Science 85: 93–107.

Coleman, R.G. and A.R. Kruckeburg. 1999. Geology and plant life of the Klamath-Siskiyou mountain area. Natural Areas Journal 19: 320–340

Consortium of North American Lichen Herbaria (CNALH). 2018: http//:lichenportal.org/portal/index.php. Last accessed on January 08, 2018.

Copeland, S. and S. Harrison. 2014. Identifying plant traits associated with topographic contrasts in a rugged and diverse region (Klamath-Siskiyou Mts, OR, USA). Ecography 38: 569–577

Cornejo, C., C. Derr and K. Dillman. 2017. *Ricasolia amplissima* (Lobariaceae): one species, three genotypes and a new taxon from south-eastern Alaska. The Lichenologist 49: 579–596.

DellaSala, D.A., S.B. Reid, T.J. Frest, J.R. Strittholt M.D. and Olson. 1999. A global perspective on the biodiversity of the Klamath-Siskiyou ecoregion. Natural Areas Journal 19: 300–319.

DiPaolo, D. and P.E. Hosten. 2015. Vegetation change following the Forest Reserve Homestead Act of 1906 in the Applegate River watershed, Oregon. Madroño 62: 101–114.

Dunwiddie, P.W. and J.D. Bakker. 2011. The future of restoration and management of prairie-oak ecosystems in the Pacific Northwest. Northwest Science 85: 83–92.

Duren, O.C., P.S. Muir and P.E. Hosten. 2012. Vegetation change from the Euro-American settlement era to the present in relation to environment and disturbance in southwest Oregon. Northwest Science 86: 310–328.

Engber, E.A., J.M. Varner III, L.A. Arguello and N.G. Sugihara. 2011. The effects of conifer encroachment and overstory structure on fuels and fire in an oak woodland landscape. Fire Ecology 7: 32–50.

El Mokni, R., L. Boutabia-Telailia and M.H. El Aouni. 2018. Occurrence and bioindication of lichens within oak forests of Tunisia. *In:* Kallel, A., M. Ksibi, H. Ben Dhia and N. Khélifi (eds). *Recent Advances in Environmental Science from the Euro-Mediterranean and Surrounding Regions*. EMCEI 2017. Springer, Cham. Berlin, Germany. Pp: 1463–1465.

Esslinger, T.L. 2000. A key for the lichen genus *Physconia* in California, with descriptions for three new species occurring within the state. Bulletin of the California Lichen Society 7(1): 1-6.

Esslinger, T.L. 2018. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada, version 22. Opuscula Philolichenum 17: 6–268.

Exeter, R.L., C. Glade and S. Loring. 2016. *Rare Lichens of Oregon*. Salem District, Bureau of Land Management, Salem Oregon. 195 pp.

Fenn, M.E., H. Dieter Nagel, I. Koseva, J. Aherne, S.E. Jovan, L.H. Geiser, A. Schlutow, T. Scheuschner, A. Bytnerowicz, B.S. Gimeno, F. Yuan, S.A. Watmough, E.B. Allen, R.F. Johnson and T. Meixner. 2014. A comparison of empirical and modelled nitrogen critical loads for Mediterranean forests and shrublands in California. *In:* M.A. Sutton et al. (eds.), *Nitrogen Deposition, Critical Loads and Biodiversity*. Springer. Pp. 357–368.

Forest Inventory and Analysis (FIA) National Program. 2011. FIA lichen communities protocol: https://www.fia.fs.fed.us/library/field-guides-methods-proc/docs/2012/field_guide_p3_5-1_sec21_10_2011.pdf.

Güvenç, Ş. and Ş. Öztürk. 2017. Difference in epiphytic lichen communities on *Quercus cerris* from urban and rural

