

Rare Moss and Lichen Surveys of BLM
Vale District, North Umatilla Co., OR &
Spokane District, South Benton Co., WA

Aloina bifrons,
Bryoerythrophyllum columbianum
and
Texosporium sancti-jacobi

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ABSTRACT

The target mosses, *Aloina bifrons*, *Bryoerythrophyllum columbianum* and the target lichen, *Texosporium sancti-jacobi* were searched for on nine parcels in the Columbia River Basin of Oregon and Washington managed by the Bureau of Land Management. Surveys using intuitive-controlled meander found *Aloina bifrons* on two parcels, *B. columbianum* on six parcels, and *Texosporium sancti-jacobi* on one parcel. Silusi Butte and the adjacent parcel have the best habitats and most species of bryophytes and lichens. The mosses, *Didymodon eckeliae*, *Gemmabryum gemmilucens*, *G. vinosum*, *Tortula protobryoides* are apparently new to Washington and a site of *T. inermis* represents the second record for the state. Noteworthy lichens include *Acarospora obpallens*, *A. rosulata*, *Rhizocarpon melanconianum*. Results continue to support that thin, fine-grain soil and rock support the best diversity of bryophytes and lichens while trampling of cattle and invasive cheatgrass, *Bromus tectorum*, significantly compromise most areas.

INTRODUCTION

The subject of this study is a continuation of Cooperative Agreement #L11AC20198-0005-0000 from 2013 and 2014 (Kofranek, 2014). The objective of the study was to find new sites of two Bureau of Land Management (BLM) Sensitive species of mosses, *Aloina bifrons*, *Bryoerythrophyllum columbianum*, and one lichen, *Texosporium sancti-jacobi*, which are thought to be rare. Species lists of each parcel were also generated. From the onset in 2013 all species of mosses encountered were identified and eventually in 2016 all species of lichens encountered were identified. All three target species are associates of biological soil crusts (McIntosh 2003a, McCune and Rosentreter 2007, Ponzetti et al. 2007, Zander 2007). Therefore, biological soil crusts (BSCs) became the focal point of the surveys. Additionally saxicolous and epiphytic species were observed or collected in the field and identified in the lab in order to capture as many species as possible.

All parcels surveyed are federally managed by the BLM and are within a 16 km radius of Hermiston, Oregon. Parcel selection was based on access. After all accessible parcels were exhausted in Oregon the balance of acreage (ac) was surveyed on the Washington side of the Columbia River. Of the nine parcels six are in Oregon and three in Washington. They are listed below from best to lowest quality habitat:

T5N-R28E-S4, 314 ac., Silusi Butte, Benton Co., WA
T5N-R28E-S2, 142 ac., Near McNary Dam, Benton Co., WA
T3N-R27E-S24, 160 ac., Ward Butte, Umatilla Co., OR
T5N-R28E-S14, 117 ac., Wanaket Wildlife Area, Umatilla Co., OR
T5N-R28E-S22, 141 ac., Power City Wildlife Area, Umatilla Co., OR
T5N-R29E-S34, 40 ac., Next to Cold Springs NWR, Umatilla Co., OR
T5N-R28E-S26, 81 ac., Hermiston ORV Trail System, Umatilla Co., OR
T3N-R27E-S12, 81 ac., Madison-Saylor Rd., Umatilla Co., OR
T5N-R29E-S4, 156 ac., 5+ miles upstream from McNary Dam, Benton Co., WA

Throughout the report locations are referred to by numerical waypoints. The waypoints are shorthand for coordinates in NAD 83 UTMs. These are listed in a separate spreadsheet with a comprehensive species list, Kofranek collection numbers, Site ID names, dates,

Township/Range/Section (T-R-S), elevation, and comments. Element Occurrence (E.O.) data forms have been provided to the BLM for populations of target and other rare species that are within 100 m of one another.

RESULTS OVERVIEW

Silusi Butte is very rich with bryophytes and lichens because of its generally pristine conditions and diversity of microhabitats. One of these habitats, protected rock outcrops, as opposed to exposed rimrock faces or level bedrock, is not common in the study area. The adjacent parcel near McNary Dam is equally as rich just smaller with less extensive habitats. The non-vascular flora of these two parcels could be benefitting from the increased humidity due to the proximity to the Columbia River (Root and McCune, 2012). Ward Butte has well-developed BSC communities including the lichen, *Acarospora schleicheri*, indicating old-growth conditions (McCune and Rosentreter 2007, Rosentreter et al. 2007). Wanaket Wildlife Area, excluding the ponds, is expansive rocky soil with good coverage of mosses and lichens, but limited in the suite of species because of the predominance of the single type of habitat. Power City Wildlife Area is similar in having both ponds and rocky areas, however, the rocky substrates there are much less extensive. The parcel next to Cold Springs National Wildlife Refuge (NWR) has a couple of areas of BSCs but of early to mid-seral development. The Hermiston Off-Road Vehicle (ORV) Trail System is very disturbed, but contains the only site of *Texosporium sancti-jacobi* found in the entire study. The small area has been preserved only by chance and has small features and *Aspicilia filiformis* not seen elsewhere. The Madison-Saylor Road parcel is very weedy and relatively recently disturbed by cattle. The parcel five miles up from McNary Dam burned just prior to surveying.

Texosporium sancti-jacobi was found once, of all the 17 parcels surveyed since 2013, at Hermiston ORV Trail System, waypoints 297, 298, and therefore is rare in the study area. It inhabits a relic patch of BSCs with high coverage of *Psora montana*, *Ceratodon purpureus*, *Aspicilia filiformis* (low amounts but also its singular occurrence). *Poa secunda* is the dominant vascular plant of the immediate area including its old dead bunch grass bases that are thoroughly infused with soil. They are unrecognizable as such away from similar but younger grass bases appearing as short soil pillars on which *T. sancti-jacobi* grows. *T. sancti-jacobi* is an indicator of old-growth *Artemisia* habitat that needs late decay stage organic substrates (Rosentreter, et al. 2007).

Aloina bifrons was found 11 times (six E.O. forms) in 2015 and 2016 indicating it is uncommon within the study area. It is on Silusi Butte and Ward Buttes. *A. bifrons* appears to be an early seral species at these sites since most of the time it was encountered on bare patches of mineral soil, not overgrown with other cryptogams or grass. Only once was it found (Silusi Butte, waypoint 015) in late seral BSC conditions being crowded out by lichens and mosses.

Bryoerythrophyllum columbianum was found 145 times (ten E.O. forms) in 2015 and 2016 indicating it is common within the study area. Of all the 17 parcels surveyed since 2013, it exists on 14. Of those it was missing from, one parcel that was burned and another it was present just a dozen meters outside. In 2015 and 2016 it was found on the Hermiston ORV Trail System parcel, Ward Butte, Power City Wildlife Area, Wanaket Wildlife Area, and Silusi Butte. It is found almost anywhere where the ground has not been recently disturbed. It emerges at the end

of early seral conditions and persists through late seral BSC developments. As with many of the lichens and bryophytes in the survey, *B. columbianum* was often associated with rock because of its protection from trampling (Root et al. 2011). In fact at the parcel with the most sites of *B. columbianum*, Wanaket with 48 sites, it is almost exclusively on rock.

Tortula cf. brevissima was found seven times indicating it is uncommon at least very locally. A minute species on Silusi Butte and the adjacent parcel on the Washington where it occupies the microhabitat of rock crevices. This species was just reported new to North America from California (Kellman, 2012) and again later from the same state (Toren, 2015).

Tortula protobryoides was found once during the 2015-2016 time period, on the parcel near McNary Dam. Records indicate it would be new Washington. This species was found only one other time, in 2013. That collection from Oregon was a first for that state as well.

Tortula inermis was found once during the 2015-2016 time period, on the Silusi Butte parcel. According to the website Consortium for Pacific Northwest Herbaria, there is one other record (Lime Hill, Asotin Co.) for Washington, which indicates that the Silusi Butte site could only be the second record for the state. This species was found only one other time throughout the study. That 2013 collection from Oregon was third for that state according to the same website. Lawton (1971) summarizes the range of the species in her regional flora as "... rare in the Pacific Northwest" not specifying from which of those state(s) it's known from, which she does in every other species treatment.

Didymodon eckeliae was found once during the 2015-2016 time period, on the parcel near McNary Dam. Literature and online herbarium records suggest that it would be new to Washington. This species was found several times on the Oregon side of the study area during the 2013-2014 time period. However, the vertical rock faces that it is associated with in Oregon were largely lacking from the parcels surveyed the last two years. It is also on the west side of the Cascade Mountains. It is probably overlooked as *D. vinealis* and may be found to be more common in the future once it is better known and recognized.

Gemmabryum (Bryum) gemmilucens was found once, in 2016, on the parcel near McNary Dam. Literature and online herbarium records suggest that it would be new to Washington. Although the Bryophyte Flora of North America Vol. 27 (BFNA) does not denote this species outside of California, it is known to be common along roadsides, etc. (Spence 2014). It is probably more widespread than the lack of records suggest.

Gemmabryum (Bryum) vinosum, was found many times (one E.O. form), in 2016, on Silusi Butte. Literature (Spence and Kellman, 2015) and online herbarium records suggest that it would be new to Washington. It is locally abundant in "rock garden" habitats. It is probably more widespread than the lack of records suggest. It was also found on the Oregon side at Juniper Canyon in 2013 and at Wanaket in 2015.

Rare lichens include *Rhizocarpon melanconianum* and *Acarospora obpallens*, which are already known from south central Washington (McCune & Rosentreter, 2007). While *A. rosulata* is

primarily a Southwestern species (Nash et al., 2007) it may not be accurate to consider it rare (Brodo, 2016) in a work of such broad scope as the coverage of North America.

Noteworthy species include *A. schleicheri*, which is indicative of late seral BSCs; *Phaeophyschia constipata* is more of a Rocky Mountain species; *Placidium cf. pilosellum*, *Lecanora* sp. 4 appears common yet remains undescribed; *Leptogium* sp. 1 is also possibly common yet remains undescribed; and *Xanthoparmelia subhosseana* is uncommon (McCune and Geiser, 2009).

Total species of mosses, including 2013 and 2014 surveys, amount to 42 species of which 20, about half, belong to a single family, the Pottiaceae, a large family of “mosses of harsh environments” (Zander, 1993, 2007). Many are ruderal species comprising a prominent component in arid regions to which they’ve adapted by complex anatomy, diverse morphology, and specific physiology (Zander, 1993).

The second highest represented family is the Grimmiaceae with eight of 42 (19%) species. The plants are typically dark green to black cushions that colonize dry siliceous rocks (Hastings and Ochyra, 2007, Hastings and Greven, 2007).

The Bryaceae is the final family with a significant percentage of species, six of 42 (14%) species. Specifically the genus *Gemmabryum* has four species of generally weedy plants with a variety of asexual propagules on disturbed soil. All three families are challenging to identify (Zander, 1993, 2007; Hastings, 2011; Spence, 2014b) and collectively comprise 81% of the moss species across the 2,400 acres surveyed from 2013 through 2016.

Only three species of liverworts were found. Coincidentally each of them represents three of four subclasses of the liverwort phylum, Marchantiophyta. The simple thalloid Metzgeriidae representative is *Fossombronia*, the complex thalloid representative of Marchantiidae is *Riccia*, and the leafy liverwort member of the Jungermanniidae is *Cephaloziella* (Crandall-Stotler and Stotler, 2000). The fourth, Sphaerocarpaceae, could be present in the study area as *Sphaerocarpos*, which is an annual found on muddy river and pond banks.

Below: Total species from 2013-2016.

Bold text indicates noteworthy species discussed above.

MOSSSES	
<i>Aloina bifrons</i>	<i>Didymodon norrisii</i>
<i>Anacolia menziesii</i>	<i>Didymodon tophaceus</i>
<i>Brachythecium albicans</i>	<i>Didymodon vinealis</i>
<i>Bryoerythrophyllum columbianum</i>	<i>Encalypta rhaptocarpa</i>
<i>Bryum argenteum</i> s.l.	<i>Funaria hygrometrica</i>
<i>Ceratodon purpureus</i>	<i>Gemmabryum barnesii</i>
<i>Coscinodon calyptratus</i>	<i>Gemmabryum caespiticium</i>
<i>Didymodon australasiae</i>	<i>Gemmabryum gemmilucens</i>
<i>Didymodon brachyphyllus</i>	<i>Gemmabryum vinosum</i>
<i>Didymodon eckeliae</i>	<i>Grimmia anodon</i>
	<i>Grimmia laevigata</i>

<i>Grimmia montana</i>
<i>Grimmia ovalis</i>
<i>Grimmia pulvinata</i>
<i>Grimmia trichophylla</i>
<i>Hennediella heimii</i>
<i>Homalothecium nevadense</i>
<i>Orthotrichum laevigatum</i>
<i>Polytrichum piliferum</i>
<i>Pseudocrossidium obtusulum</i>
<i>Pterygoneurum ovatum</i>
<i>Schistidium flaccidum</i>
<i>Syntrichia caninervis</i>
<i>Syntrichia montana</i>
<i>Syntrichia papillosissima</i>
<i>Syntrichia ruralis</i>
<i>Tortula acaulon</i>
<i>Tortula brevipes</i>
<i>Tortula cf. brevissima</i>
<i>Tortula inermis</i>
<i>Tortula protobryoides</i>

LIVERWORTS

<i>Cephaloziella divaricata</i>
<i>Fossombronia</i> sp.
<i>Riccia</i> sp.

