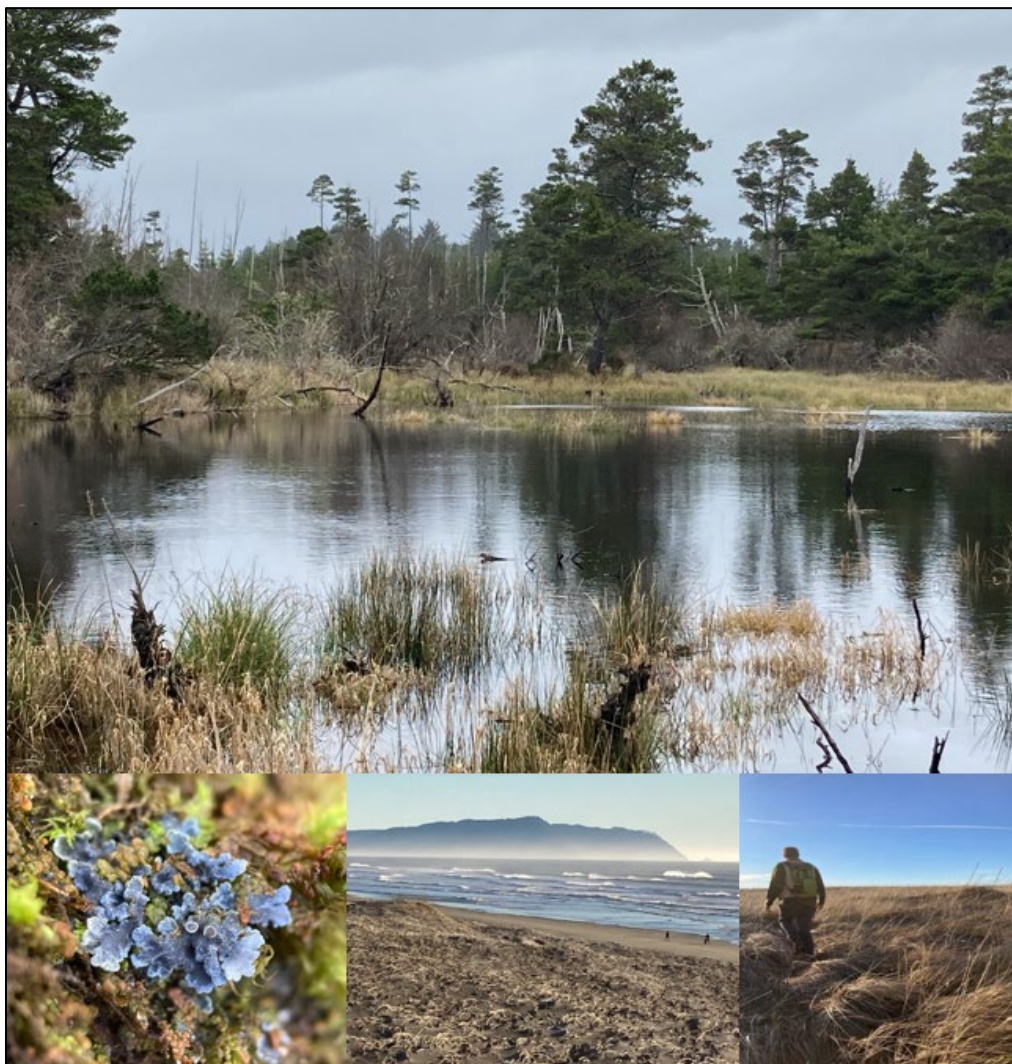




Inventory of Lichen and Bryophyte Communities in the Yeon Unit of Lewis and Clark National Historical Park

Final Report

Natural Resource Report NPS/LEWI/NRR—2023/2607



ON THE COVER

Lichen and bryophyte habitat at Lewis and Clark National Historic Park
NPS

Inventory of Lichen and Bryophyte Communities in the Yeon Unit of Lewis and Clark National Historical Park

Final Report

Natural Resource Report NPS/LEWI/NRR—2023/2607

Siskiyou BioSurvey, LLC
265 Ball Road
Eagle Point OR, 97524

Funding for this project provided by the National Park Service Inventory and Monitoring Program

December 2023

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Report Series is used to disseminate comprehensive information and analysis about natural resources and related topics concerning lands managed by the National Park Service. The series supports the advancement of science, informed decision-making, and the achievement of the National Park Service mission. The series also provides a forum for presenting more lengthy results that may not be accepted by publications with page limitations.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible and technically accurate.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available in digital format from the [Natural Resource Publications Management website](#). If you have difficulty accessing information in this publication, particularly if using assistive technology, please email irma@nps.gov.

Please cite this publication as:

Siskiyow BioSurvey, LLC. 2023. Inventory of lichen and bryophyte communities in the Yeon Unit of Lewis and Clark National Historical Park: Final report. Natural Resource Report NPS/LEWI/NRR—2023/2607. National Park Service, Fort Collins, Colorado. <https://doi.org/10.36967/2301457>

Contents

	Page
Figures.....	iv
Tables.....	v
Appendices.....	v
Executive Summary	vi
Introduction.....	1
Methods.....	3
Results.....	4
Bryophytes.....	6
Lichens	7
New additions to the Yeon unit lichen species list.....	9
Yeon Unit Habitats.....	9
Yeon Property: Salix Swamp	11
Yeon Property: Mesic Shore Pine Forest	12
Yeon Property: Dune Crests.....	15
Yeon Property: Remnant Prairies.....	16
Sunset Beach State Recreation Site Property	17
Future and Remaining Work.....	19