areas in Bursa (Turkey). Pakistan Journal of Botany 49: 631–637.
Insarov, G.E., E.E. Moutchnik and I.D. Insarova. 2010. Epiphytic lichens under air pollution stress in Moscow: Methodology for long-term monitoring. Problems of Ecological Monitoring and Ecosystem Modelling 23: 277–296.
Jovan, S. 2003. Distributions and habitat models of epiphytic *Physconia* in north-central California. Bulletin of the California Lichen Society 10: 29–35.
Jovan, S. 2008. *Lichen Bioindication of biodiversity, air quality, and climate: baseline results from monitoring in Washington, Oregon, and California*. USDA Forest Service, General Technical Report GTR-PNW 737. 115 pgs.
Kappelle, M. and H.J.M. Sipman. 1992. Foliose and fruticose lichens of Talamanca montane *Quercus* forests, Costa Rica. Brenesia 37: 51–58.
Lindblom, L. 1997. The genus *Xanthoria* (Fr.) Th. Fr. in North America. Journal of the Hattori Botanical Laboratory 83: 75–172.
Lumbsch, H.T., T. Ahti, S. Altermann, G. Amo De Paz, A. Aptroot, U. Arup, A. Bárcenas Peña, P.A. Bawingan, M.N. Benatti, L. Betancourt, C.R. Björk, K. Boonpragob, M. Brand, F. Bungartz, M.E.S. Cáceres, M. Candan, J.L. Chaves, P. Clerc, R. Common, B.J. Coppins, A. Crespo, M. Dal-Forno, P.K. Divakar, M.V. Duya, J.A. Elix, A. Elvebakk, J.D. Fankhauser, E. Farkas, L. Itatí Ferraro, E. Fischer, D.J. Galloway, E. Gaya, M. Giralt, T. Goward, M. Grube, J. Hafellner, J.E. Hernández M., M.A. Herrera Campos, K. Kalb, I. Kärnefelt, G. Kantvilas, D. Killmann, P. Kirika, K. Knudsen, H. Komposch, S. Kondratyuk, J.D. Lawrey, A. Mangold, M.P. Marcelli, B. McCune, M.I. Messuti, A. Michlig, R. Miranda González, B. Moncada, A. Naikatini, M.P. Nelsen, D.O. Øvstedal, Z. Palice, K. Papong, S. Parnmen, S. Pérez-Ortega, C. Printzen, V.J. Rico, E. Rivas Plata, J. Robayo, D. Rosabal, U. Ruprecht, N. Salazar, L. Sancho, L. Santos De Jesus, T. Santos Vieira, M. Schultz, M.R.D. Seaward, E. Sérusiaux, I. Schmitt, H.J.M. Sipman, M. Sohrabi, U. Søchting, M.Z. Søgaard, L.B. Sparrius, A. Spielmann, T. Spribille, J. Sutjaritturakan, A. Thammathaworn, A. Thell, G. Thor, H. Thüs, E. Timdal, C. Truong, R. Türk, L. Umaña Tenorio, D.K. Upreti, P. van den Boom, M. Vivas Rebuelta, M. Wedin, S. Will-Wolf, V. Wirth, N. Wirtz, R. Yahr, K. Yeshitela, F. Ziemmeck, T. Wheeler and R. Lücking 2011. One hundred new species of lichenized fungi: a signature of undiscovered global diversity. Phytotaxa 18: 1-127.
Marmor, L., T. Randlane, I. Juriado and A. Saag. 2017. Host tree preferences of red-listed epiphytic lichens in Estonia. Baltic Forestry 23: 364–373.
McCune, B. 2003. An unusual ammonia-affected lichen community on the Oregon coast. Evansia 20: 132–137.
McCune, B. and L. Geiser. 2009: *Macrolichens of the Pacific Northwest. Second Edition*. Oregon State University Press, Corvallis. 464 pp.
McCune, B. and R. Rosentreter. 2014. New lichen records from Oregon to Alaska in North America. Evansia 31: 1–7.
Noss, R.F. and R.L. Peters. 1995. Endangered ecosystems. A status report on America's vanishing habitat and wildlife. Defenders of Wildlife, Washington, DC. 151 pgs.
Oran, S. and S. Öztürk 2012. Epiphytic lichen diversity on *Quercus cerris* and *Q. frainetto* in the Marmara region (Turkey) [Marmara bölgesi'ndeki *Quercus cerris* ve *Q. frainetto* üzerindeki epifitik liken çeşitliliği]. Turkish Journal of Botany 36: 175–190.
Parks, C.G., S.R. Radosevich, B.A. Endress, B.J. Naylor, D. Anzinger, L.J. Rew, B.D. Maxwell and K.A. Dwire. 2005. Natural and land-use history of the Northwest mountain ecoregions (USA) in relation to patterns of plant invasions. Perspectives in Plant Ecology, Evolution and Systematics 7: 137–158
Pérez-Pérez, R.E., G. Castillo-Campos and M.E.D.S. Cáceres. 2015. Diversity of corticolous lichens in cloud forest remnants in la Cortadura, Coatepec, Veracruz, México in relation to phorophytes and habitat fragmentation. Cryptogamie, Mycologie 36(1): 79-92.
Prieto, M., G. Aragón and I. Martínez 2010. The genus *Catapyrenium* s. lat. (Verrucariaceae) in the Iberian Peninsula and the Balearic Islands. The Lichenologist 42: 637–684.
Root, H. T., J. E. D. Miller and B. McCune. 2011: Biotic soil crust lichen diversity and conservation in shrub-steppe habitats of Oregon and Washington. The Bryologist 114(4): 796-812.
Sharnoff, S. 2014. *A Field Guide to California Lichens*. Yale University Press. New Haven, Conneticut. 505 pp.
Sheehy, S. 2017. Grant enables increase to lichen list of Lava Beds National Monument in Siskiyou and Modoc Counties, California. Bulletin of the California Lichen Society 24: 6–15.
Sugihara, N.G. and L.J. Reed. 1987. *Vegetation Ecology of the Bald Hills Oak Woodlands of Redwood National Park.* Redwood National Park Research and Development Technical Report 21. Redwood National Park, Arcata, CA. 78 pp.
Stebbins, G.L. and J. Major. 1965. Endemism and speciation in the California flora. Ecological Monographs 35: 1–35.
Tønsberg, T. and T. Goward. 2001. *Sticta oroborealis* sp. nov. and other Pacific North American lichens forming dendriscocauloid cyanotypes. The Bryologist 104: 12–23.
Upreti, D.K. and S. Chatterjee. 2000. Distribution of lichens on *Quercus* and *Pinus* trees in Almora district, Kumaon Himalayas, India. Geophytology 28: 41–49.
United States Forest Service National Lichen Air Quality Database: 2018 http://gis.nacse.org/lichenair/ last accessed January 11, 2018.