LICHENS

<i>Acarospora americana</i>
<i>Acarospora obpallens</i>
<i>Acarospora rosulata</i>
<i>Acarospora schleicheri</i>
<i>Arthonia glebosa</i>
<i>Aspicilia filiformis</i>
<i>Aspicilia mastrucata</i>
<i>Aspicilia reptans</i> "clade #7" sensu Di Meglio '16
<i>Buella punctata</i>
<i>Caloplaca jungermanniae</i>
<i>Caloplaca tominii</i>
<i>Candelaria pacifica</i>
<i>Candelariella aggregata</i>
<i>Candelariella citrina</i>
<i>Candelariella vitellina</i>
<i>Circinaria caesiocinerea</i>
<i>Circinaria cinerae</i>

<i>Cladonia cariosa</i>
<i>Cladonia chlorophaea</i>
<i>Cladonia fimbriata</i>
<i>Cladonia pulvinella</i>
<i>Cladonia</i> sp. (squamules only)
<i>Collema coccophorum</i>
<i>Collema fuscovirens</i>
<i>Collema tenax</i>
<i>Dermatocarpon reticulatum</i>
<i>Diploschistes muscorum</i>
<i>Endocarpon loscosii</i>
<i>Endocarpon pusillum</i>
<i>Evernia prunastri</i>
<i>Fuscopannaria cyanolepra</i>
<i>Lecanora cenisia</i>
<i>Lecanora garovaglii</i>
<i>Lecanora muralis</i>
<i>Lecanora pseudomellae</i>
<i>Lecanora</i> sp. "4" (McCune & Resentreter, '07)
<i>Lecidea atrobrunnea</i>
<i>Lecidea tessellata</i>
<i>Lepraria cacuminum</i>
<i>Leptochidium albociliatum</i>
<i>Leptogium lichenoides</i>
<i>Leptogium</i> sp. "1" (McCune & Resentreter, '07)
<i>Leptogium tenuissimum</i>
<i>Lobothallia alphoplaca</i>
<i>Massalongia carnosia</i>
<i>Melanelixia subargentifera</i>
<i>Melanelixia subaurifera</i>
<i>Peltigera didactyla</i>
<i>Peltigera rufescens</i>
<i>Phaeophyscia constipata</i>
<i>Phaeophyscia sciastra</i>
<i>Physcia adscendens</i>
<i>Physconia enteroxantha</i>
<i>Placidium cf. pilosellum</i>
<i>Placidium squamulosum</i>
<i>Placynthiella uliginosa</i>
<i>Placynthium nigrum</i>
<i>Pleopsidium flavum</i>
<i>Polychidium muscicola</i>
<i>Psora cerebriformis</i>
<i>Psora dicipiens</i>

<i>Psora globifera</i>
<i>Psora montana</i>
<i>Rhizocarpon melanconianum</i>
<i>Rhizoplaca chrysoleuca</i>
<i>Rhizoplaca melanophthalma</i>
<i>Texosporium sancti-jacobi</i>
<i>Toninia sedifolia</i>
<i>Umbilicaria phaea</i>

<i>Xanthomendoza galericulata</i>
<i>Xanthomendoza mendozae</i>
<i>Xanthoparmelia</i> cf. <i>coloradoensis</i>
<i>Xanthoparmelia loxodes</i>
<i>Xanthoparmelia plittii</i>
<i>Xanthoparmelia subhosseana</i>

DISCUSSION

With just a few historical records for *Aloina bifrons* and *Bryoerythrophyllum columbianum* prior to the study, these results more accurately reflect their abundance by the increased number of occurrences. Considering the tendency of *A. bifrons* on undisturbed stable conditions and the land use practices of agriculture and grazing etc., it is reasonable to extrapolate that it maintains its uncommon distribution throughout eastern Oregon and Washington. The study also reveals the prevalent nature of *Bryoerythrophyllum columbianum* as a population core in the Columbia River Basin and further supports the namesake of this western North American endemic.

Follow up questions are: How wide spread are these two species? What is their exact range? For example, *B. columbianum* was only known in Oregon from a few counties along the Columbia River on the east side of the Cascades (ORBIC, 2013). Subsequently it has turned up in Crook Co. (Chimney Rock Campground), about 150 miles southwest (Kofranek coll. #6660).

The resulting species list has further elucidated the Columbia River Basin especially in terms of mosses including rare or unexpected species. Some of these are associated with BSCs. However because lichens are the most diverse organisms of BSCs, BSCs have largely fallen into the domain of lichenology. Consequently bryophytes are often identified only to the genus level (Rosentreter et al., 2007; Ponzetti and McCune, 2001), functional type (Dettweiler-Robinson et al., 2013; Ponzetti et al., 2007), or not addressed at all (Root et al., 2011) and therefore have become an understudied component of BSCs.

Some of the neglect is not only ascribed to the difficulty of identifying a disparate group of life form (McIntosh, 2003) and challenging ones at that, but also the added fact that these mosses are still being discovered and described. McIntosh (2003) in his study of nearby Hanford Reach National Monument did not identify two species of *Didymodon* and one *Bryum* although he has a Ph.D in bryophytes of semi-arid steppe. It is a good chance the unidentified species were undescribed at the time or at least not well known yet.

Maybe not coincidentally two species of *Didymodon* and one *Bryum* s.l. have subsequently been described. *D. norrisii* (Zander, 1999) has been considered all but endemic to California. Yet it being found within this study area helps explain its true range. Likewise, *D. eckeliae* (Zander, 2001) is a species whose habitat and range remained unclear all these years. Now, much due to this study, both species are known from both sides of the Cascades; *D. eckeliae* from WA and BC, *D. norrisii* from WA and four other counties in OR. Finally within the timeframe of this study *Gemmabryum vinosum* was described (Spence and Kellman, 2015). These are examples of

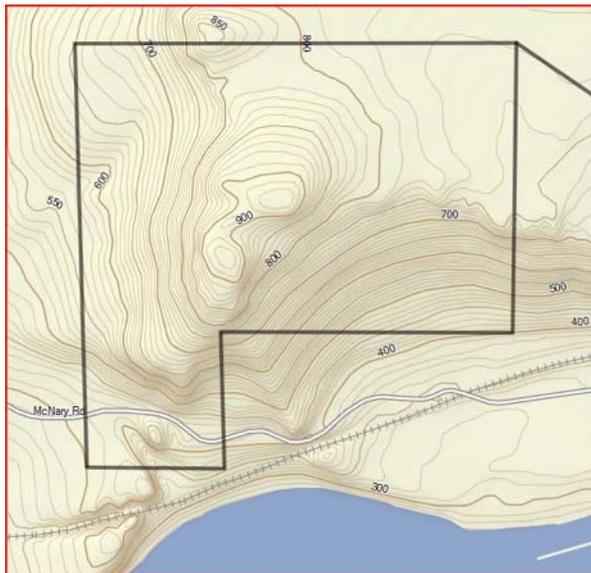
how much knowledge has been gained since 1999 and how active and beneficial the state of bryology is now.

It is recommended that future surveys within the Columbia Basin target the species highlighted above and that they be conducted in March through May. Many bryophytes have perfectly ripe capsules at this time.

Silusi Butte, Benton Co., WA
T5N-R28E-S4, 314 ac.
February 16, 17, 2016



Below: topographic map and aerial view of 314 ac. parcel.



Results

The target moss, *Aloina bifrons*, was found 4 times (two E.O. forms). The target moss species, *Bryothryphyllum columbianum*, was found 24 times (three E.O. forms). The target lichen species, *Texosporium sancti-jacobi*, was not found.

Noteworthy mosses include, *Tortula inermis*, which was found once and *Tortula cf. brevissima* was found four times (one site form). Noteworthy lichens include *Rhizocarpon melanconianum* found twice, *Acarospora rosulata* found three times, and *Phaeophyscia constipata* once.

Site Description

This parcel and the following one are on the south side Horse Heaven Hills; the north side of Horse Heaven Hills was studied by Ponzetti et al. (2007).

This rectangular BLM parcel with a small panhandle encompasses all of Silusi Butte. It extends from 360 ft. up to the summit of the butte at 920 ft. in elevation. The promontory is located on the Washington side of the Columbia River just north of McNary Dam and west of Interstate 82. All aspects are present with south and west most predominant. The south facing area in the southeast of the parcel is a large-scale anciently-formed curved escarpment that steeply rises up to the summit. The long west-facing slope also reaches the summit, but not as steeply. The northeast corner of the parcel levels out as part of the greater local plateau. In the panhandle of the southwest corner is a ravine.

Below left: Silusi Butte from McNary Rd. Below right: looking N NW along west-facing slope from waypoint 020.



Habitats that yielded interesting and the most quantity of species are areas with features such as rock outcrops, rimrock walls, and generally convex topographies (ridges, shoulders, and summit). These exposed well-draining situations also have thin, gravelly soils that are sparsely vegetated by vascular plants. BSCs occupy these excellent habitats and are closely associated with *Crocidium multicaule*. Examples of this are north and east facing slopes just below the summit at waypoints 012-017.

Conversely habitats that offer few bryophytes or lichens are in concave topographies such as swales, saddles, and slope bottoms. Here soil (sand) and moisture accumulates and frequently supports complete coverage of grasses and herbaceous plants.

Juniperus and other trees are absent from this parcel. Other vascular plants include *Artemisia tridentata* (south side of McNary Rd. only), *Chrysothamnus nauseosus* (minimal), *Purshia tridentata*, *Balsamorhiza sagittata*, *Draba verna*, *Lomatium gormanii*, *Madia glomerata*, *Sysimbrium altissimum*, *Salsoa kali*, *Poa secunda*, and other bunchgrasses. *Bromus tectorum* is prevalent throughout the parcel and was one of the few green plants at the time of the survey. Its immature leaves still colored whole slopes, as is evidence in photos. Trace evidence of grazing appear moderately to old aged.

Silusi Butte, apparently, is a traditional destination for local high school students to paint prominent rock faces facing the interstate with their forthcoming graduating year. Although the paint is thick and covers broad areas of bryophytes and lichens, it doesn't last as long as one might think due to extreme weathering.

Below: prominent rock outcrops that are painted. Also see waypoint 005 photo below.



Abundance and Distribution

This parcel has many excellent habitats and in places is high in both bryophyte and lichen species diversity and biomass. BSC species are very well-represented here, as are saxicolous lichens, and a few epiphytes. The total number of lichens is 53 species. Although there are less than half as many bryophytes, 25 species, their biomass is higher. Overall BSC coverage is high and may be explained by the winters being relatively warm and wet (Ponzetti & McCune, 2001).

Aloina bifrons is present at four locations (two E.O. forms) scattered patchily along a ridge from the southwest to the northeast up to a shoulder of the summit. *A. bifrons* is sparse lower down (waypoint 005) where it occupies bare undisturbed mineral soils that fill the interspaces of low rising rocky mounds.

Below: *Aloina bifrons* at waypoint 005.



Farther up the ridge, near the summit (waypoint 030), the habitat is excellent for bryophytes and lichens. There is thin rocky soil with sparse *B. tectorum* and forbs. The BSC lichen, *Ascarospora schleicheri*, is here indicating that conditions are well-aged. It extends to the summit and surrounding areas. Here, *A.*

bifrons occupies its typical micro-niche of small patches of bare mineral soil between rocks. There are less than 20 stems without sporophytes.

Below: waypoint 030, *Aloina bifrons* and excellent habitat for BSCs and saxicolous species. Looking N at summit.



Below: waypoint 030, *Aloina bifrons* at knife tip.



Continuing another 50 meters along the upper slope *A. bifrons* reappears in a crevice of a two-meter high basalt rock wall (waypoint 033). On the leeward side of the sub-summit this habitat is rich with mosses and lichens. There are more than 20 stems of *A. bifrons* here in a 9 cm² area, many of them fertile.

Below: waypoint 033. Left *Aloina bifrons* at knife tip, bottom center. Right: *Aloina bifrons* with sporophytes. *Bryoerythrophyllum columbianum* also.



A. bifrons ultimately terminates on the east side of the exposed and rounded summit shoulder (waypoint 015). Cobble sized rocks with saxicolous lichens cover the ground with *Bromus tectorum*.

Below: waypoint 015, *A. bifrons* lower right hand corners at knife tip. Left: looking S towards Hermiston.



All locations of *A. bifrons* encountered thus far for this study indicate it is a pioneer species because they have been on bare undisturbed mineral soil without immediate competition. This site (waypoint 015) however, is an example of the late stage of its place in succession. Here, *A. bifrons* is growing on organic soil, being crowded out by lichens, and overgrown by larger mosses.

Below: waypoint 015. Left: *A. bifrons* at knife tip. Right: *A. bifrons* being overgrown.



Accordingly there is a higher success rate of finding *A. bifrons* when visually targeting easy to spot patches of bare mineral soil. The location above was incidentally discovered when observing other species up close.

Bryoerythrophyllum columbianum is common along a ridge arcing from the southwest to the east. It is often present in BSC communities and rocky areas. Below are photos of habitat sites. Also see waypoints 005, 030, 033 above.

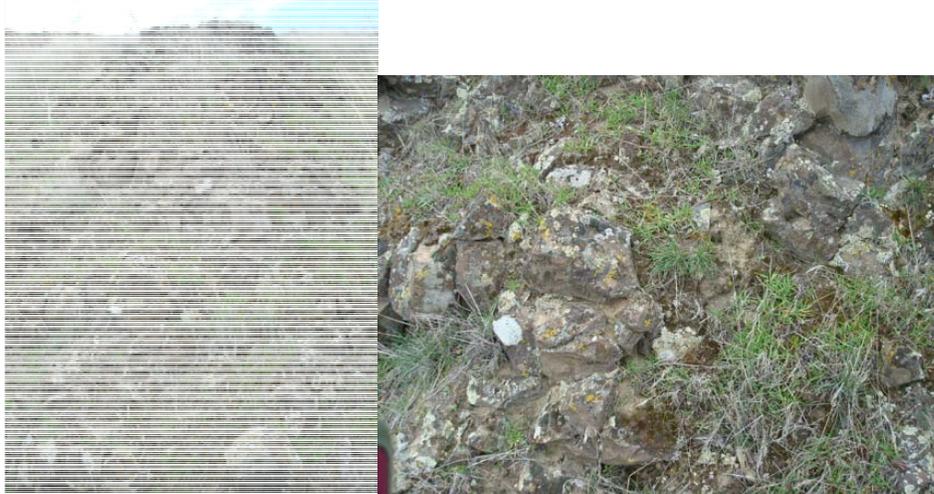
Below: waypoint 009, with *Bryoerythrophyllum columbianum*.