Figures

	Page
Figure 1. Lichen survey intensity map.....	5
Figure 2. The number of bryophytes by habitat type in the Yeon Unit.	6
Figure 3. Locations of ORBIC listed lichen species encountered during this survey.....	7
Figure 4. The number of lichen species by habitat type in the Yeon Unit.....	8
Figure 5. Map of Yeon unit habitat areas and bryophyte collecting locations.....	10
Figure 6. <i>Cephaloziella divaricata</i> a common leafy liverwort on the Yeon Unit and <i>Ricciocarpos natans</i> , a thalloid liverwort that is often found in nutrient rich lowland ponds.....	12
Figure 7. <i>Frullania franciscana</i> is an epiphytic leafy liverwort restricted to coastal forests of the Pacific Northwest.....	14
Figure 8. <i>Ulota phyllantha</i> is a common epiphytic moss in coastal shore pine forests.	14
Figure 9. Large mound of <i>Campylopus introflexus</i> in fire management areas of the dune.	16
Figure 10. Map of area Sunset property with bryophyte collection sites.....	18
Figure 11. <i>Cetrelia cetrarioides</i> (ORBIC G4-S3) in situ on arboreal moss and liverwort mat, on <i>Salix hookeriana</i>	21
Figure 12. <i>Usnea rubicunda</i> (ORBIC-S3) in situ on <i>Salix hookeriana</i>	22
Figure 13. <i>Pannaria rubiginosa</i> (ORBIC-S1) in situ on arboreal bryophyte mat on <i>Salix hookeriana</i>	23
Figure 14. Photo showing the habitat of <i>Pannaria rubiginosa</i> (ORBIC-S1) on <i>Salix</i> at edge of seasonally inundated wetland.....	24

Tables

	Page
Table 1. Level of search effort for each unit.	4
Table 2. Listed lichen species encountered during inventory.	8
Table 3. <i>Sceptridium multifidum</i> locations in UTM format, Zone 10N	17

Appendices

	Page
Appendix A: Identification and Nomenclature Sources	20
Appendix B: Photos of ORBIC Listed Species	21

Executive Summary

The 106-acre Yeon Unit of Lewis and Clark National Historic Park lies along the immediate coast eight miles north of Seaside, Oregon. The primary objective of these surveys was to capture the complete lichen and bryophyte flora of the Yeon property with focus on the remnant prairies and the salix swamp, report on any rare species observed or collected, and document the extent and population size of the rare lichen, *Pannaria rubiginosa*. Surveys were conducted in December 2021 and January 2022. While this report sufficiently characterizes the lichen and bryophyte flora of the Yeon property, it is not sufficient for the Sunset property. For a complete list of the non-vascular flora of the Sunset property, a more intentional survey should be conducted.

Of the 46 bryophyte species recorded, none of them are considered rare by ORBIC. The species checklist reflects a bryoflora typical of Pacific Northwest coastal dune ecosystems. The collection of *Dicranum rhabdocarpum* needs to be verified as it is rare in Oregon and there is low confidence in the species level determination of it. The invasive moss, *Campylopus introflexus*, was found throughout the site in impacted areas especially where fire management had been conducted. This moss should be monitored as it has spread throughout most areas of the dune and may displace native bryophytes and complicate ecological succession in fire/restoration areas.

Lichens were found throughout the 106-acre Yeon unit, although in varying density and diversity. The fore dunes adjacent to the open sand area of the coast historically hosted the coastal prairie habitat but now this area was almost completely infested with the invasive beachgrasses *Ammophila arenaria* and *A. breviligulata*. In this area these xerophytic *Ammophila* species occupied nearly 100% of the terrestrial habitat and there were no trees or shrubs to provide arboreal lichen habitat. There were a few small patches of remnant prairie within the swaths of *Ammophila* spp. that were generally smaller than 10m². In these areas the lichens were dominated by *Cladonia*, *Peltigera* and *Scytinium* species.

In general, the shore pine habitat that has not been recently thinned had a dense canopy and therefore the surveyable lichen habitat had very low rates of lichen colonization. The exceptions were the areas with edge effects. The west side facing the foredunes hosted a few arboreal species. Light gaps within this forest had minimal arboreal and terrestrial species colonization. Thinned shore pine plantations had a slightly higher concentration of species richness and increased biomass due to the abundance of light that penetrates to the surveyable habitat. These were limited to fairly common species in genera such as *Hypogymnia*, *Platismatia*, and *Usnea*. The area with the richest lichen diversity was in the interdunal wetland and willow swamp areas. These habitats had rich and well developed cyanolichen communities.

Introduction

The 106-acre Yeon Unit of Lewis and Clark National Historic Park lies along the immediate coast eight miles north of Seaside, Oregon. The property consists of stabilized dune and interdunal wetlands covered in pine forest, and dominated by non-native vegetation such as Scotch broom and beach grass. There are also native plant communities present with forest species such as evergreen huckleberry, salal and western sword fern. Native trees that dominate the wetland areas include crab apple, red alder and Hooker's willow. The primary objective of these surveys was to capture the complete lichen and bryophyte flora of the Yeon property with focus on the remnant prairies and the salix swamp and report on any rare species observed or collected.

Bryophyte surveys were conducted by Miles Berkey in the Yeon and Sunset properties from December 14 – 16, 2021. The survey of the Sunset property was conducted after the Yeon Property was surveyed.

Lichen surveys were conducted by Nils Nelson, Jay Scelza and John Villella on January 4-6, 2022. Two of these lichenologists returned to complete the survey on January 22-23, 2022. A brief lichen bioblitz was conducted in 2019 by Northwest Lichenologists. During this bioblitz a very rare lichen, *Pannaria rubiginosa* (ORBIC-S1) was discovered. One focus of the current inventory was to map the extent of this *P. rubiginosa* population, count and document the population size, and locate additional individuals or populations. This was done while concurrently documenting all lichen species present on the property with emphasis on finding additional rare species or any other taxa of interest.

