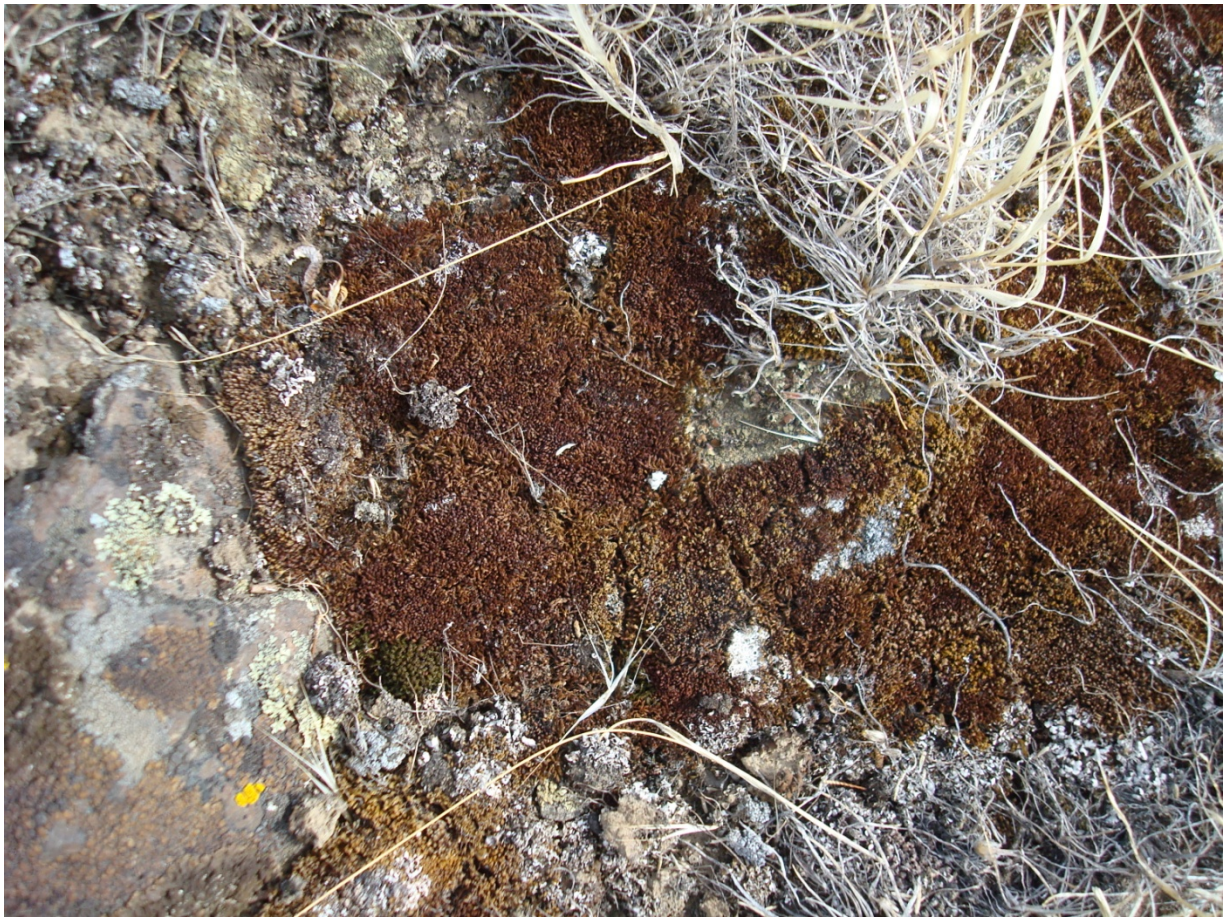
Rare Moss and Lichen Surveys of BLM Vale District