van Herk, C.M. 2001. Bark pH and susceptibility to toxic air pollutants as independent causes of changes in epiphytic lichen composition in space and time. The Lichenologist 33: 419–441.
Villella, J., S. Benson, T. Carlberg, J.E.D. Miller, and E.B. Peterson. 2010. The lichens of the Horseshoe Ranch Wildlife Area. Bulletin of the California Lichen Society 17: 9–12.
Villella, J., S. Loring and B. McCune. 2013a. The lichens of southwest Oregon's Illinois River watershed. Bulletin of the California Lichen Society 20: 33–48.
Villella, J., D. Stone, L.M. Calabria and G.D. Eide. 2013b. Macrolichen communities of *Quercus garryana* in the Puget Trough and Columbia River Gorge areas of Washington State. North American Fungi 8: 1–22.
Villella, J. and S. Sheehy. 2016. Additional site of Umbilicaria hirsuta from southwestern Oregon and the associated lichenicolous fungus *Arthonia circinata* new to North America. Bulletin of the California Lichen Society 22: 19–21.
Whittaker, R.H. 1961. Vegetation history of the Pacific coast states and the 'central' significance of the Klamath region. Madroño 16: 5–23.
Wright, D. 1998. Collections from the 1998 Northwest Lichen Guild - CALS field trip to the Pilot Rock area, Siskiyou Mountains, Jackson County, Oregon, May 23, 1998. Bulletin of the California Lichen Society 5: 28–37.

Appendix I – Macrolichens of *Quercus garryana* in the Cascade-Siskiyou National Monument

Nomenclature follows Esslinger (2018). Bolded species are listed with ORBIC. Species recommended for conservation ranking in Oregon are denoted with an asterisk (*). Floristic group is denoted as: (PT) pan-temperate, (NW) Pacific Northwest temperate, (WT) west temperate, (WM), western montane, (OC) oceanic, (CM) California madrean.

Ahtiana sphaerosporella (Müll. Arg.) Howard - WM
Alectoria sarmentosa (Ach.) Ach. – NW
Bryoria capillaris (Ach.) Brodo & D. Hawksw. – NW
Bryoria fremontii (Tuck.) Brodo & D. Hawksw. – NW
Bryoria fuscescens (Gyeln.) Brodo & D. Hawksw. – PT
Bryoria pseudofuscescens (Gyeln.) Brodo & D. Hawksw. – NW
Bryoria simplicior (Vain.) Brodo & D. Hawksw. – WM
Candelaria pacifica M. Westb. & Arup – WT
Cetraria chlorophylla (Willd.) Hale – NW
Cetraria orbata (Nyl.) Fink – NW
Cetraria platyphylla Tuck. – NW
Cladonia chlorophaea (Flörke ex Sommerf.) Sprengel – PT
Cladonia fimbriata (L.) Fr. – PT
***Collema curtisporum* Degel.** – WM
Collema nigrescens (Hudson) DC. – OC
Dendriscocaulon intricatulum (Nyl.) Henssen – OC
Evernia prunastri (L.) Ach. – NW
Hypogymnia enteromorpha (Ach.) Nyl. – OC
Hypogymnia imshaugii Krog – NW
Hypogymnia physodes (L.) Nyl. – WM
Hypogymnia tubulosa (Schaerer) Hav. – NW
Hypogymnia wilfiana Goward, T. Sprib. & Ahti – WM
***Hypotrachyna revoluta* (Flörke) Hale** – OC
Kaernefeltia merrillii (Du Rietz) A. Thell & Goward – OC
Leptogium pseudofurfuraceum P. M. Jørg. & Wallace – WT
Leptogium saturninum (Dickson) Nyl. – PT
Letharia columbiana (Nutt.) J. W. Thomson – NW
Letharia vulpina (L.) Hue – WT
Lobaria anomala (Brodo & Ahti) T. Sprib. & McCune – OC
Lobaria anthraspis (Ach.) T. Sprib. & McCune – OC
Lobaria hallii (Tuck.) Zahlbr. – OC
Lobaria pulmonaria (L.) Hoffm. – OC
Melanelixia californica A. Crespo & Divakar – CM
Melanelixia glabratula (Lamy) Sandler & Arup – OC
Melanelixia subargentifera (Nyl.) O. Blanco et al. – PT
Melanohalea elegantula (Zahlbr.) O. Blanco et al. – WT
Melanohalea exasperatula (Nyl.) O. Blanco et al. – WM
Melanohalea multispora (A. Schneider) O. Blanco et al. – NW
Melanohalea subelegantula (Essl.) O. Blanco et al. – OC
Melanohalea subolivacea (Nyl.) O. Blanco et al. – NW
Nephroma helveticum Ach. – OC
Nephroma resupinatum (L.) Ach. – NW