While this report sufficiently characterizes the lichen and bryophyte flora of the Yeon property, it is not sufficient for the Sunset property. For a complete list of the non-vascular flora of the Sunset property, a more intentional survey should be conducted.

Deliverables included:

- Excel document of Species (4 sheets)
- Report
- GIS Maps of collection sites with attributes
- GIS shape files of ORBIC listed species occurrences



Surveyors inspecting terrestrial lichens in remnant prairie habitat with *Ammophila* infested foredune in the background.

Methods

Surveys were conducted utilizing the intuitive control transect method, wherein all habitats were transected throughout the 106-acre Yeon property with the levels of intensity determined by the surveyors on the ground, based on intrinsic factors including quality of habitat, abundance and or diversity of target species present, availability of favorable substrates, etc. All substrates including terrestrial and arboreal surfaces were inspected. These intuitive surveys were intended to capture all non-vascular species present with an emphasis on locating ORBIC listed species. Areas with low likelihood of supporting Oregon Biodiversity Information Center (ORBIC) listed species received a moderate level of coverage while those areas with high likelihood of supporting ORBIC listed species were surveyed intensively.

Surveyors mapped the locations of each ORBIC-listed species occurrence and recorded a count or estimate of abundance at each location. Each occurrence was identified and photographed in situ. Species of conservation concern were mapped using handheld GPS units and waypoints were averaged to within 6-meter accuracy. Specimens that were collected for identification in the lab were destroyed through the process of identifying.

Surveyors documented all species encountered and recorded the habitat in which it was found along with general substrate notes. Lichen and bryophyte communities were mapped and delineated in the inventory spreadsheet. All listed species were mapped and GIS shapefiles were created.

Results

Table 1 and Figure 1 show an accounting of search effort in each unit. The following is a list of rare bryophyte species that were surveyed for in both the Yeon and Sunset properties but were not found:

- *Campylopus schmidii*
 - Small golden yellow – green – blackish turf former; awns are erect separating it from the squarrose awns of *C. introflexus*; Occurs in partially stabilized sand dunes near the ocean around vernal pools; If in LEWI properties it is threatened by the invasion of *C. introflexus*.
- *Campylopus atrovirens*
 - Plant green to blackish in dense tufts with conspicuous hyaline leaf tips; Usually grows on wet rocks; 1 location for Oregon from stabilized coastal dune near Heceta Beach, Lane County reported from John Christy, 1978. If this occurs in LEWI, then it would be threatened by *C. introflexus*.
- *Limbella fryei*
 - Plants dendroid to 13 tall; found on wet and rotting wood in coastal shrub swamps; Endemic to the coastal Oregon, is very rare with only two known populations.

Table 1. Level of search effort for each unit.

Unit	Bryophyte survey time (hrs)	Lichen survey time (hrs)
Yeon Salix swamp	2	30
Yeon mesic shore pine forest	6	10
Yeon dune crests	1	4
Yeon remnant prairies	1.3	10
Sunset Beach	2	6