Below left: waypoint 020 with *Bryoerythrophyllum columbianum* and four thalli of *Acarospora schleicheri*. Below right: waypoint 027, *B. columbianum* on exposed ridge, McNary Dam in background.



Below: waypoint 035 with *Bryoerythrophyllum columbianum*.



Tortula cf. brevissima is a minute reddish brown piliferous species with stems < 1 mm wide, not twisted or contorted when dry. It occurs in exposed situations on mineral soil infused into old bunchgrass bases or between rocks. It is present at four locations scattered patchily along an exposed north northeast oriented ridge (waypoint 027, see above for photo of that location/habitat).

Tortula inermis is located in the panhandle in the southwest of the parcel. There is a ravine in the extreme south, 45 meters wide with two opposing basalt cliffs. Conditions here are cooler and moister than elsewhere in the parcel. The tall cliffs provide shade longer throughout the day decreasing evaporation. The closer proximity to the river also provides additional humidity. Short rock walls are rich with bryophytes and lichens.

There are five or so small patches of *T. inermis* growing in crevices of the rock wall within a 10 x 9 meter area at waypoint 040. Some were fertile at time of the survey. It is easy to identify in the field by its mucicous (without a hair point) leaf tip which is unlike most other *Tortula*, *Syntrichia*, or *Encalypta*. It usually has capsule that also differs from *Encalypta*. When dry, its leaves fold longitudinally, completely closing as a book and tightly spiral around the stem.

According to PNW Herbaria website this population represents only the second record for Washington.

<http://www.pnwherbaria.org/m/datasets/bryophytes/pages/pottiaceae/tortula-inermis.htm>

Below: waypoint 040. Right: *Tortula inermis* lower right corner at knife tip. Columbia R. and OR at far left background. Right: *Tortula inermis* at lower center at knife tip, same location as left photo.



Below: waypoint 040, *Tortula inermis*.



Other noteworthy species include *Phaeophyscia constipata*, which overlaps with *T. inermis* mentioned above. There are 10-20 thalli of *P. constipata* across a 10 x 35 meter area along waypoints 040, 041, 042.

Below: waypoint 041, *Phaeophyscia constipata*.



The conspicuous yellow “wash” on the east-facing cliff in the above photo of waypoint 040 is the crustose lichen, *Pleopsidium (Acarospora) flavum*. Also in this area on exfoliating bark of dead *Artemisia tridentata* is *Lecanora* cf. sp. 4 (McCune & Rosentreter, 2007). It appears to be common yet undescribed (McCune, 2015).

Below: waypoint 039, cf. *Lecanora* sp. 4 (McCune & Rosentreter, 2007)



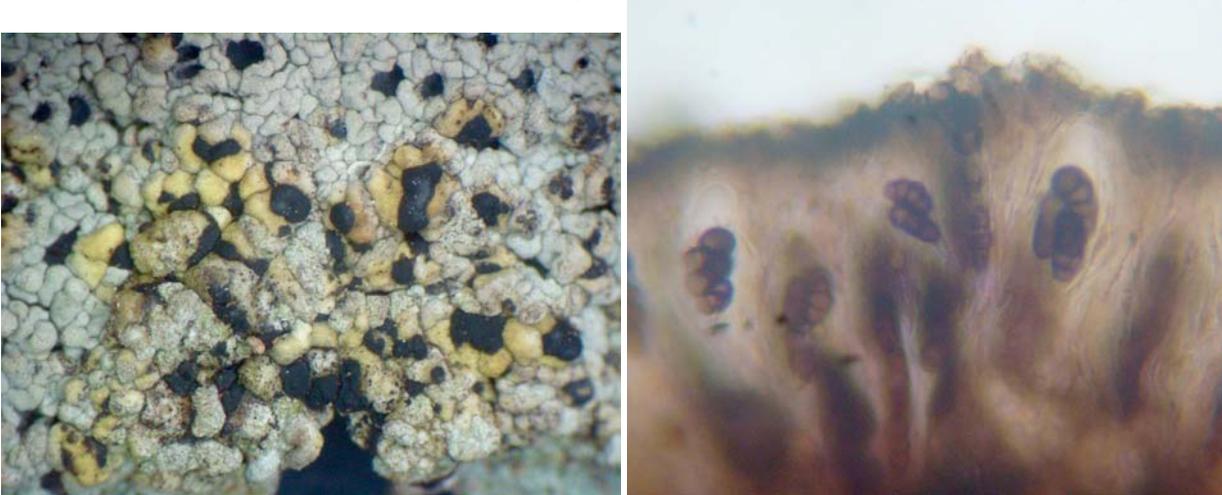
The moss, *Gemmabryum vinosum*, has long been known about and was finally described last year (Spence & Kellman, 2015). The green to wine red bulbiform stems grow in caespitose patches among sheltered rock crevices such as “rock gardens” of rocky hillocks. Although it is abundant in places at Silusi Butte, it was not known from Washington prior to this study.

Below: waypoint 002, newly described *Gemmabryum vinosum*.



Rhizocarpon melanconianum is a rare BSC lichen species (McCune & Rosentreter, 2007). The yellow crustose species is parasitic on *Diploschistes muscorum*. It is growing in exposed conditions on a ridge (waypoint 027, see above for photo of that habitat).

Below: waypoint 027, yellow thallus of *Rhizocarpon melanconianum* and 3-septate spores.



Acarsopora rosulata is a light brown saxicolous crustose lichen species growing on exposed rock faces. According to Brodo (2016) this western species is “rare,” but perhaps to those more familiar with the local flora it may be less so. It was collected from waypoints 027, 033 (see photo of it in 142 ac. parcel description).

Xanthoparmelia subhosseana and *X. loxodes* (formerly *Neofuscelia loxodes*) are saxicolous foliose lichens that are both present here. They differ by, among other things, in chemical spot tests. Although *X. subhosseana* is uncommon across its range, it is known from basalt plateaus and steppe (McCune and Geiser, 2009). See photo under 142 ac. parcel description, waypoint 049. Present at waypoint 027, see above for photo of that habitat.

Below left: waypoint 033, *Lecidea tessellata* (white w/ black apothecia), one of the most common saxicolous crustose lichens. Below right: waypoint 002, common lichens *Candelariella vitellina* (yellow), *Lecidea atrobrunnea* (brown), *Lecanora muralis* (cream).



Below: waypoint 019, good BSC habitat with abundant *Diploschistes muscorum* as dislodged flakes.



Below left: waypoint 003, large isidioid specimen of *Collema* cf. *fuscovirens* (with affinity to *C. undulata* var. *granulosum*). Below right: immature sporophytes of the common *Grimmia pulvinata*.



Silusi Butte species list.

MOSSES

<i>Aloina bifrons</i>
<i>Anacolia menziesii</i>
<i>Bryoerythrophyllum columbianum</i>
<i>Bryum argenteum</i> s.l.
<i>Ceratodon purpureus</i>
<i>Didymodon australasiae</i>
<i>Didymodon brachyphyllus</i>
<i>Didymodon vinealis</i>
<i>Encalypta rhapsocarpa</i>
<i>Funaria hygrometrica</i>
<i>Gemmabryum caespiticium</i>
<i>Gemmabryum vinosum</i>
<i>Grimmia laevigata</i>
<i>Grimmia montana</i>
<i>Grimmia ovalis</i>
<i>Grimmia pulvinata</i>
<i>Grimmia trichophylla</i>
<i>Polytrichum piliferum</i>
<i>Pseudocrossidium obtusulum</i>
<i>Pterygoneurum ovatum</i>
<i>Syntrichia caninervis</i>
<i>Syntrichia ruralis</i>
<i>Tortula cf. brevissima</i>
<i>Tortula inermis</i>

LIVERWORTS

<i>Cephaloziella divaricata</i>

LICHENS

<i>Acarasopora rosulata</i>
<i>Acarospora schleicheri</i>
<i>Arthonia glebosa</i>
<i>Aspicilia mastrucata</i>
<i>Aspicilia reptans</i>
<i>Buella punctata</i>
<i>Caloplaca jungermanniae</i>
<i>Caloplaca tominii</i>
<i>Candelaria pacifica</i>
<i>Candelariella aggregata</i>
<i>Candelariella citrina</i>
<i>Candelariella vitellina</i>
<i>Circinaria cinerae</i>

<i>Cladonia chlorophaea</i>
<i>Cladonia fimbriata</i>
<i>Cladonia pulvinella</i>
<i>Cladonia</i> sp. (squamules only)
<i>Collema</i> cf. <i>fuscovirens</i>
<i>Collema tenax</i>
<i>Diploschistes muscorum</i>
<i>Endocarpon pusillum</i>
<i>Fuscopannaria cyanolepra</i>
<i>Lecanora garovaglii</i>
<i>Lecanora muralis</i>
<i>Lecanora pseudomellae</i>
<i>Lecanora</i> sp. "4" (McCune & Rosentreter, '07)
<i>Lecidea atrobrunnea</i>
<i>Lecidea tessellata</i>
<i>Lepraria cacuminum</i>
<i>Leptochidium albociliatum</i>
<i>Leptogium lichenoides</i>
<i>Leptogium</i> sp. "1" (McCune & Rosentreter, '07)
<i>Lobothallia alphoplaca</i>
<i>Massalongia carnosa</i>
<i>Melanelixia subargentifera</i>
<i>Melanelixia subaurifera</i>
<i>Phaeophyscia constipata</i>
<i>Phaeophyscia sciastra</i>
<i>Physcia adscendens</i>
<i>Physconia enteroxantha</i>
<i>Placidium squamulosum</i>
<i>Placynthiella uliginosa</i>
<i>Pleopsidium flavum</i>
<i>Psora cerebriformis</i>
<i>Rhizocarpon melanconianum</i>
<i>Rhizoplaca melanophthalma</i>
<i>Toninia sedifolia</i>
<i>Umbilicaria phaea</i>
<i>Xanthomendoza galericulata</i>
<i>Xanthomendoza mendozae</i>
<i>Xanthoparmelia</i> cf. <i>coloradoensis</i>
<i>Xanthoparmelia loxodes</i>
<i>Xanthoparmelia plittii</i>
<i>Xanthoparmelia subhosseana</i>

Near McNary Dam, Benton Co., WA
T5N-R28E-S2, 142 ac.
February 19, 2016



Above: waypoint 048, southwest corner of 142 ac. parcel, looking east.

Below: topographic map and aerial view of 142 ac. parcel.





Results

The target mosses, *Aloina bifrons*, *Bryoerythrophyllum columbianum*, and lichen, *Texosporium sancti-jacobi*, were not found.

Noteworthy mosses include, *Tortula protobryoides*, which was found once, *Tortula cf. brevissima*, was found three times (one site form), *Gemmabryum gemmilucens* was found once, and *Didymodon eckeliae* was found once. Noteworthy lichens include *Acarospora obpallens* and *A. rosulata*, which were each found once (no E.O. forms).

Site Description

This BLM parcel occupies a portion of the north bank of the Columbia River and is an elongated rectangle oriented east-west. The elevation ranges from 390 to 705 feet and is predominantly south facing. Physical features include slopes, draws, swales, basalt plateau, and rimrock.

Below: looking west at general landscape of 142 ac. parcel with rimrock and slopes.



Juniperus and other trees are absent from this parcel. Other vascular plants include *Artemisia tridentata*, *Chrysothamnus nauseosus*, *Purshia tridentata*, *Crocidium multicaule*, *Draba verna*, *Lomatium gormanii*, *L. cf. cous*, *Asclepias speciosa*, *Sysimbrium altissimum*, *Salsoa kali*, *Poa secunda*, and other bunchgrasses. *Bromus tectorum* is prevalent throughout the parcel and was one of the few plants that were green at the time of the survey.

Abundance and Distribution

This parcel is very similar to the 314 ac. parcel just one mile to the west. However it has less topographic relief and features, otherwise the species lists are almost the same. The diversity of bryophytes and lichens are both high. In limited areas biomass can be high also: *Ceratodon purpureus*, *Syntrichia ruralis* covering sandy soil and *Lecanora muralis* covering cobble-sized rocks (e.g. waypoint 055).

Below: waypoint 055. Left: *Ceratodon purpureus*, *Syntrichia ruralis*. Right: *Lecanora muralis* covering rocks.



The most interesting habitats are the rimrock walls, rock outcrops, and generally level thin rocky soil. Saxicolous lichens favor the rimrock wall while pockets of soil are colonized by terricolous species of mosses and lichens. On rock outcrops the soil is in the interspaces of rocks and along rimrock walls it collects on horizontal shelves of the basalt. The thin rocky soils support rich communities of BSCs and are closely associated with *Crocidium multicaule* and *Poa secunda*.

Below: waypoint 050, example of rimrock wall habitat with *Acarospora rosulata* (rusty, upper left corner), *Pleopsidium flavum* (bright yellow), *Candelariella vitellina* (golden yellow), *Rhizoplaca melanophthalma*, *Umbilicaria phaea*, *Lecidea tessellata*.



Below: waypoint 052, examples of soil collecting on shelves of basalt rimrock.



Below: waypoint 051, *Lecanora cenisia*



Below: waypoint 048, example of thin rocky soils with BSCs and *Crocidium multicaule*.