Nodobryoria abbreviata (Müll. Arg.) Common & Brodo – NW
Nodobryoria oregana (Tuck.) Common & Brodo – NW
Normandina pulchella (Borrer) Nyl. – OC
Parmelia barrenoae Divakar, M. C. Molina & A. Crespo – WT
Parmelia hygrophila Goward & Ahti – NW
Parmelia sulcata Taylor – PT
Parmeliopsis hyperopta (Ach.) Arnold – PT
Peltigera canina (L.) Willd. – WM
Peltigera collina (Ach.) Schrader – NW
Peltigera membranacea (Ach.) Nyl. – OC
Peltigera ponojensis Gyelnik – WM
Peltigera praetextata (Flörke ex Sommerf.) Zopf – WM
Phaeophyscia orbicularis (Necker) Moberg – WT
Physcia adscendens (Fr.) H. Olivier – PT
Physcia aipolia (Ehrh. ex Humb.) Fürnr. – PT
Physcia alnophila (Vainio) Loht., Moberg, Myllys & Tehler – PT
Physcia biziana (A. Massal.) Zahlbr. – WT
Physcia stellaris (L.) Nyl. – PT
Physcia subalbinea Nyl. – WT
Physcia tenella (Scop.) DC. – OC
Physciella chloantha (Ach.) Essl. – PT
Physconia americana Essl. – OC
Physconia californica Essl. * – CM
Physconia enteroxantha (Nyl.) Poelt – WT
Physconia fallax Essl. * – CM
Physconia isidiigera (Zahlbr.) Essl. – WM
Physconia perisidiosa (Erichsen) Moberg – WT
Placidium fingens (Breuss) Breuss * – CM
Platismatia glauca (L.) W. L. Culb. & C. F. Culb. – OC
Platismatia wheeleri Goward, Altermann & Björk – WM
Polycauliona candelaria (L.) Frödén, Arup, & Søchting – OC
Polycauliona polycarpa (Hoffm.) Frödén, Arup, & Søchting – OC
Polychidium muscicola (Sw.) Gray – WM
Ramalina farinacea (L.) Ach. – OC
***Rostania quadrifida* (D. F. Stone & McCune) McCune** – OC
Scytinium cellulosum (P. M. Jørg. & Tønsberg) Otálora, Jørg. & Wedin – OC
Scytinium lichenoides (L.) Otálora, P. M. Jørg. & Wedin – WM
Scytinium tacomae (P. M. Jørg. & Tønsberg) McCune – NW
Scytinium teretiusculum (Wallr.) Otálora, P. M. Jørg. & Wedin – PT
Usnea cavernosa Tuck. – PT
Usnea cornuta Körber – PT
Usnea diplotypus Vainio – PT
Usnea glabrata (Ach.) Vainio – WT
Usnea hirta (L.) Weber ex F. H. Wigg. – PT
Usnea pacificana P. Halonen – OC
Usnea perplexans Striton – WT
Usnea scabrata Nyl. – WT
Usnea substerilis Motyka – WT
Usnea wasmuthii Räsänen – OC
Waynea californica Moberg – CM
Xanthomendoza hasseana (Räsänen) Søch., Kärnefelt & S.Y.Kondr. – PT
Xanthomendoza oregana (Gyelnik) Søch., Kärnefelt & S.Y.Kondr. – WT
Xanthoparmelia sp. – WM
Xanthoria parietina (L.) Th. Fr. – PT