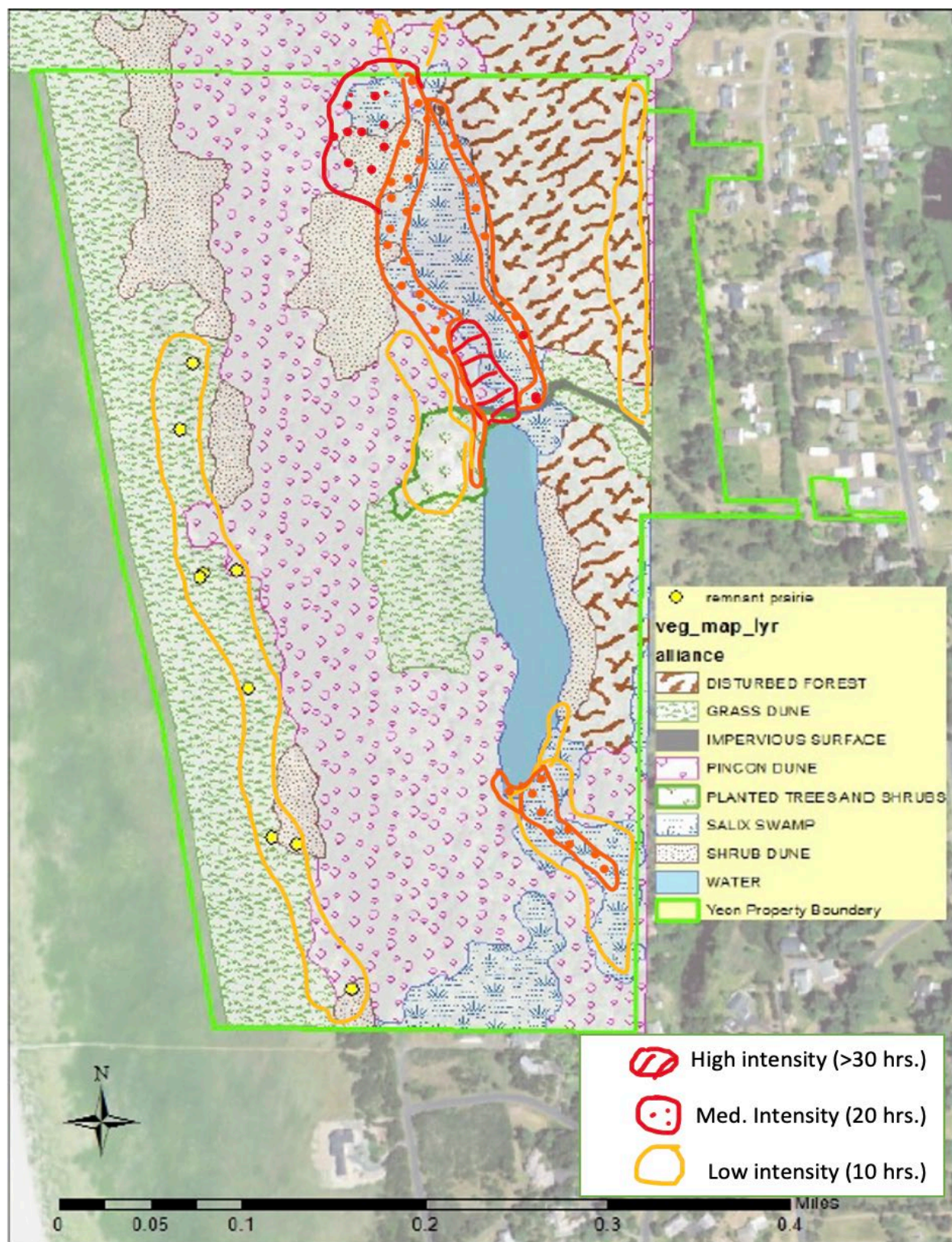


Figure 1. Lichen survey intensity map.



Surveyor Nils Nelson inspecting arboreal lichen habitat on Salix and Malus in interdunal swamp habitat.

Bryophytes

The bryophyte species list created from this project serves as the first effort to develop a baseline inventory of mosses, liverworts, and hornworts for the Yeon property. See Figure 2 for the number of bryophytes in each habitat of the Yeon Unit. Of the 46 species recorded, none of them are considered rare by ORBIC. The species checklist reflects a bryoflora typical of Pacific Northwest coastal dune ecosystems. The collection of *Dicranum rhabdocarpum* needs to be verified as it is rare in Oregon and there is low confidence in the species level determination of it. Lastly, the invasive moss, *Camphylopus introflexus*, was found throughout the site in impacted areas especially where fire management had been conducted. This moss should be monitored as it has spread throughout most areas of the dune and may displace native bryophytes and complicate ecological succession in fire/restoration areas.

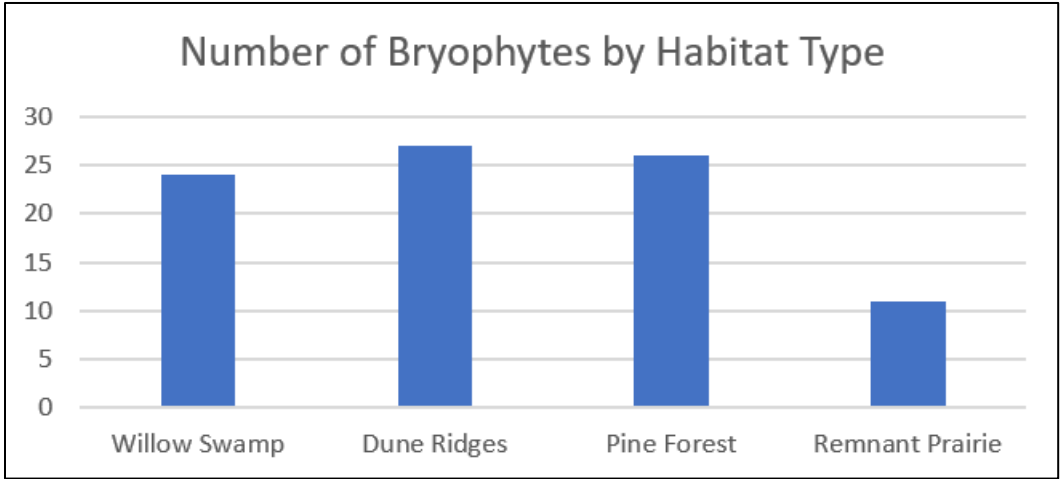


Figure 2. The number of bryophytes by habitat type in the Yeon Unit.

Lichens

A total of 65 lichen species were encountered during this study. Nineteen lichen species are newly recorded for the Yeon Unit (see below). Combining the list from this effort and the results of the earlier bioblitz conducted by the Northwest Lichenologist, the total number of lichens known from the Yeon Unit now stands at 75 species. Five listed species were encountered, four of which are state ranked by ORBIC (Figure 3). Listed lichen species are described in more detail in Table 2. Distinct communities of lichens and bryophytes were encountered within the various habitats (Figure 2; Figure 4). Some species were widespread across the unit while others were restricted to a given habitat.



Figure 3. Locations of ORBIC listed lichen species encountered during this survey.

Table 2. Listed lichen species encountered during inventory.