Below: waypoint 049, example of BSCs with *Toninia sedifolia* (bluish), *Collema tenax*, *Placynthium nigrum*, *Endocarpon pusillum*, *E. loscosii*, *Caloplaca timinii*, *Cladonia squamules*, *Placidium squamulosum*, *Didymodon vinealis* (reddish), *Encalypta rhapsocarpa*, *Pseudocrossidium obtusulum*, *Syntrichia ruralis*, (on rock *Lecanora muralis* and/or *L. garovaglii*).



Below: waypoint 049 with *Toninia sedifolia*. Bottom right: *Placynthium nigrum* in background.



Conditions not favored by bryophytes and lichens are areas where soil (sand) has accumulated such as depressions, swales, and slope bottoms now covered with grass.

There is a short “slot” interrupting a length of rimrock at waypoint 057. It is 1-2 m wide and 2-3 m high. The sheltered feature supports lush growths of mosses and lichens such as *Anacolia menziesii*, *Grimmia*, *Syntrichia ruralis*, *Physconia enteroxantha*, *Xanthoparmelia plittii*. The protected conditions are suitable for *Phaeophyscia constipata*, but it is not present.

Below: waypoint 057, slot in rimrock with lush flora.



Below: from central parcel looking east with sand blowout and ORV trails in middle distance.



Specifically the best area of the parcel is in the southwest corner along south facing rimrock on the east shoulder of a draw. All six “noteworthy” species mentioned above are here within the cluster of waypoints 050-054.

Tortula protobryoides was incidentally collected from waypoint 052. A small collection of a few stems without capsules makes it impossible to prove its identity, however, its leaves match the verified specimen from Juniper Canyon. It grows on soil of the small shelves of the rimrock. Given how thoroughly collections were made and under ideal field weather for botanizing BSCs (damp overcast conditions), it is evidently truly sparse. The Juniper Canyon collection (DK #6324A) was made in April and has perfectly aged capsules. Therefore further searches for this species should be conducted in April or maybe March.

Tortula cf. brevissima and *Didymodon eckeliae* were found at waypoint 051 where they both share a crevice of the rimrock wall. *Tortula cf. brevissima* was also found nearby in the same habitat at waypoints 050 and 054 where it is usually just one to a few small cushions. Specimens that were not obviously *D. vinealis* were regularly sampled and of those many collections only one was captured as *D. eckeliae*. Therefore *D. eckeliae* appears to be rare, at least locally. It does not appear to be known yet from Washington.

Below: waypoint 051, *Didymodon eckeliae* above, *Tortula cf. brevissima* below.



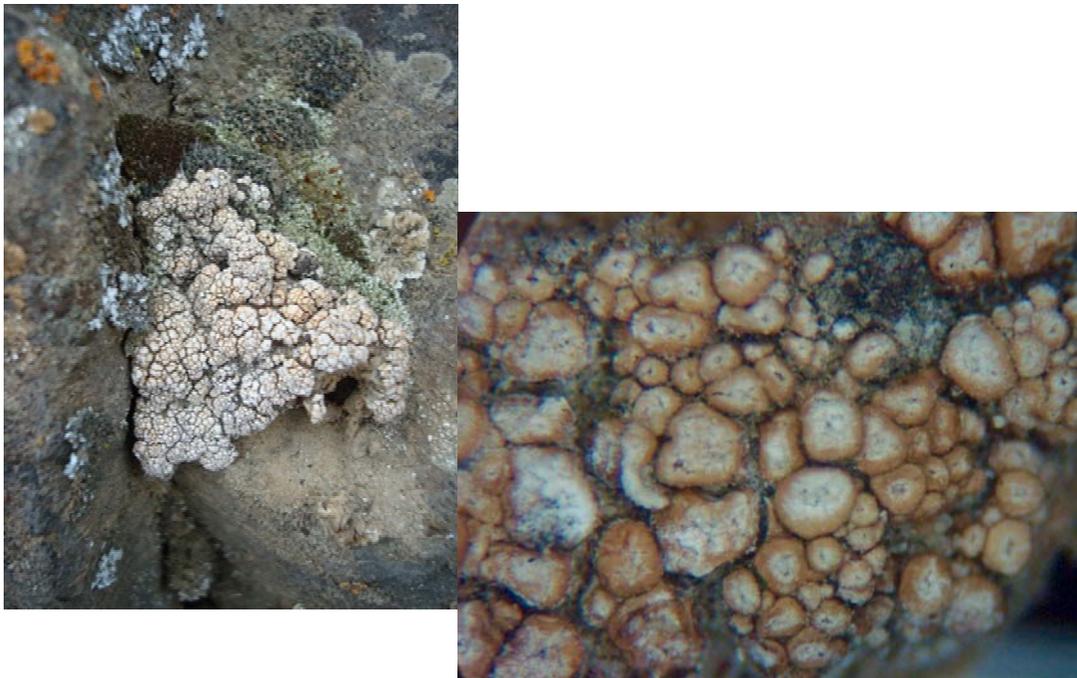
Gemmabryum gemmilucens is another species incidentally collected. The small specimen of only a few stems has axillary bulbils that match the description. Found at waypoint 054 on soil of rimrock with *Tortula cf. brevissima* and *Acarospora obpallens*.

Acarospora obpallens is a rare polymorphic species of a more southerly distribution (Brodo, 2016. McCune and Rosentreter, 2007. Nash et al., 2007). It was found growing on soil-filled crevices of rock at waypoint 054.

Below: waypoint 054, rimrock wall with *Gemmabryum gemmilucens*, *Tortula cf. brevissima*, *Acarospora obpallens*. Below right: *A. obpallens* at top left and small amount top center.



Below: waypoint 054, *Acarospora obpallens*.



Acarospora rosulata was found on vertical faces of the rimrock wall at waypoint 050. See description of parcel 314 ac. for more information. Several thalli are present at this immediate location.

Below: waypoint 050, *Acarospora rosulata*. Bottom right: looking east, *A. rosulata* as rust colored spot in bottom left corner.



Gemmabryum vinosum is present in this parcel. See description of parcel 314 ac. for more information.

Bryoerythrophyllum columbianum was found shortly off parcel to the south at waypoint 059.

Xanthoparmelia subhosseana and *X. loxodes* are both present in the area. See description of parcel 314 ac. for more information.

Below: waypoint 049, *Xanthoparmelia subhosseana* or *X. loxodes*.



Species of 142 ac. parcel near McNary Dam.

MOSESSES

<i>Didymodon eckeliae</i>
<i>Anacolia menziesii</i>
<i>Bryum argenteum</i> s.l.
<i>Ceratodon purpureus</i>
<i>Didymodon australasiae</i>
<i>Didymodon brachyphyllus</i>
<i>Didymodon vinealis</i>
<i>Encalypta rhamnifera</i>
<i>Gemmabryum caespiticium</i>
<i>Gemmabryum gemmilucens</i>
<i>Gemmabryum vinosum</i>
<i>Grimmia laevigata</i>
<i>Grimmia montana</i>
<i>Grimmia ovalis</i>
<i>Grimmia pulvinata</i>
<i>Grimmia trichophylla</i>
<i>Polytrichum piliferum</i>
<i>Pseudocrossidium obtusulum</i>
<i>Pterygoneurum ovatum</i>
<i>Syntrichia caninervis</i>
<i>Syntrichia ruralis</i>
<i>Tortula cf. brevissima</i>
<i>Tortula protobryoides</i>

LIVERWORTS

<i>Cephaloziella divaricata</i>

LICHENS

<i>Acarospora obpallens</i>
<i>Acarospora rosulata</i>
<i>Acarospora schleicheri</i>
<i>Aspicilia reptans</i>
<i>Caloplaca jungermanniae</i>
<i>Caloplaca tominii</i>
<i>Candelaria pacifica</i>
<i>Candelariella aggregata</i>

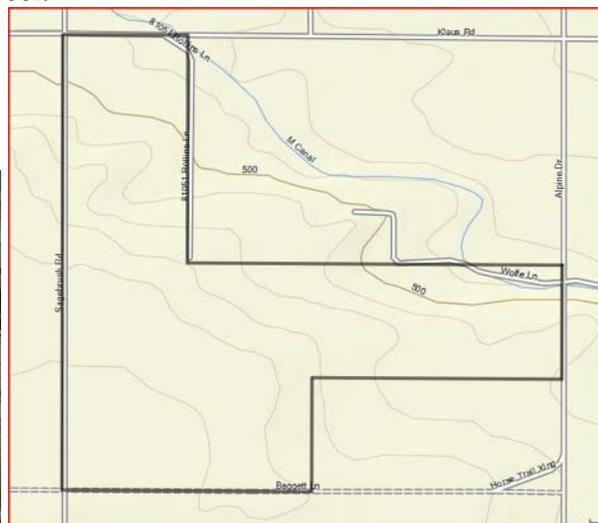
<i>Candelariella citrina</i>
<i>Candelariella vitellina</i>
<i>Circinaria cinerae</i>
<i>Cladonia</i> sp. (squamules only)
<i>Collema tenax</i>
<i>Dermatocarpon reticulatum</i>
<i>Diploschistes muscorum</i>
<i>Endocarpon loscosii</i>
<i>Endocarpon pusillum</i>
<i>Lecanora cenisia</i>
<i>Lecanora garovaglii</i>
<i>Lecanora muralis</i>
<i>Lecidea atrobrunnea</i>
<i>Lecidea tessellata</i>
<i>Lepraria cacuminum</i>
<i>Leptochidium albociliatum</i>
<i>Leptogium lichenoides</i>
<i>Lobothallia alphoplaca</i>
<i>Massalongia carnosa</i>
<i>Melanelixia subaurifera</i>
<i>Physconia enteroxantha</i>
<i>Placidium squamulosum</i>
<i>Placynthiella uliginosa</i>
<i>Placynthium nigrum</i>
<i>Pleopsidium flavum</i>
<i>Psora cerebriformis</i>
<i>Rhizoplaca melanophthalma</i>
<i>Toninia sedifolia</i>
<i>Umbilicaria phaea</i>
<i>Xanthomendoza galericulata</i>
<i>Xanthomendoza mendozae</i>
<i>Xanthoparmelia</i> cf. <i>coloradoensis</i>
<i>Xanthoparmelia loxodes</i>
<i>Xanthoparmelia plittii</i>
<i>Xanthoparmelia subhosseana</i>

**Hermiston Off-Road Vehicle Trail System, Umatilla Co, OR.
T5N-R28E-S26, 81 ac.
October 7, 9, 10, 2015**



Above: waypoint 206. View from central location of Hermiston ORV trail system parcel looking north.

Below: topographic map and aerial view of parcel.



Results

The target lichen species, *Texosporium sancti-jacobi*, was found 16 times (one E.O. form). The target moss species, *Bryoerythrophyllum columbianum*, was found 33 times (two E.O. forms). The target moss, *Aloina bifrons* was not found.

Site Description

This designated ORV trail system is shortly north of Hermiston just east of Highway 395. The 81 acre BLM parcel has two panhandles and is surrounded by private residences. Loose sandy trails the width of 4-wheelers crisscross throughout the parcel. A lightweight electrical fence cordons off the east panhandle where evidence of equestrian activity is prevalent throughout. The ground conditions are much poorer on the east section caused by roaming ungulates as opposed to the patchy disturbance caused by ORVs that tend to remain on established trails. Rubbish, including gun shells and items used for target shooting, are also present in the east panhandle as well as to the north. A power line corridor passes through the southwest of the parcel and M Canal through the east. The sandy terrain undulates and is slightly oriented towards the northeast. Physical features include low broad ridges, embankments, and depressions. Rim rock is absent and only one small boulder was seen. The elevation ranges from 490 – 540 ft.

Trees are absent; other vascular plant coverage includes large old *Artemisia tridentata*, *Purshia tridentata*, *Eriogonum*, *Salsola kali*, *Bromus tectorum*, *Sisymbrium altissimum* and *Poa secunda*.

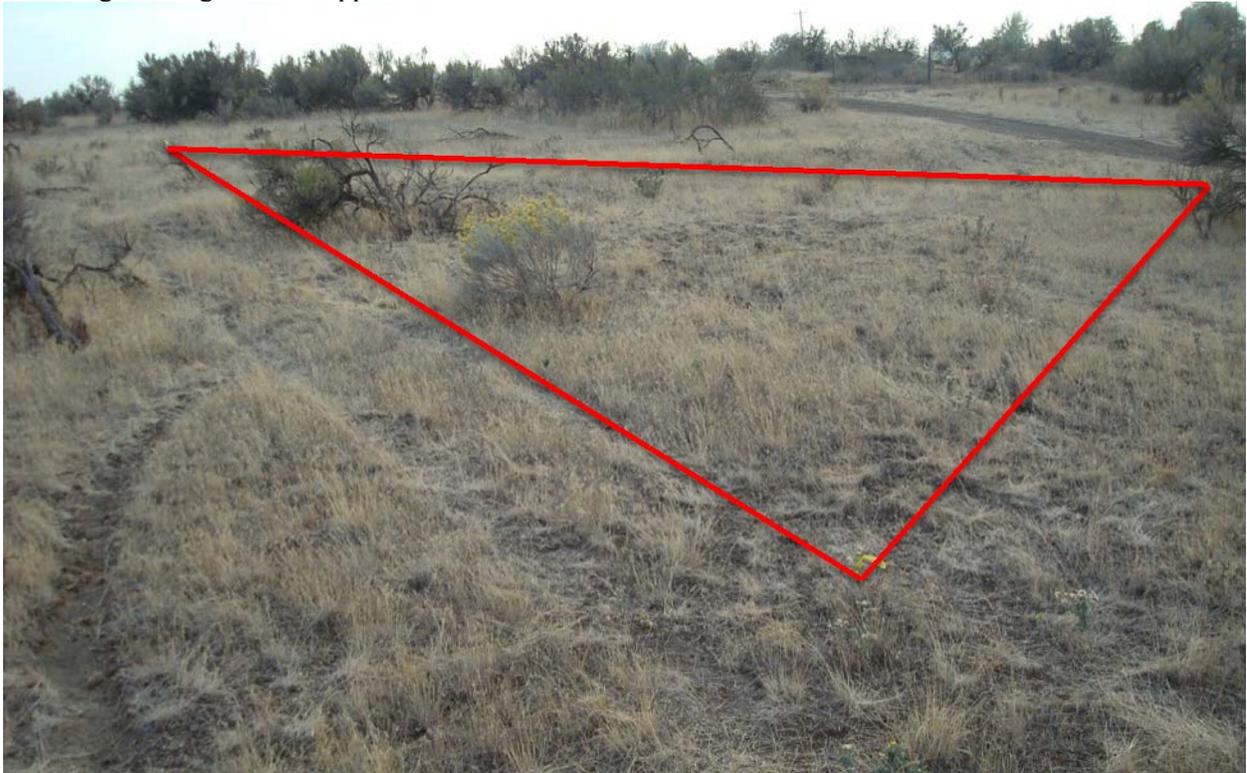
In Some areas *B. tectorum* is thick, choking out BSC species. However, in most areas it is less dominant, allowing small patches of *Pseudocrossidium obtusulum*, *Gemmabryum caespiticium*, *Syntrichia ruralis*, and *Cladonia* to persist. The best situations in the parcel are where *B. tectorum* is replaced by a small bunch grass, *Poa secunda*. This allows the interspaces to develop BSCs. These small habitats, that haven't been run over recently, are where *Bryoerythrophyllum columbianum* and other locally infrequent species are found such as *Placidium squamulosum* and *Diploschistes muscorum*. Ultimately they form a mat completely covering the immediate area. In these locations there are often rabbit pellets and the condition of the ground appears lightly worn by small animal traffic. Could the BSCs be benefitting from the rabbits cropping the grass and thereby controlling cover?