Species	Listing Rank	Notes
<i>Cetrelia cetrarioides</i>	ORBIC G4-S3	Several scattered populations with several individuals at each population; arboreal within the willow swamp
<i>Pannaria rubiginosa</i> (syn. <i>P. oregonensis</i>)	ORBIC G4-S2	One fertile thallus and several smaller thalli were encountered on the bole of a <i>Salix hookeriana</i> along the north side of the gravel road where the road crosses between the lake and the seasonally inundated swamp approximately 150 feet northeast of the Yeon Residence. The seasonally inundated swamp and adjacent hardwoods north and south of the gravel road were thoroughly searched but no more individuals were located after approximately 35 surveyor-hours of intensive searching. Recent work by McCune et al. (2022) has assigned all Pacific Northwest material of <i>Pannaria rubiginosa</i> and <i>P. rubiginella</i> to a newly described species, <i>P. oregonensis</i> . While we recognize this as valid, in order to avoid confusion, we chose to refer to this species as <i>P. rubiginosa</i> in this report because this taxon is rare and listed as ORBIC S2.
<i>Peltigera hymenina</i>	ORBIC GNR-S2	This rare pelt lichen was located in a small remnant prairie patch adjacent to shore pine forest.
<i>Sticta limbata</i>	Nature Serve G3	This species is not ORBIC listed but has a Nature Serve global ranking of G3-Vulnerable. Although not rare in Oregon, a ranking of G3-Vulnerable means that it is vulnerable in some part of its global range. This lichen was widely scattered with many locations scattered throughout the cyanolichen rich areas within the willow swamps, it is not further mapped in this report.
<i>Usnea rubicunda</i>	ORBIC G4-S3	Several individuals were located in one population located near the road to the house in the willow swamp.

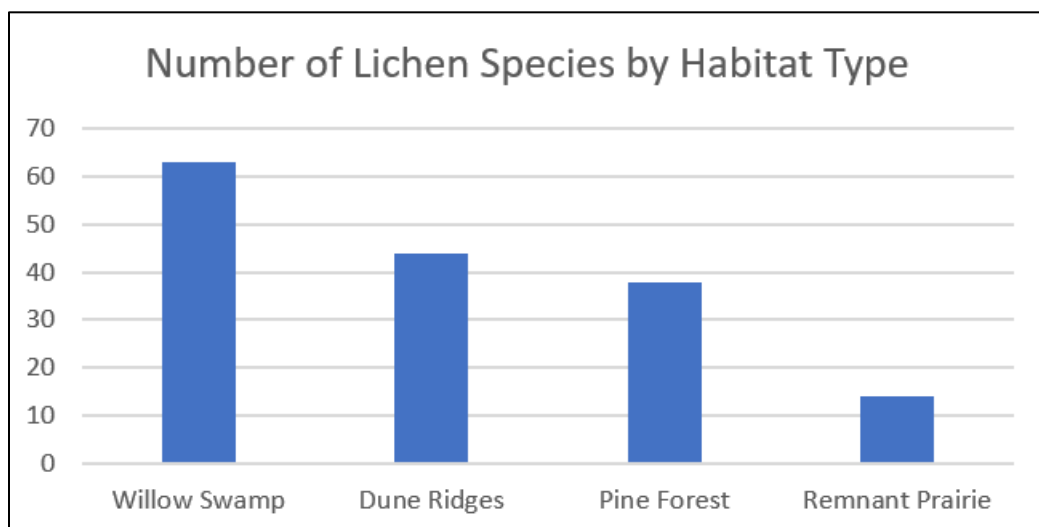


Figure 4. The number of lichen species by habitat type in the Yeon Unit.

New additions to the Yeon unit lichen species list

New additions to the Yeon unit lichen species list include the following:

- *Alectoria sarmentosa*
- *Arthopyrenia analepta*
- *Cladonia chlorophaea*
- *Cladonia coniocrea*
- *Cladonia furcata*
- *Cladonia squamosa*
- *Graphis pergracilis*
- *Lecanora confusa*
- *Lepra amara*
- *Nephroma helveticum*
- *Parmelia hygrophila*
- *Parmelia pseudosulcata*
- *Parmelia squarrosa*
- *Parmotrema arnoldii*
- *Physcia aipolia*
- *Platismatia glauca*
- *Platismatia herrei*
- *Ramalina roesleri*
- *Tuckermanopsis orbata*

Yeon Unit Habitats

This unit contains a variety of distinct habitats including willow swamps with wetlands and ponds, shore pine plantations and Scotch broom-dominated shrub communities, beach grass-dominated areas with small remnant prairies, and dune ridges with some native shrub cover (Figure 5).

Although this area is an example of a relatively undeveloped coastal dune ecosystem, the property is much different than Lewis and Clark would have encountered it. This region has been influenced by various colonial management practices that have an influence on the non-vascular plant communities that occur at the site. *Cytisus scoparius*, *Ammophila arenaria* and several species of exotic pine were reportedly planted on the site during the first half of the 20th century (pers. comm. Carla Cole). More recently some areas have been thinned by cutting and piling woody debris, mainly *Pinus spp.* on stabilized dunes in shore pine plantation areas.



Legend

- Collection Sites
- Yeon_Property
- Yeon_Pond
- Dune
- Salix_Swamp
- Salix_Swamp
- MESIC_PINCON_FOREST

0 0.13 0.25 0.5 Miles

Figure 5. Map of Yeon unit habitat areas and bryophyte collecting locations.

Lichens are found throughout the 106-acre Yeon unit, although in varying density and diversity. The fore dunes adjacent to the open sand area of the coast historically hosted the coastal prairie habitat but now this area is almost completely infested with the invasive beachgrasses *Ammophila arenaria* and *A. breviligulata*. In this area these xerophytic *Ammophila* species occupy nearly 100% of the terrestrial habitat and there are no trees or shrubs to provide arboreal lichen habitat. There are a few

small patches of remnant prairie within the swaths of *Ammophila spp.* that are generally smaller than 10m². In these areas the lichens are dominated by *Cladonia*, *Peltigera* and *Scytinium* species.