The ORV trail system is an area in various stages of recovery. The continuously turned loose sandy soil of ORV trails adjacent to less disturbed conditions provides good examples of BSC colonization, development, and succession. Large recently exposed grains of sand are first colonized by *Syntrichia ruralis* and large pleurocarpous species of Brachytheciaceae e.g. *Brachythecium albicans* and *Homalothecium nevadense*. Less disturbed areas with finer grained and firmer packed soil have greater species diversity. Gelatinous lichens (*Collema*, *Leptochidium*, *Leptogium*) are often prominent in these situations.

Abundance and Distribution

Texosporium sancti-jacobi is present in the southwest corner of the parcel at waypoints 297, 298. Evenly scattered throughout a 10m x 10m x 10m triangular area, 16 thalli were seen. Thalli average in size 1 cm² on old *Poa secunda* (syn. *P. sandbergii*) bases. The condition of the bases are in advanced decay stage and almost unrecognizable because they are by now 1-2 cm² mineral soil pedestals. At least one thallus was detached and vagrant. At the moment it was found, it rested with a few rabbit pellets of similar size and weight corralled in a microsite from a recent wind event.

Below: waypoints 297, 298. Habitat of *Texosporium sancti-jacobi*, TESA-Site1-DK-6895. Area within red triangle is larger than it appears.



Below: waypoint 298. *T. sancti-jacobi*, white thallus with dark greenish spore mass.



Below: waypoint 297. *T. sancti-jacobi* at knife tips. Below left: excellent development of BSC with *Psora montana* (appearing purplish) and *Aspicilia filiformis*. Below right: unattached thallus of *T. sancti-jacobi* deposited by wind with other objects of similar size and weight such as rabbit pellets.



Below: waypoint 298. Below left: another habitat view showing interspaces between *Poa secunda* that are colonized by BSCs. *T. sancti-jacobi* at knife tip. Below right: example of *T. sancti-jacobi* on still recognizable *Poa secunda* base.



The triangular area is covered with the most unique and probably the oldest BSCs encountered for this study. In fact, it was the distinct quality of this habitat that was noticed first. The coverage of BSCs is high with *Psora montana* being the dominant species. The thalli of *Diploschistes muscorum* are so large and old that sizeable gray flakes have broken off and lay strewn about. Most notable is the first and only local site of *Aspicilia filiformis*. Although “fairly common” (McCune & Rosentreter 2007), it’s three dimensional habit is particularly vulnerable to physical damage (Belnap et al. 2001). Large specimens of this charismatic species are present here where it is a close associate of *T. sancti-jacobi*.

Below: waypoint 297. *Aspicilia filiformis*, in this case a close associate of *T. sancti-jacobi*.



Outside of the triangular area of BSC and *Poa secunda* is thick *B. tectorum* and sparse but large *Artemisia tridentata*. This area is adjacent to a well-used four-wheeler trail without anything to dissuade riders from driving over the area on a whim and quickly destroying it. Although faint historical tire tracks are evident from passing over this area, the reason for the survival of this refugium of *T. sancti-jacobi* is only chance. Because this site is in a suburban setting, it was probably grazed a long time ago, if ever, which is a ubiquitous and significant source of disturbance for BSCs to heal from (Ponzetti and McCune 2001). In the meantime, its habitat, which was probably much larger, has been whittled down by four-wheeler trails to this last remaining patch. Coincidentally there is a nearby area that is fenced off. If this barbed wire fencing could be expanded to include the *T. sancti-jacobi* site it would protect the only known site in Umatilla Co. and the Vale BLM District.

Bryoerythrophyllum columbianum is common throughout most of the parcel and was found 33 times (two E.O. forms). However, it is absent from the eastern panhandle. Evidently because horses roam the eastern panhandle (penned in with an electrical fence) not remaining on trails as four-wheelers tend to do.

The first site, BRCO13-Site27-DK-no collection, includes five observed points (waypoints 199, 201-203, 294) evenly scattered for 150 meters and distributed linearly. One end is located near the western fence, along Sagebrush Rd, midway up the northern panhandle and extends from the southwest to the northeast. There are a few coin size, 1-2 cm², patches of *B. columbianum* per point. These are in microhabitats that are level or concave, have little coverage of *Bromus tectorum*, and associated with *Pseudocrossidium obtusulum*, *Syntrichia ruralis*, *Ceratodon purpureus*, *Bryum argenteum*, *Gemmabryum caespiticeum*, *Didymodon vinealis*, *D. brachyphyllus*, *Riccia* sp., *Cladonia squamules*, *Leptogium lichenoides*, and *Polychidium musicola*.

Below left: waypoint 202, BRCO13-Site27-DK- no collection. Below right: waypoint 204, insect (probably Carabidae ground beetle) throw mounds create freshly exposed soil by micro-disturbances in areas choked with grass.

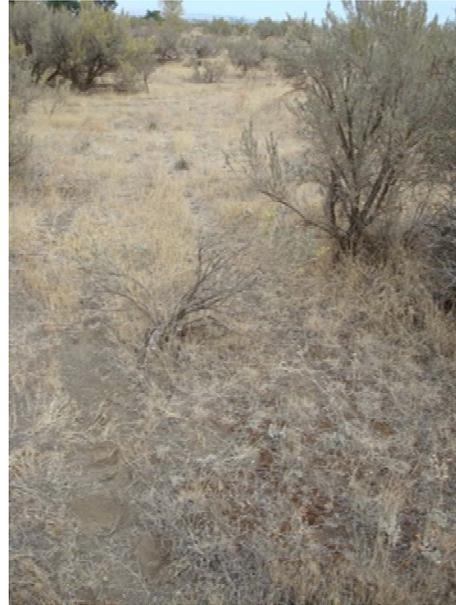


The second site of *Bryoerythrophyllum columbianum*, BRCO13-Site28-DK-6877, includes 27 observed points (waypoints 207-216 & 218-235) occupying the central core of the parcel as a 30+ ac. isodiametric polygon. Within this area *B. columbianum* is sparsely but evenly scattered to the north, almost absent in the center, then densely populated to the south along Baggett Ln. An average quantity of *B. columbianum* at each point is about 1-2m² at 3-5% coverage. Physical conditions and associated species remain much the same as the first site only with the addition of *Didymodon australasiae*.

Below: waypoint 207, *Bryoerythrophyllum columbianum*, BRCO13-Site28-DK-6877.



Below: waypoint 207, habitat of *Bryoerythrophyllum columbianum*, BRCO13-Site28-DK-6877.



Below left: waypoint 209, habitat of *Bryoerythrophyllum columbianum*, BRCO13-Site28-DK-6877.
Below right: same location, *B. columbianum* as dark reddish spots, not yellowish orange patches.



The largest area of *Bryoerythrophyllum columbianum* (at waypoint 209) is a 20m x 20m area with 1% coverage beneath the power line corridor. Here bushes and grass are minimal, a gravel service road is on the west side and a sandy four-wheeler trail to the east.

The large old *Artemisia tridentata* are often covered with conspicuous epiphytic lichens. *Xanthomendoza galericulata* is bright orange and *Candelaria pacifica* bright yellow. Both genera are known to have high nitrogen deposition requirements (McCune & Geiser 2009), which can be attributed to local sources of agriculture, cattle, and urban pollution. *A. tridentata* branches also have *Physconia enteroxantha* and *Evernia prunastri*. Upon closer inspection there is a drab green crustose lichen with black apothecia,

Buellia punctata. However, the most noteworthy is another crustose species with white apothecia rims. This keys out to “*Lecanora* sp. 4” in McCune & Rosentreter 2007 and is reportedly “rarely collected”.

The number four refers to an undescribed species in an article that focused on a group of *Lecanora* (Śliwa & Wetmore 2000). Later *L.* sp. 4 was described as *L. laxa* (Printzen 2001, Śliwa pers. comm. 2015), but according to McCune (Pers. comm. 2015) it still didn’t account for another similar but unique species. So it remains undescribed and inaccurately referred to *Lecanora* sp. 4.

Hermiston ORV Trail System Species List

MOSSES

<i>Brachythecium albicans</i>
<i>Bryoerythrophyllum columbianum</i>
<i>Ceratodon purpureus</i>
<i>Didymodon australasiae</i>
<i>Didymodon brachyphyllus</i>
<i>Didymodon vinealis</i>
<i>Gemmabryum caespiticium</i>
<i>Grimmia trichophylla</i>
<i>Homalothecium nevadense</i>
<i>Pseudocrossidium obtusulum</i>
<i>Syntrichia ruralis</i>

LIVERWORTS

<i>Cephaloziella divaricata</i>
<i>Riccia</i> sp.

LICHENS

<i>Arthonia glebosa</i>
<i>Aspicilia filiformis</i>
<i>Aspicilia reptans</i>
<i>Buella punctata</i>
<i>Candelaria pacifica</i>
<i>Cladonia</i> sp. (squamules only)
<i>Collema coccophorum</i>
<i>Diploschistes muscorum</i>
<i>Endocarpon pusillum</i>
<i>Evernia prunastri</i>
<i>Lecanora</i> sp. 4
<i>Leptochidium albociliatum</i>
<i>Leptogium lichenoides</i>
<i>Physconia enteroxantha</i>
<i>Placidium squamulosum</i>
<i>Polychidium muscicola</i>
<i>Psora montana</i>
<i>Texosporium sancti-jacobi</i>
<i>Xanthomendoza galericulata</i>

Ward Butte, Umatilla Co., OR
T3N-R27E-S24, 160 ac.
October 8, 2015



Above: Ward Butte parcel, looking north at sub-summit. Swale out of view in middle distance.

Below: topographic map and aerial views of parcel.



Results

The target moss species, *Aloina bifrons*, was found seven times (four E.O. forms). The target moss species, *Bryoerythrophyllum columbianum*, was found 35 times (two E.O. forms). The target lichen species, *Texosporium sancti-jacobi*, was not seen.

Noteworthy lichens include *Acarospora schleicheri*, a BSC lichen indicating old growth conditions.

Site Description

This square BLM parcel occupies the south end of a north-south oriented hill. The terrain within the parcel moderately slopes from near the summit down below the footslope where it becomes level. The elevation ranges from 930 to 740 feet.

Although trees and *Artemisia tridentata* are absent some small shrubs are present as well as *Sisymbrium altissimum*, *Bromus tectorum*, and *Poa secunda*. Rocky substrates are absent.

Abundance and Distribution

Aloina bifrons is an uncommon component of the local BSCs. Its scattered patchy distribution reflects the range of the very good BSC habitats within the parcel. These are in the north central, south to the middle, and over to the east and southeast corner. Usually with just a small cluster of stems per waypoint, *A. bifrons* is never abundant.

The first site, ALBI7-Site13-DK-6880, is present in the southeast corner (waypoint 237) in a broad concave topography. It is growing on fine textured soil in the interspaces of *Poa secunda* without shrub cover. Associated species include *Pseudocrossidium obtusulum*, *Bryoerythrophyllum columbianum*, *Didymodon australasiae*, and *Tortula brevipes*. From there, the next site is 76 m to the north along the eastern boundary at waypoint 239. This 30m x 20m area has an almost contiguous BSC community in the interspaces between small grasses and forbs. *B. columbianum* is also present here (BRCO13-Site29-DK-6891).

Below: waypoint 239, close up of *Aloina bifrons* habitat, ALBI7-Site13-DK-6880 and *Bryoerythrophyllum columbianum* BRCO13-Site29-DK-6891.



The second site, ALBI7-Site14-DK-no coll., has three patches, linearly distributed along the east boundary. From waypoint 243 northwards 14 m to waypoint 244 then another 11 m northwards and ends

at waypoint 246. *A. bifrons* grows among sparse coverage of small bunch grass with *Pseudocrossidium obtusulum*, *Didymodon australasiae*, *D. vinealis*, and *Syntrichia*.

Below: waypoint 246, habitat of *Aloina bifrons*, ALBI7-Site14-DK-no coll., looking southwest to west.



Below: at waypoint 246, *Aloina bifrons*, ALBI7-Site14-DK-no coll.



The third site, ALBI7-Site15-DK- no coll., comprises a single location (waypoint 260) in the north central part of the parcel. There is only a trace amount of *A. bifrons* in an open area with sparse bunch grass and BSC species filling the interspaces.

The fourth site, ALBI7-Site16-DK- no coll., another single location, is in the middle of the parcel at waypoint 269. It is in another habitat of about half small bunch grass and half BSC species including *B. columbianum* (BRCO13-Site29-DK-6891).

Below: waypoint 269. *Aloina bifrons*, ALBI7-Site16-DK- no coll. and *Bryoerythrophyllum columbianum*, BRCO13-Site29-DK-6891. Below left: habitat in foreground, looking northeast. Below right: close up of habitat.



B. columbianum is common and evenly scattered throughout the range of the very good BSC habitats within the parcel as described above. There are small to moderate amounts of it at each location.

The first site, BRCO13-Site29-DK-6891, occupies a 26 acre polygon across the backslope of the butte in the center of the parcel (waypoints 240-242, 247, 261, 262, 265-282). From there it extends south as a panhandle near the eastern boundary (waypoints 237, 239, 280-282). Typical conditions of this site in which *B. columbianum* is found are in the interspaces of *Poa secunda* with other BSC species such as *Pseudocrossidium obtusulum*, *Didymodon australasiae*, *Tortula brevipes*, *Leptogium lichenoides*, and *Cladonia squamules*.

The second site, BRCO13-Site30-DK-no coll., covers a six-acre trapezoid straddling the south-southwest aspects of the upper hillslope. The upper half of this site (waypoints 248, 250, 252, 253, 255) resides on the shoulder of the summit where the terrain is generally level and grasses, including *Bromus tectorum*, are sparse. Associated species include *Psora globifera*, *Lecanora garovaglii* (usually on rock but on soil here), *Collema tenax*, *Acarospora schlecheri*, *Aspicilia reptans*, and *Leptochidium albociliatum*. The lower half of this site (waypoints 256-259) is on a moderate hillslope within good BSC habitat however, conditions are grassier and diversity less rich than the upper half.

The best development of BSCs are in the central portion of the parcel from the shoulder of the summit at the north end down slope to the swale and over to the east side and southeast corner. Within this area the BSCs are moderate to very good in coverage and moderate to good in diversity. The best areas are the interspaces between *Poa secunda* and sparse *B. tectorum* where the soil is fine grain and not loose. In these situations prevalent species are *Psora globifera*, *Diploschistes muscorum*, *Aspicilia reptans*, *Bryoerythrophyllum columbianum*, and *Didymodon australasiae*.

Below: waypoint 264, example of very good BSC development and coverage. *Collema tenax* (black) top, *Psora globifera* (brown) below.



In particular there are large gray flakes of broken *Diploschistes muscorum* thalli, resembling dried mud, littered throughout the good habitats. When considering that *D. muscorum* initially parasitizes *Cladonia* (Rosentreter et al. 2007), overgrows it, and ultimately reaches a size large enough to detach, be blown, and break; this represents a lot of time. Congruently, *Acarospora schleicheri*, an indicator of old growth conditions (Root et al. 2011, Rosentreter et al. 2007) is present but limited to the shoulder of the summit of the parcel. This location (waypoint 252) is the best habitat of the parcel, in highly exposed conditions in which these organisms thrive.

Below: waypoint 252. Example of very good BSC habitat on the shoulder of the summit. Below left: *Acarospora schleicheri* (yellow) with *Psora globifera*. Below right: *Lecanora garovaglii*.



BSCs are generally absent from the northwest and northeast corners of the parcel because the hill slopes are dominated by non-bunching grass. Likewise at the south end of the parcel is a broad shallow swale and because of its increased moisture it is dominated by *Bromus tectorum* which consequently excludes BSCs. Along the west and in the southwest corner BSCs are only minimally present because the level terrain, and presumably deeper soil, is prone to northern pocket gopher activity. In this otherwise grass-dominated habitat, the throw mounds of the gophers introduce exposed soil which are then established by only a few species of colonizing moss: *Didymodon vinealis*, *Pterygoneurum ovatum*, *Encalypta rhaptocarpa*.

Below left: recently excavated gopher mound with bare soil. Below right: aged gopher mound with *Didymodon vinealis* et al., the apogee of BSC development before being overgrown by grass.



Ward Butte Species list

MOSSES

<i>Aloina bifrons</i>
<i>Bryoerythrophyllum columbianum</i>
<i>Bryum argenteum</i> s.l.
<i>Ceratodon purpureus</i>
<i>Didymodon australasiae</i>
<i>Didymodon brachyphyllus</i>
<i>Didymodon vinealis</i>
<i>Encalypta rhaptocarpa</i>
<i>Gemmabryum caespiticium</i>
<i>Pseudocrossidium obtusulum</i>
<i>Pterygoneurum ovatum</i>
<i>Syntrichia caninervis</i>
<i>Syntrichia ruralis</i>
<i>Tortula brevipes</i>

LICHENS

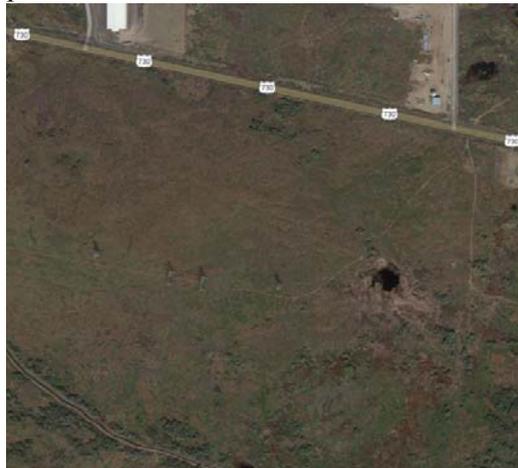
<i>Acarospora schleicheri</i>
<i>Arthonia glebosa</i>
<i>Aspicilia reptans</i>
<i>Caloplaca tominii</i>
<i>Candelariella aggregata</i>
<i>Cladonia</i> sp. (squamules only)
<i>Collema tenax</i>
<i>Diploschistes muscorum</i>
<i>Endocarpon loscosii</i>
<i>Endocarpon pusillum</i>
<i>Lecanora garovaglii</i>
<i>Leptochidium albociliatum</i>
<i>Leptogium lichenoides</i>
<i>Massalongia carnosa</i>
<i>Placidium squamulosum</i>
<i>Psora globifera</i>

Wanaket Wildlife Area, Umatilla Co., OR
T5N-R28E-S14, 117 ac.
October 11, 2015



Above: waypoint 317, looking northwest, representative of typical habitat.

Below: topographic map and aerial view of 117 ac. parcel.



Results

The target moss species, *Bryoerythrophyllum columbianum*, was found 48 times (one E.O. form). The target moss, *Aloina bifrons*, and the target lichen species, *Texosporium sancti-jacobi*, were not found.

Acarospora schleicheri is present at waypoint 332.

Site Description

This trapezoid-shaped BLM parcel has Hwy 730 as its northern boundary. It ranges in elevation from 470 ft. to 500 ft. and is relatively level. There are two main habitat types. The first is dry rocky plains with exposed flat volcanic bedrock. Within this habitat there is a gradual transition between thick patches of *B. tectorum* choking out other species, thin coverage of *B. tectorum* with bare soil in the interspaces of grass that often transitions to rocky soil, and then rock with saxicolous species. Some vascular plants include *Artemisia tridentata* (sparse), *Chrysothamnus nauseosus*, *Opuntia polyacantha*, *Sysimbrium altissimum*, *Salsoa kali*, and *Bromus tectorum*.

This habitat is very similar to the BLM parcel surveyed in 2013 next to Hat Rock State Park (T5N-R29E-S22). Most of that parcel is on the top of a basalt bluff and shares many of the same species.

The other habitat is ponds with associated swales and vernal wet depressions. Melting blocks of ice from retreating ice sheets formed what are now seasonally and permanently flooded kettle ponds. *Populus trichocarpa*, *Elaeagnus angustifolia*, and *Salix* line the water's edge. There is also *Typha latifolia*, *Schoenoplectus tabernaemontani*, and graminoids. The permanent ponds were searched for aquatic bryophytes such as *Drepanocladus*, *Fontinalis*, *Leptodicyium*, but none were found.

Below: wet areas associated with kettle ponds along the south boundary.



Distribution and Abundance

Bryophyte and lichen diversity and biomass is low to moderate. The sandy soil is disturbed from grazing and foot traffic (e.g. hunters), therefore, most species are restricted to rock substrates or thin soil over rock. The durable sub-surface of rock withstands trampling. Mosses and lichens cover much of the rock, but across the landscape the species composition is generally homogenous.

Below: waypoint 317 with typical array of species: *Bryoerythrophyllum columbianum*, *Grimmia ovalis*, *G. trichophylla*, *Pseudocrossidium obtusulum*, *Syntrichia ruralis*, *Bryum argenteum*, *Xanthoparmelia loxodes/subhosseana*, and *Lecanora muralis*.



Below: waypoint 345, the highest point of rocky relief of the parcel, < 1m, with *Opuntia polyacantha* lower right.



Bryoerythrophyllum columbianum (BRCO13-Site32-DK-6909) is commonly and evenly scattered across the dry rocky areas of this parcel. Coverage ranges from 1% to 30% per square meter per location. It is most abundant here of all the parcels surveyed for this study.

Below: waypoint 317, abundant amount of *Bryoerythrophyllum columbianum*.



Below left: waypoint 332, large 50m x 50m area of good BSC habitat with *Acarospora schleicheri* and the only location of the liverwort *Riccia* for the study. Below right: waypoint 331 with good BSC habitat of thin rocky soil, *Poa secunda*, and abundant *Bryoerythrophyllum columbianum*.



Wanaket Wildlife Area Species List

MOSSES

<i>Bryoerythrophyllum columbianum</i>
<i>Bryum argenteum</i> s.l.
<i>Ceratodon purpureus</i>
<i>Didymodon australasiae</i>
<i>Didymodon vinealis</i>
<i>Encalypta rhaptocarpa</i>
<i>Gemmabryum vinosum</i>
<i>Grimmia ovalis</i>
<i>Grimmia trichophylla</i>
<i>Pseudocrossidium obtusulum</i>
<i>Syntrichia caninervis</i>
<i>Syntrichia ruralis</i>

LICHENS

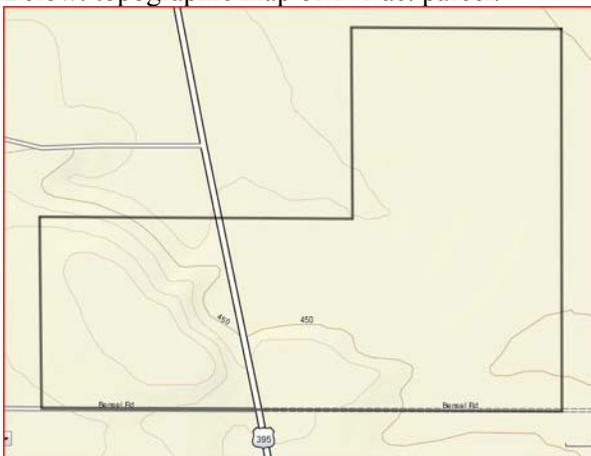
<i>Acarospora schleicheri</i>
<i>Candelaria pacifica</i>
<i>Candelariella aggregata</i>
<i>Cladonia</i> sp. (squamules only)
<i>Diploschistes muscorum</i>
<i>Lecanora garovaglii</i>
<i>Lecanora muralis</i>
<i>Leptochidium albociliatum</i>
<i>Lobothallia alphoplaca</i>
<i>Melanelixia subaurifera</i>
<i>Xanthomendoza galericulata</i>
<i>Xanthoparmelia loxodes</i> &/or <i>X. subhosseana</i>
<i>Xanthoparmelia</i> cf. <i>plittii</i>

Power City Wildlife Area, Umatilla Co., OR
T5N-R28E-S22, 141 ac.
October 10, 2015



Above: northerly view from south central parcel.

Below: topographic map of 141 ac. parcel.



Below: aerial view of 141 ac. parcel.



Results

The target moss species, *Bryoerythrophyllum columbianum*, was found four times (one E.O. form). The target moss, *Aloina bifrons*, and the target lichen species, *Texasporium sancti-jacobi*, were not found.

Site Description

This “L”- shaped BLM parcel straddles Hwy 395 in Power City just southeast of Umatilla. It ranges in elevation from 480 ft. on the west side of the highway down to 440 ft. on the east side. There is a mosaic of habitats including sagebrush steppe, meadow, and variably wet areas. The wet areas are kettle ponds that are seasonally and permanently flooded that according to the interpretive sign, were formed by melting blocks as ice sheets retreated. This is the case on the east side of the highway where the undulating topography is thickly vegetated mostly with grasses that choke out potential terrestrial bryophytes and lichens. The entire west side is disturbed sagebrush steppe with level sandy ground and low plant diversity.

Some vascular plants include *Populus trichocarpa*, *Elaeagnus angustifolia*, *Salix*, *Artemisia tridentata*, *Chrysothamnus nauseosus*, *Asclepias speciosa*, *Sysimbrium altissimum*, *Salsoa kali*, and *Bromus tectorum*.

Distribution and Abundance

Bryophyte and lichen diversity and biomass is low to moderate. Thick grass and continuous foot traffic prevent BSCs from establishing. However, what few rocky conditions that are present are well covered with mosses and lichens, but they are still rather limited in diversity. These situations: low-rising, dry hillocks of volcanic outcrops and boulders are surrounded by thickly vegetated seasonal wet habitat, a sort of reverse oasis in which *Bryoerythrophyllum columbianum* is present.

Below: examples of rocky hillocks with *B. columbianum* amidst seasonally wet meadows. Left: waypoint 309. Right: waypoint 304.