In general, the shore pine habitat that has not been recently thinned has a dense canopy and therefore the surveyable lichen habitat (defined as all substrates from the ground to 7' up on arboreal surfaces) has very low rates of lichen colonization. The exceptions are the areas with edge effects. The west side facing the foredunes hosts a few arboreal species. Light gaps within this forest have minimal arboreal and terrestrial species colonization. Thinned shore pine plantations have a slightly higher concentration of species richness and increased biomass due to the abundance of light that penetrates to the surveyable habitat. These are limited to fairly common species in genera such as *Hypogymnia*, *Platismatia*, and *Usnea*, etc.

The area with the richest lichen diversity is in the interdunal wetland and willow swamp areas. These habitats have rich and well developed cyanolichen communities. Following is a synopsis of each of the major habitats with a focus on characteristic non-vascular species that characterize these habitats.

Yeon Property: Salix Swamp

- Bryophyte survey time: 2 hours
- Lichen survey time: 30 hours

This area with the richest lichen diversity is in the interdunal wetland and willow swamp areas. This habitat is found in the lowland deflation plains which are inundated with fluctuating water levels throughout the rainy season. It is dominated by *Salix hookeriana* and *Malus fusca* which occupy the shores and extend partially into the inundated wetland. The understory has patchy occurrences of *Vaccinium ovatum* and *Gaultheria shallon*. These habitats have rich and well developed cyanolichen communities.

In this setting the trunks and tree boles are often dominated by bryophytes but that abundance shifts more towards lichens on the smaller diameter branches. These shrubby trees represent a lichen diversity hotspot within the Yeon property. This is likely due to the combination of sustained high atmospheric moisture content, protection from dominant winds due to steep slopes on the west flank, light availability due to the deciduous nature of the trees and their patchy distribution, and the coarseness inherent in twig and bole bark of these hardwoods. Diverse epiphytic lichen communities are found here that are high in total species richness on both the branches and main stems of these trees.

Moreover, the community is dominated by cyanolichens, often in dense clusters, with species such as *Lobaria anthraspis*, *Nephroma resupinatum*, *Nephroma helveticum*, *Sticta limbata* (G3), and *Peltigera collina*. Chlorolichens are also abundant and include several *Usnea* species, *Ramalina roesleri*, *Parmotrema* species, *Mennegazia subsimilis*, *Normandina pulchella*, and *Hypogymnia heterophylla*.

ORBIC listed lichen species of interest that occur in this habitat include: *Pannaria rubiginosa* (ORBIC GNR-S1), *Cetrelia cetrarioides* (ORBIC G4-S3), and *Usnea rubicunda* (ORBIC-S3). The

survey team spent the majority of their time searching in this habitat northeast of the Yeon residence, given its species diversity and known *P. rubiginosa* population.

For bryophytes the Yeon pond south of the driveway was surveyed first. Species diversity here was low probably due to the graminoid dominance around the margin of the pond and the fire activity on the east shore. The south end of the pond supported waterlogged woody debris where most species from the Yeon pond were reported. Near the north end of the pond, the invasive moss, *Campylopus introflexus*, was found forming small mounds on sand.

Bryophyte diversity was higher in the swamp north of the driveway. Graminoids were less abundant, allowing for available bryophyte microsites. The west side of this swamp supports species such as *Ricciocarpos natans* (Figure 6), an aquatic thalloid liverwort that floats on the surface of quiescent ponds. Other species encountered here include *Scapania umbrosa*, a small infrequent liverwort, and the aquatic mosses *Fontinallis howellii* and *Dichelyma uncinata*.



Figure 6. *Cephaloziella divaricata* a common leafy liverwort on the Yeon Unit (left) and *Ricciocarpos natans*, a thalloid liverwort that is often found in nutrient rich lowland ponds (right).

Yeon Property: Mesic Shore Pine Forest

- Bryophyte survey time: 6 hours
- Lichen survey time: 10 hours

The overstory of this habitat type is dense in most areas, with the exception of the eastern portions of the property where trees were recently thinned. Conifers consisting primarily of young to mid-aged *Pinus contorta* var. *contorta* dominate this habitat. *Tsuga heterophylla*, and occasionally larger *Picea sitchensis* trees also occur sporadically, primarily in and around the thinned areas to the east. In the shrub layer *Vaccinium ovatum* and *Gaultheria shallon* dominate. *Cytisus scoparius* and *Myrica californica* are also common shrubs in this setting. Forb cover is sparse consisting mostly of *Polystichum munitum*.

The shore pine habitat that has not been recently thinned has a dense canopy and therefore the surveyable lichen habitat are nearly devoid of lichens. The exceptions are the west edge facing the foredunes and the thinned areas, which host a few common arboreal lichen species. Lichen species that occur commonly include: *Usnea* species, *Hypogymnia heterophylla*, *H. lophyrea*, *Parmelia sulcata*, *Ramalina roesleri*, *R. farinacea*, *Parmotrema* species, and *Cladonia* species.

The mesic shore pine forest had the highest bryophyte diversity within the property. The species diversity here are represented in the epiphytic flora. Common coniferous epiphytic bryophytes include *Frullania nisqualensis* and *F. franciscana* (Figure 7), *Hypnum circinale*, *Isothecium stoloniferum*, *Ulota phyllantha* (Figure 8), and *Dicranum fuscescens*. The understory was mostly composed of willows which commonly hosted *Orhotrichum lyellii*, *O. pulchellum*, *Alsia californica*.

Bryophyte coverage of the mesic shore pine forest floor was low and supported a lower species diversity. Carpet forming species such as *Kindbergia oregana* and *Hylocomium splendens* were scattered throughout the site as well as other less common species such as *Hygroamblystegium varium* which was usually found within the wet sedge-dominated depressions. Rotting wood and other downed woody debris was scarce, but when encountered, *Buckiella undulata*, *Dicranum scoparium*, *Hypnum circinale*, *Rhytidiadelphus lorus*, *R. triquetris*, *Scapania bolanderi* and *Cephaloziella divarcata* were often present.