Bryoerythrophyllum columbianum is restricted to the rocks of the habitats described above, but have attained the largest-sized patches encountered during the entire study. There are four locations (waypoints 304, 306, 308, 309) clustered in the northeast lobe of the parcel. The rocky sagebrush steppe “islands” range in size from 4m x 15m to 20m x 30m with coverage of *B. columbianum* from 1% to 10%.

Below: waypoint 304, large patch of *Bryoerythrophyllum columbianum* 2 decimeters long.



The permanent ponds were searched for aquatic bryophytes such as *Drepanocladus*, *Fontinalis*, *Leptodicyium*, but none were found.

Another interesting feature are a couple of seasonal springs at waypoints 305 and 307. Dry at the time of survey they are marked by white salty residue. Apparently a type of caliche that forms when water rises to the surface and evaporates depositing salts behind as precipitates.

The residue at waypoint 305 is 3m x 5m is pure, farinose, and not associated with any bryophytes or lichens.

Below: waypoint 305. Left: springhead. Right: caliche



Below: example of coarser, granular caliche



At the site of waypoint 307 the unique habitat did not yield any unique species except the moss, *Funaria hygrometrica*. It is a ubiquitous and hardy species with a tolerance for extremely variable substrates such as post fire char, dung, and this high pH situation. *F. hygrometrica* is well known for its curly setae (capsule stems), however, these are straight, but it is also a variable species.

Below: waypoint 307. *Funaria hygrometrica* (reddish brown sporophytes) and caliche (white) along runnel.



Below: waypoint 307 *Funaria hygrometrica* (reddish brown sporophytes) and caliche (white).



Power City Wildlife Area Species List
 MOSSES

<i>Brachythecium albicans</i>
<i>Bryoerythrophyllum columbianum</i>
<i>Ceratodon purpureus</i>
<i>Didymodon australasiae</i>
<i>Didymodon brachyphyllus</i>
<i>Didymodon vinealis</i>
<i>Funaria hygrometrica</i>
<i>Gemmabryum caespitium</i>
<i>Grimmia laevigata</i>
<i>Grimmia montana</i>
<i>Grimmia trichophylla</i>
<i>Pseudocrossidium obtusulum</i>
<i>Syntrichia caninervis</i>

<i>Syntrichia ruralis</i>
<i>Tortula brevipes</i>

LICHENS

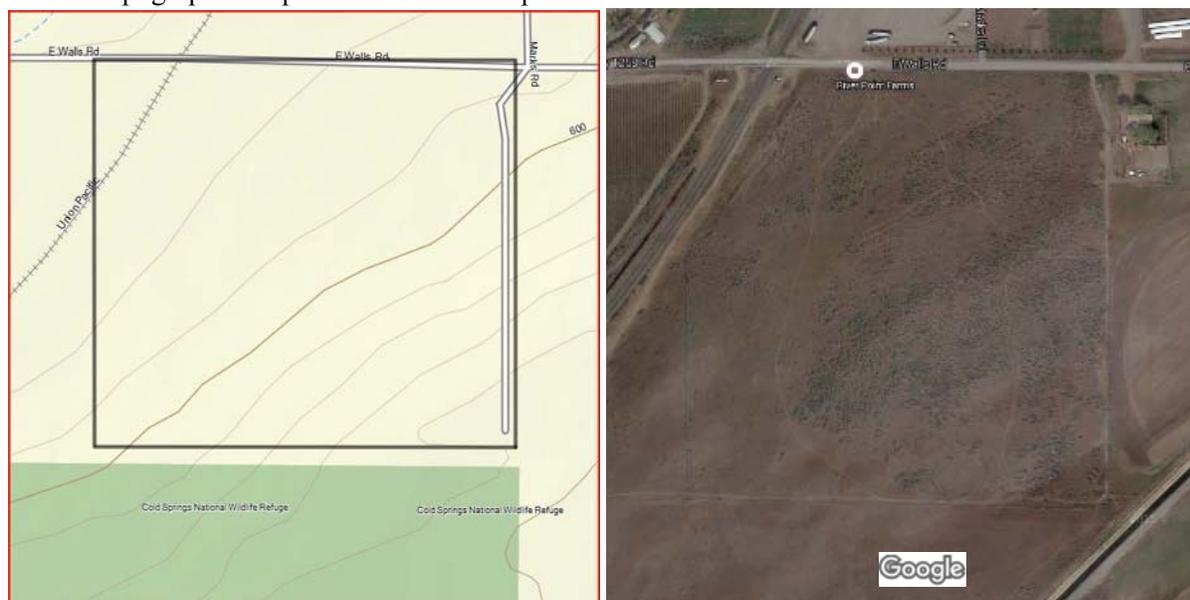
<i>Candelaria pacifica</i>
<i>Cladonia sp. (squamules only)</i>
<i>Collema tenax</i>
<i>Diploschistes muscorum</i>
<i>Endocarpon pusillum</i>
<i>Evernia prunastri</i>
<i>Lecanora muralis</i>
<i>Leptochidium albociliatum</i>
<i>Physconia enteroxantha</i>
<i>Xanthomendoza galericulata</i>

Next to Cold Springs NWR, Umatilla, Co., OR
T5N-R29E-S34, 40 ac.
February 20, 2016

Below: panorama from left to right looking southwest, west, and north at typical view of parcel.



Below: topographic map and aerial view of parcel.



Results

The target mosses, *Aloina bifrons*, *Bryoerythrophyllum columbianum*, and lichen, *Texosporium sancti-jacobi*, were not found.

Noteworthy species include the moss, *Tortula acaulon* and the lichens *Lecanora* sp. "4" and *Leptogium tenuissimum*, each of which were collected once.

Site Description

This square BLM parcel gently slopes from 640 ft. in the southeast corner down to 570 ft. in the northwest corner. The parcel faces the northwest and aside from shallow swales is generally featureless. One small boulder was encountered otherwise rocky substrates are absent. Habitats alternate between meadow and mature sagebrush steppe.

Juniperus and other trees are absent from this parcel. Vascular plants include *Artemisia tridentata*, *Chrysothamnus nauseosus*, *Purshia tridentata*, *Eriogonum*, *Crocidium multicaule* (low amounts), *Draba verna*, *Opuntia polyacantha*, *Sysimbrium altissimum*, *Madia glomerata*, *Salsoa kali*, *Poa secunda*, and *Bromus tectorum*.

Abundance and Distribution

Lichen diversity and biomass is low across the parcel. However, bryophyte biomass is much higher than it is for lichens, and where grass is not choking them out the ground is covered with mosses (*Syntrichia ruralis*, *Ceratodon purpureus*). There are broad expanses of BSC coverage, however, it is all mid seral, if that, in development.

The best of these BSCs are linearly distributed 150 meter from the southwest to northeast parallel to the adjacent railroad tracks (waypoints 061-063 & 072). Here *Poa secunda* is present and *Artemisia* is minimal. By the appearance of the weathered soil the area is vernal wet and retains water longer than the surrounding area. The soil is finer grained and has developed small-scale topographic relief, “rolling” crust morphology (Rosentreter et al., 2007).

Below left: waypoint 072 looking north, different ground conditions with good BSCs. Bottom right: waypoint 061, BSC species on mounded soil.



Below left: waypoint 061, soil conditions with evidence of ponding. Below right: *Diploschistes muscorum* (white) and *Leptochidium albociliatum* (black), *Pterygoneurum ovatum*, and other BSC species.



The second best area for BSCs are along an artificially formed swale (old canal?), waypoints 069-071. Here BSCs are best developed along the shoulder of the swale and lichens reach their highest biomass as *Cladonia squamules*. Fruiting specimens keyed out to *C. cariosa* and *C. chlorophaea*. Also present here are *Diploschistes muscorum*, *Arthonia glebosa*, *Pterygoneurum ovatum*, *Syntrichia ruralis*, *Ceratodon purpureus*, relatively large patches of *Cephaloziella divaricata*, and the only site of *Fossombronia* for the study. The *Fossombronia* specimen was sterile, and therefore impossible to identify to species.

The “infrequently collected” *Leptogium tenuissimum* (McCune and Rosentreter, 2007) is also present here.

Below: waypoint 069, swale trailing off into distance with BSC community in foreground.



Below: waypoint 069. Bottom left: *Cladonia chlorophaea* with *Diploschistes muscorum* already parasitizing the bases of the podetia. Bottom right: “large” amounts of *Cephaloziella divaricata* (dark)



This parcel is also the only place where *Tortula acaulon* (syn. *Phascum cuspidatum*) has been found. When fertile, a distinctive species with immersed capsules otherwise probably overlooked.

Below: waypoint 066. Below left: *Tortula acaulon* with light green capsules on fist size soil clod. Below right: Habitat with *T. acaulon* bottom center.



Below: waypoint 064 with *Lecanora* cf. sp. #4. Bottom right: looking north with *Lecanora* cf. sp. #4 on *Artemisia tridentata* stem in foreground.



As seen in other parcels close to populated areas and agricultural industry the branches and twigs of *Artemisia tridentata* are covered with bright colored nitrophilous lichens. Orange *Xanthoria gariculata* and yellow *Candelaria pacifica* are responding to air born nitrogen and/or other nutrients originating from those sources.



Next to Cold Springs NWR Species List
 MOSSES

<i>Bryum argenteum</i> s.l.
<i>Ceratodon purpureus</i>
<i>Didymodon australasiae</i>
<i>Didymodon vinealis</i>
<i>Encalypta rhaptocarpa</i>
<i>Funaria hygrometrica</i>
<i>Gemmabryum caespitium</i>
<i>Pseudocrossidium obtusulum</i>
<i>Pterygoneurum ovatum</i>
<i>Syntrichia ruralis</i>
<i>Tortula acaulon</i>

LIVERWORTS

<i>Cephaloziella divaricata</i>
<i>Fossombronia</i> sp.

LICHENS

<i>Acarospora americana</i>
<i>Arthonia glebosa</i>
<i>Aspicilia reptans</i>
<i>Caloplaca tominii</i>
<i>Candelaria pacifica</i>
<i>Candelariella citrina</i>
<i>Circinaria caesiocinerae</i>
<i>Cladonia cariosa</i>
<i>Cladonia chlorophaea</i>
<i>Cladonia</i> sp. (squamules only)
<i>Diploschistes muscorum</i>
<i>Endocarpon pusillum</i>
<i>Lecanora muralis</i>
<i>Lecanora</i> cf. <i>sp. 4</i> (McCune & Resentreter, '07)
<i>Leptochidium albociliatum</i>
<i>Leptogium lichenoides</i>
<i>Leptogium tenuissimum</i>
<i>Physconia enteroxantha</i>
<i>Xanthomendoza galericulata</i>

Madison-Saylor Rd., Umatilla Co.
T3N-R27E-S12, 81 ac.
October 9, 2015



Above: waypoint 292, looking north at better than average conditions of parcel, 10 m x 10 m patch of bunchgrass.

Below: topographic map and aerial view of 81 ac. parcel.



Results

The target moss species, *Bryoerythrophyllum columbianum*, was found once. The target moss, *Aloina bifrons*, and the target lichen species, *Texosporium sancti-jacobi*, were not found.

Site Description

This featureless rectangular BLM parcel slopes slightly eastward from 740 to 700 ft. Rocks, trees, and *Artemisia* are absent. Some vascular plants include *Chrysothamnus nauseosus*, *Salsoa kali*, *Sysimbrium altissimum*, *Madia glomerata*, *Bromus tectorum*, and bunchgrass. *B. tectorum*, and the mulch it creates, carpets most of the ground preventing BSCs from developing. Where the soil is bare it has been disturbed by grazing and little more than *Syntrichia ruralis* can persist.

Below: an example of the allelopathic effects of the resinous *Madia glomerata*. These exclusionary patches are common across the parcel.



Abundance and Distribution

Bryophyte and lichen diversity and biomass are both low. The area closest to developing BSCs is in the southwest corner. This is probably because it is opposite the entrance to the northeast of the fenced off parcel where cattle have funneled in and out. The area with the potential for the earliest BSC development is tens of square meters broad between waypoints 284-286. What little is present here now is literally thin and low in diversity. It extends from here towards the southeast at waypoint 287, and onto waypoint 288 an area 10m x 30 m.

Bryoerythrophyllum columbianum is within this area at waypoint 285 in a 10 m x 10 m area habitat occupying 1% of 1m².

Below: waypoint 285. Bottom left: *Bryoerythrophyllum columbianum* (reddish) not collected. Bottom right: *B. columbianum* at sharpie pen tip, note sparse grass cover.



Below left: waypoint 291, *Candelariella aggregata* (yellow) and *Buellia punctata* on grass stubble.



While surveying a burrowing owl was inadvertently flushed. Returning to where it flew from its den was discovered with fresh talon prints and bird droppings at its entrance.

Below: burrowing owl den created by badger or coyote.



Madison-Saylor Rd Species List

MOSSES

<i>Bryoerythrophyllum columbianum</i>
<i>Ceratodon purpureus</i>
<i>Didymodon australasiae</i>
<i>Didymodon brachyphyllus</i>
<i>Didymodon vinealis</i>
<i>Funaria hygrometrica</i>
<i>Pseudocrossidium obtusulum</i>
<i>Syntrichia ruralis</i>

LICHENS

<i>Aspicilia reptans</i>
<i>Buellia punctata</i>
<i>Candelariella aggregata</i>
<i>Cladonia sp. (squamules only)</i>
<i>Leptochidium albociliatum</i>

5+ miles upstream from McNary Dam, Benton Co., WA
T5N-R29E-S4, 156 ac.
February 18, 2016



Below: topographic map and aerial view of 156 ac parcel.



Results

The target mosses, *Aloina bifrons*, *Bryoerythrophyllum columbianum*, and lichen, *Texosporium sancti-jacobi*, were not found.

Noteworthy species include the lichen *Acarospora schleicheri*.