Figure 7. *Frullania franciscana* is an epiphytic leafy liverwort restricted to coastal forests of the Pacific Northwest. The “vittae” is a small stripe of discolored cells that can be useful to distinguish it from *F. nisqualensis*.



Figure 8. *Uloa phyllantha* is a common epiphytic moss in coastal shore pine forests.

Yeon Property: Dune Crests

- Bryophyte survey time: 1 hour
- Lichen survey time: 4 hours

These areas have some drier and windswept habitat with a variety of conifers consisting mostly of early seral *Pinus contorta* var. *contorta* and sparse *Picea sitchensis*. Much of this habitat has been affected by recent thinning programs that have significantly opened up the canopy and allows for more light to reach the lower arboreal surfaces and terrestrial habitat. Shrubs are common, unless thinned, and consist mainly of *Cytisus scoparius*. Patchy cover *Ammophila arenaria* is found in the herbaceous layer. These areas have arboreal lichen communities dominated by fruticose chlorolichens such as *Ramalina farinacea*, *Usnea cornuta*, *Hypogymnia heterophylla*, and *Hypogymnia lophrea*. A few terricolous species were present scattered within the habitat.

The main dune that runs north to south within the Yeon property also has a relatively low bryophyte diversity. Near the south end of the property, mature Sitka spruce and shore pines provide substrate for such coast epiphytes as *Frullania franciscana*, *Alsia californica*, and *Ulota phyllantha*; however, most of the dune has received heavy invasive species control and fire management which has reduced bryophyte microhabitats. Within these impacted areas, species such as *Polytrichum juniperum*, *Ceratodon purpureus* are common; around burn piles, *Funaria hygrometrica* is present. The invasive moss, *Campylopus introflexus* (Figure 9) was found throughout the disturbed areas of the dune.



Figure 9. Large mound of *Campylopus introflexus* in fire management areas of the dune.

Yeon Property: Remnant Prairies

- Bryophyte survey time: 1 hr. 20 min
- Lichen survey time: 10 hours

This area is not good lichen and bryophyte habitat in the thick patches of dune grasses. There are a few small patches of remnant prairie that are generally less than 10m² within thick and dominant *Ammophila spp.* These are often in swales and along existing game trails, generally close to the shore pine habitat. Vascular species present include *Hypochaeris radicata* and *Achillea millefolium*. These areas have few lichens due to dominance of vascular plants, grasses, and mosses but in areas of more exposed low-lying terrain some lichens were present on soil. These include *Peltigera hymenina* (ORBIC GNR-S2), *Leptogium palmatum*, *Leptogium* (undescribed), and *Cladonia* species.

Bryophyte diversity in the remnant prairies was relatively low compared to the rest of the property. However, in certain remnant prairies where graminoid coverage was low, a higher species diversity was observed. As a general trend, pleurocapous (mosses that grow along the substrate) mosses such as *Hygroamblystegium varium*, and *Kindbergia oregana* were observed more in the graminoid dominant prairies, while acrocarpous (mosses that grow perpendicular to the substrate) mosses such as *Bryum ssp.*, *Acaulon ssp.*, and *Funaria hygrometrica* were observed where open soil was available

and graminoid coverage was low. Below are the site names for each remnant prairie in the Yeon Property. Fortunately, *Campylopus introflexus* was not found within any of the remnant prairie plots below. However, as it is becoming problematic throughout the site, these prairies should be monitored for its invasion.

Sceptridium multifidum incidental sightings

The uncommon grape fern *Sceptridium multifidum* (formerly *Botrychium multifidum*) was encountered incidentally during these inventory surveys in several locations in remnant prairie habitats and in game trails within the *Ammophila* dune grass habitat on the western edge of the property. Because this species can be an indicator of high-quality habitat and potential habitat for other rare species, we are listing several locations here for future botanical survey efforts (Table 3).

Table 3. *Sceptridium multifidum* locations in UTM format, Zone 10N

Locations	Easting	Northing
1	427655	5104383
2	427580	5104707
3	427532	5104791

Sunset Beach State Recreation Site Property

- Date: 12/16/2021
- Survey time bryophytes: 2 hours
- Survey time lichens: 6 hours

The amount of time spent surveying the Sunset property was inadequate to fully represent the flora of the property. However, the inventory presented here provides the common lichens and bryophyte species of a late-successional dune-interdunal ecosystem. Lichen surveys on Sunset Beach State Recreation Site land to the north were conducted with focus on locating additional *P. rubiginosa* populations in similar habitat to that found on the Yeon property, but it was not found there (Figure 10).

Because the Sunset property has a series of dunes and interdunal swamps of different sizes and age, it likely supports a broader bryophyte diversity compared to the Yeon property. *Campylopus introflexus* had extensive coverage in areas of fire management. This is an invasive moss that is rapidly spreading along coastal dunes where fire, restoration, dune stabilization and other management related impacts have shown to encourage its spread.