Site Description

This square BLM parcel occupies the upper north bank and lower plateau along the Columbia River. It gently slopes south from 680 ft. in northeast corner down to 500 ft. in the southwest corner. The exposed

flat terrain lacks most physical features other than a small draw in the south central parcel that has been recently disturbed and has loose sand. Except for scattered small boulders, rocky features are absent.

The parcel has been recently burned and there is evidence of grazing before that. There are no bushes or their charred remains. The ground is 50% bare sandy soil and 50% forbs and sparse low grass, *Lomatium gormanii*, and *Sysimbrium altissimum*.

Below right: example of ground conditions. Below left: looking southeast and downslope.



Abundance and Distribution

Bryophyte and lichen diversity and biomass are very low. Saxicolous species better survived the burn than terricolous species. All but one species of lichens present are on rock. Remarkably and ironically the one terricolous species that did survive is *Acaraspora schleicheri*, a species indicative of old-growth BSC conditions. Several thalli of theirs were seen. Ruderal species of mosses are already establishing themselves.

Below: *Acaraspora schleicheri*, fire survivor.



Parenthetically another noteworthy species of moss was encountered off of BLM property while accessing the above parcel. Access was obtained by walking eastwards along the railroad tracks to the parcel. Along side of the tracks at waypoint 045 are a couple of small calcareous springs with *Didymodon tophaceus* covering them. Although it is not deemed rare it is no more common than calcareous springs

are in the region. It has not been seen elsewhere in the study and brings the number of species of the notoriously difficult genus to six.

Below: waypoint 045, looking east, calcareous spring with *Didymodon tophaceous* (dark green), off of BLM property.



Species of 156 ac. parcel.

MOSSES

<i>Bryum argenteum</i> s.l.
<i>Ceratodon purpureus</i>
<i>Didymodon vinealis</i>
<i>Gemmabryum caespiticium</i>
<i>Grimmia pulvinata</i>
<i>Pseudocrossidium obtusulum</i>
<i>Syntrichia ruralis</i>

LICHENS

<i>Acarospora schleicheri</i>
<i>Aspicilia reptans</i>
<i>Cladonia</i> sp. (squamules only)
<i>Lecanora garovaglii</i>
<i>Lecanora muralis</i>
<i>Lecidea tessellata</i>
<i>Rhizoplaca melanophthalma</i>
<i>Umbilicaria phaea</i>
<i>Xanthoparmelia plittii</i>

References

- Barkworth, Mary E., Laurel K. Anderton, Kathleen M. Capels, Sandy Long, Michael B. Piep. 2007. Manual of Grasses for North America. Utah State University Press, Logan, Utah. 640 pp.
- Belnap, J. J. H. Kaltenecker, R. Rosentreter, J. Williams, S. Leonard and D. Eldridge. 2001. Biological Soil Crusts: Ecology and Management. USDI Bureau of Land Management National Science and Technology Center Denver, Colorado, Technical Reference 1730-2.
- Brodo, Irwin M. 2016. Keys to the Lichens of North America. Yale University Press. 427 pp.
- Brodo, Irwin M., S. D. Sharnoff and S. Sharnoff. 2001. Lichens of North America. Yale University Press. 795 pp.
- Christy, John A. and Judith S. Harpel. 1997. Rare Bryophytes Of The Interior Columbia River Basin And Northern Great Basin, USA. Journal of the Hattori Botanical Laboratory 82: 61-75.
- Christy, John A. and David H. Wagner. 2013. Checklist of Mosses of Oregon. Unpublished manuscript.
- Clarke, S. E. and S. A. Bryce. 1997. Hierarchical subdivisions of the Columbia Plateau & Blue Mountains ecoregions, Oregon & Washington. General Technical Report PNW-GTR-395. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR. 114p. <ftp://ftp.epa.gov/wed/ecoregions/>
- Consortium of North American Bryophyte Herbaria (accesses July 2016)
<http://bryophyteportal.org/portal/>
- Consortium of Pacific Northwest Herbaria (accesses July 2016)
<http://www.pnwherbaria.org>
- Crandall-Stotler, Barbara and Raymond E. Stotler. 2000. Morphology and Classification of the Marchantiophyta. Pp. 21-70 in: Jonathon A. Shaw and Bernard Goffinet. Bryophyte Biology. Cambridge University Press, United Kingdom. 476 pp.
- Dettweiler-Robinson, Eva, Jeanne M. Ponzetti, Jonathon D. Bakker. 2013. Long Term Changes in Biological Soil Crust Cover and Composition. Ecological Processes. Online journal accessed 2015.
<http://ecologicalprocesses.springeropen.com/articles/10.1186/2192-1709-2-5>
- Di Meglio, Joseph. 2016. *Aspicilia reptans*: Morphological Traits Supporting Phylogenetic Data. Northwest Scientific Association 87th annual meeting. Abstract and poster.
- Hardman, Amanda. 2010. High Plains Drifter, a Vagrant Moss Discovered in Northeast Oregon. *Evansia* 27 (3) 94–99.

- Hastings, Roxanne I. and Henk C. Greven. 2007. Grimmiaceae. Pp. 225-258 in: Flora of North America Editorial Committee. Flora of North America north of Mexico. Volume 27. Oxford University Press, New York. 713 pp.
- Hastings, Roxanne and Ryzard Ochya. 2007. Grimmiaceae. Pp. 204-206 in: Flora of North America Editorial Committee. Flora of North America north of Mexico. Volume 27. Oxford University Press, New York. 713 pp.
- Heinlen, Erica R. and Dale H. Vitt. 2003. Patterns of Rarity in Mosses of the Okanogan Highlands of Washington State: An Emerging Coarse Filter Approach to Rare Moss Conservation. *The Bryologist* 106 (1) 34-52.
- Hermann, F.J. & E. Lawton. 1968. A new species of *Didymodon* (Bryophyta) from Oregon and Washington. *Bulletin of the Torrey Botanical Club* 95: 387-389.
- Hitchcock, Leo C. and Arthur Cronquist. 1976. Flora of the Pacific Northwest. Tenth Printing 1996. University of Washington Press. Seattle, USA
- Jørgensen, Per M. and Trevor Goward. 2015. Notes on the *Collema tenax* complex, with recognition of two further species in the genus *Enchylimum* (Ach.) Gray. *Evansia* 32 (1) 42-47.
- Kellman, Kenneth. 2012. *Tortula brevissima* Schiffn., New to North America. *Evansia* 29 (2) 50-53.
- Kofranek, David. 2014. Rare Moss and Lichen Surveys of BLM Vale District, North Umatilla Co., OR, *Aloina bifrons*, *Bryoerythrophyllum columbianum*, and *Texosporium sancti-jacobi*. <http://www.fs.fed.us/r6/sfjnw/issssp/documents3/inv-rpt-br-li-vale-blm-201404.pdf>
- Lawton, E. 1971. Moss Flora of the Pacific Northwest. Hattori Botanical Laboratory, Nichinan, Japan. 362 pp.
- Lewis, M. 1981. Prodrromus Bryologiae Andinae II. *Bryoerythrophyllum columbianum* disjunctively distributed between steppes of northwestern U.S.A. and Bolivia. *Bryologist* 84: 536-538. [Eventually recognized as a new species to Bolivia]
- Malcolm, Bill, Nancy Malcolm, Jim Shevock, Dan Norris. 2009. California Mosses. Micro-Optics Press, Nelson, New Zealand.
- McCune, Bruce. 2016. Key to the Lichen Genera of the Pacific Northwest. Unpublished. 296 pp.
- McCune, Bruce. 2015. Personal communication.
- McCune, Bruce. 2007. Miscellaneous Keys to Microlichens of the Pacific Northwest of North America. Unpublished. 296 pp.

McCune, Bruce and Roger Rosentreter. 1992. *Texosporium sancti-jacobi*, a Rare Western North American Lichen. *The Bryologist* 95 (3) 329-333.

McCune, B. and Roger Rosentreter. 2007. Biotic soil crust lichens of the Columbia River Basin. In: *Monographs in North American Lichenology*, vol. 1. Northwest Lichenologists, Corvallis, OR, pp. 1-105.

McCune, Bruce, and Linda Geiser. 2009. *Macrolichens of the Pacific Northwest*, ed. 2. Corvallis, OR: Oregon State University Press.

McIntosh, Terry T. 1989. Bryophyte Records from the Semiarid Steppe of Northwestern North America, Including Four Species New to North America. *The Bryologist* 92 (3) 356-362.

McIntosh, T.T. 2003a. An assessment of lichen and bryophyte biodiversity and biological soil crust community relationships in the Hanford Reach National Monument. Report to The Nature Conservancy of Washington. Biospherics Environmental, Vancouver, British Columbia. 54 pp.

_____. 2004. COSEWIC assessment and status report on the Columbian carpet moss *Bryoerythrophyllum columbianum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 19 pp.
http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr%5Fcolumbian%5Fcarpet%5Fmoss%5Fe%2Epdf

McIntosh, Terry T., Matthew Vander Haegen and M. Schroeder. 2007. Patterns in biological soil crust recovery in Conservation Reserve Program fields, Washington State. Washington Department of Fish and Wildlife Publications. 22 p.

Nash, T.H., III, B. D. Ryan, C. Gries, and F. Bungartz (eds.). 2002. *Lichen Flora of the Greater Sonoran Desert Region, Vol. 1*. Lichens Unlimited, Arizona State University, Tempe, Arizona. 532 pp.

Nash, T.H., III, B. D. Ryan, P. Diederich, C. Gries, and F. Bungartz (eds.). 2004. *Lichen Flora of the Greater Sonoran Desert Region, Vol. 2*. Lichens Unlimited, Arizona State University, Tempe, Arizona. 742 pp.

Nash, T.H., III, C. Gries, and F. Bungartz (eds.). 2007. *Lichen Flora of the Greater Sonoran Desert Region, Vol. 3*. Lichens Unlimited, Arizona State University, Tempe, Arizona. 567 pp.

Norris, D.H. & J.R. Shevock. 2004b. Contributions toward a bryoflora of California: II. A key to the mosses. *Madroño* 51: 133-269.

Oregon Biodiversity Information Center. 2013.
<http://inr.oregonstate.edu/orbic>

- Ponzetti, J.M., McCune, B., 2001. Biotic soil crusts of Oregon's shrub steppe: community composition in relation to soil chemistry, climate, and livestock activity. *Bryologist* 104 (2), 212-225.
- Ponzetti, J.M., McCune, B., Pyke, D., 2007. Biotic soil crusts in relation to topography, cheatgrass and fire in the Columbia Basin, Washington. *Bryologist* 110 (4), 706-722.
- Printzen, C. 2001. Corticolous and lignicolous species of *Lecanora* (Lecanoraceae, Lencanorales) with usnic or isousnic acid in the Sonoran Desert Region. *The Bryologist* 104: 382-409.
- Root, H. T., J. E. D. Miller & B. McCune. 2011. Biotic soil crust lichen diversity and conservation in shrub-steppe habitats of Oregon and Washington. *The Bryologist* 114(4): 796–812.
- Root, H.T., McCune, B., 2012a, Regional patterns of biological soil crust lichen species composition related to vegetation, soils, and climate in Oregon, USA, *Journal of Arid Environments* (2012), doi:10.1016/j.jaridenv.2011.11.017
- Root, H. T., and B. McCune. 2012b. Surveying for biotic soil crust lichens of shrub steppe habitats in the Columbia Basin. *North American Fungi* 7(7): 1-21. doi: [http://dx.doi: 10.2509/naf2012.007.007](http://dx.doi.org/10.2509/naf2012.007.007)
- Root, Heather T. 2013. Personal communication via e-mail.
- Rosentreter, R., M. Bowker, and J. Belnap. 2007. *A Field Guide to Biological Soil Crusts of Western U.S. Drylands*. U.S. Government Printing Office, Denver, Colorado.
- Sharp, A.J., Howard Crum, Patricia Eckel. 1993. *The Moss Flora of Mexico*. *Memoirs of the New York Botanical Garden*, Vol. 69.
- Śliwa, L. 2015. Personal communication.
- Śliwa, L. and C.M. Wetmore. 2000. Notes on the *Lecanora varia* group in North America. *The Bryologist* 103: 475-492.
- Spence, John R. 2014. *Gemmabryum*. Pp. 129-140 in: *Flora of North America* Editorial Committee. *Flora of North America north of Mexico*. Volume 28. Oxford University Press, New York. 702 pp.
- Spence, John R. 2014b. *Introductory Guide to the Bryaceae*. Unpublished. 28 pp.
- Spence, John R. and Kenneth M. Kellman. 2015. New and Interesting Species of *Gemmabryum* J.R. Spence & H.P. Ramsay (Bryaceae, Bryopsida) From California and the West. *Madroño* 62(2): 124-135.

- Toren, David R. 2015. A Moss Flora of Lake County, California. *Madroño* 62: 241-268.
- Zander, Richard. 1993. Genera of the Pottiaceae: Mosses of Harsh Environments. *Bulletin of the Buffalo Society of Natural Resources*, Vol. 32.
- Zander, Richard. 1999. A New Species of *Didymodon* (Bryopsida) from Western North America and a Regional Key to the Taxa. *The Bryologist* 102 (1), 112-115.
- Zander, Richard H. and Ryszard Ochyra. 2001. *Didymodon tectorum* and *D. brachyphyllus* (Musci, Pottiaceae) in North America. *The Bryologist* 104 (3), 372-377.
- Zander, Richard H. 2001. A new species of *Didymodon* (Musci) from California. *Madroño* 48: 298-300.
- Zander, Richard H. 2007. *Bryoerythrophyllum*. Pp. 565-569 in: *Flora of North America* Editorial Committee. *Flora of North America north of Mexico*. Volume 27. Oxford University Press, New York. 713 pp.
- Zander, Richard H. 2007. *Pottiaceae*. Pp. 476-481 in: *Flora of North America* Editorial Committee. *Flora of North America north of Mexico*. Volume 27. Oxford University Press, New York. 713 pp.