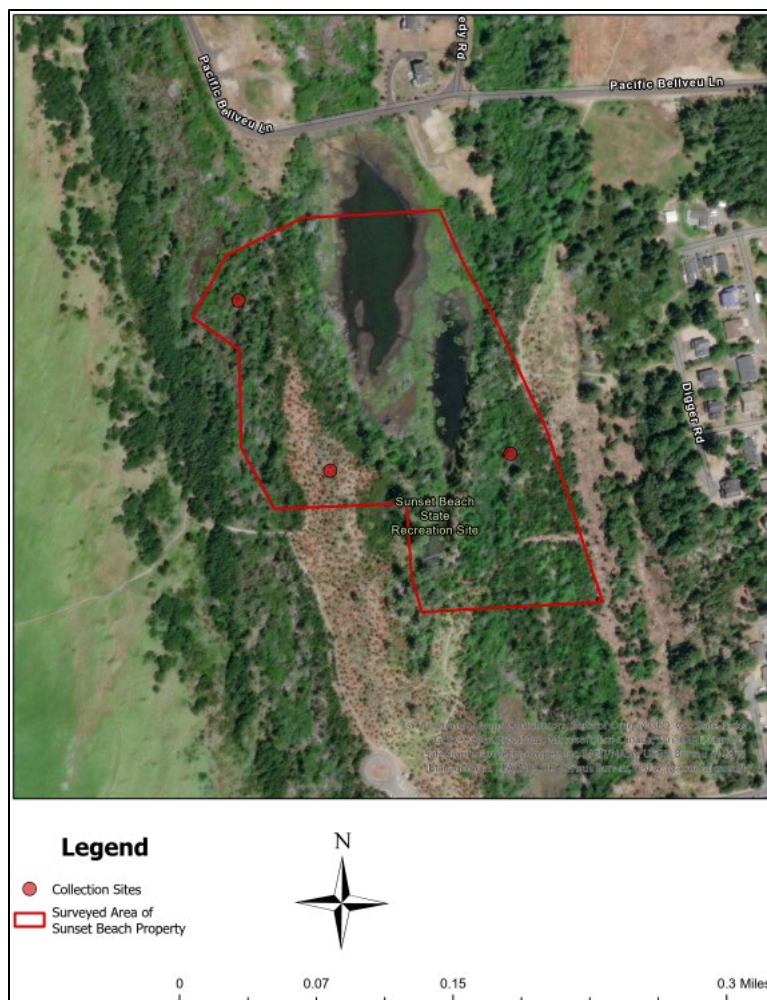


Figure 10. Map of area Sunset property with bryophyte collection sites.

Future and Remaining Work

The collections of *Dicranodontium denudatum* and *Dicranum rhabdocarpum* will likely be sent to Terry McIntosh in Vancouver, B.C. for verification. One lichen species collected in the remnant prairie habitat could not be determined with confidence and was given to Dr. Daphne Stone who indicated that it is an undescribed *Leptogium* or *Scytinium*. Once these species are determined, we will contact Carla Cole with the results and the collections will be submitted where necessary. The populations of these species currently are not threatened by *C. introflexus*, fire management, invasive removal, or restoration activity.

Campylopus introflexus within both the Yeon Property and the Sunset property is becoming problematic. It has a near continuous spread along the trail that runs north-south through the Yeon Property. Likely it has spread from the trail corridor upslope into the fuels reduction areas of the dune. Controlling the spread of this moss has shown little success. There is a strong relationship between the spread of this moss and fire activity on coastal dunes. Ways to practice fuel reduction while suppressing the spread of this moss should be a priority. For more information on *Campylopus introflexus* see here: <https://www.cabi.org/isc/datasheet/108875#4B56393D-4A2A-4DAB-93C0-A8B8892496B0>.

Appendix A: Identification and Nomenclature Sources

- Brodo, I. M., S. D. Sharnoff, and S. Sharnoff. 2001. Lichens of North America. Yale University Press.
- Doyle, W. T., and R. E. Stotler. 2006. Contributions toward a bryoflora of California III. Keys and annotated species catalogue for liverworts and hornworts. *Madroño*, 53(2): 89-197.
- Hitchcock, C. L., and A. Cronquist. 2018. Flora of the Pacific Northwest: an illustrated manual. University of Washington Press.
- Lawton, E. 1971. Moss Flora of the Pacific Northwest. *J Hattori Bot Lab*, 1: 1-362.
- McCune, B. and L. Geiser. 2009. Macrolichens of the Pacific Northwest. Oregon State University Press.
- McCune, B. 2017. Microlichens of the Pacific Northwest, Vol 1. Wild Blueberry Media, Corvallis, Oregon.
- McCune, B. 2017. Microlichens of the Pacific Northwest, Vol. 2. Wild Blueberry Media, Corvallis, Oregon.
- McCune, B., M. Schultz, T. Fennell, A. Passo, and J. M. Rodriguez. 2022. A new endemic, *Pannaria oregonensis*, replaces two misapplied names in the Pacific Northwest of North America. *The Bryologist*, 125(1): 170-185.
- Norris, D. H. and J. R. Shevock. 2004. Contributions toward a bryoflora of California: II A key to the mosses. *Madrono*: 133-269.
- Wiedemann, A. M., L. D. Johnston, and F. H. Smith. 1999. Plants of the Oregon coastal dunes. Oregon State University Press.

Appendix B: Photos of ORBIC Listed Species

Figures 11 through 14 show ORBIC listed species.



Figure 11. *Cetrelia cetrarioides* (ORBIC G4-S3) in situ on arboreal moss and liverwort mat, on *Salix hookeriana*.



Figure 12. *Usnea rubicunda* (ORBIC-S3) in situ on *Salix hookeriana*.



Figure 13. *Pannaria rubiginosa* (ORBIC-S1) in situ on arboreal bryophyte mat on *Salix hookeriana*. Note that several small (approx. 1-2mm) individual thalli can be seen to the right of the main thallus.



Figure 14. Photo showing the habitat of *Pannaria rubiginosa* (ORBIC-S1) on *Salix* at edge of seasonally inundated wetland.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 405/191614, December 2023

National Park Service
U.S. Department of the Interior



Natural Resource Stewardship and Science

1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525