North Umatilla Co., OR

Aloina bifrons,
Bryoerythrophyllum columbianum
and
Texosporium sancti-jacobi

by David Kofranek
April 2014



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Abstract
The rare mosses, *Aloina bifrons*, *Bryoerythrophyllum columbianum* and the rare lichen, *Texosporium sancti-jacobi* were searched for on seven parcels in the Columbia Basin of Oregon managed by the Bureau of Land Management. Surveys using intuitive-controlled meander found *B. columbianum* on all parcels, *Aloina bifrons* on three parcels, and *Texosporium sancti-jacobi* was not found. Umatilla Butte has the best habitat for biological soil crusts and the site most likely to harbor *T. sancti-jacobi* because of patches of pristine habitat and the presence of the late successional soil crust *Acarospora schleicheri*. Two moss species new to Oregon, *Tortula inermis* and *T. protobryoides*, were found in Juniper Canyon. The rare mosses *Didymodon norrisii* and *D. eckeliae* were found on five parcels. Thin, fine-grain soil and rock support the best diversity of bryophytes and lichens, however the trampling of cattle and invasive cheatgrass, *Bromus tectorum*, significantly compromise most areas.

Introduction
The purpose of this project was to find new sites of two rare mosses, *Aloina bifrons*, *Bryoerythrophyllum columbianum*, and one rare lichen, *Texosporium sancti-jacobi*. All three target species are associates of biotic soil crusts (McIntosh 2003a, McCune and Rosentreter 2007, Ponzetti et al. 2007, Zander 2007). Therefore, biotic soil crusts (BSC) were observed in the field except for thorough identification of crustose lichens. That difficult and time consuming task is beyond the scope of this project. All bryophytes, all macrolichens, and some crustose lichens on all substrates were identified. Neither target species of moss appears to be closely associated with crust communities. Instead, they were found where the habitat was appropriate, regardless of the presence of crustose lichens.

BSCs are important because they bind soil therefore reduce wind erosion, affect hydrology, add nutrients and organic matter to the soil, decreases soil temps, and inhibit weed establishment (Belnap et al. 2001, McCune and Rosentreter 2007, McIntosh et al. 2007). By species composition and abundance, seral stages can be ascertained (McIntosh 2003a) they can also indicate soil pH and thereby useful for land management. They are fragile ecosystems of arid regions across the world (Belnap et al. 2001). Locally in the Columbia Basin they are particularly rich and threatened (Root and McCune, 2012a).

All parcels surveyed are owned by the Bureau of Land Management (BLM) and lie from one quarter to 14 miles from the south side of the Columbia River in Umatilla Co., Oregon. Initially Juniper Canyon was the area of focus but access issues prevented surveys there other than the BLM's western most parcel. Instead, additional parcels were surveyed and are listed below from best to lowest quality habitat:

T5N-R28E-S28, 161 ac. Umatilla Butte
T6N-R30E-S35, 161 ac. Juniper Canyon
T5N-R29E-S22, 80.3 ac. next to Hat Rock State Park
T5N-R30E-S4, 40.5 ac. next to McNary Wildlife Refuge & Hwy 730
T3N-R28E-S22, 318 ac. Echo Meadows
T5N-R29E-S22, 40.2 ac. Salmon Point Rd & 730 Hwy
T5N-R29E-S20, 159 ac. Craig Rd & Progress Rd

Locations referred to by one, two, or three numerical digits represent waypoints. The waypoints are shorthand for coordinates in NAD 83 UTMs. These are listed in a spreadsheet provided in Appendix B with a comprehensive species list, Kofranek collection numbers, dates, and T-R-S.

Site forms are provided for locations of target or rare species that are within 100 m of one another.

In the photos, those with a mechanical pencil with a pink ribbon or collecting knife, have the species of interest at its tip.

Results Summary

Umatilla Butte has well-developed BSC communities including the lichen, *Acarospora schleicheri*, indicating old growth conditions (McCune and Rosentreter 2007, Rosentreter et al. 2007). The impacts from grazing and cheatgrass are low at the butte unlike the rest of the parcels. Although Juniper Canyon is impacted, its rocky areas are refugia for rare species, two of which are new to the state. The top of the bluff next to Hat Rock State Park has well-developed BSC's and saxicolous (rock dwelling) species. The hill slope next to McNary Wildlife Refuge & 730 Hwy has a little bit of "everything". Echo Meadows has the most *Aloina* but little else. The parcel at Salmon Point Rd & 730 Hwy is small and very impacted but has two rocky areas with rare species (*Didymodon norrisii*). The ground at Craig Rd & Progress Rd is very disturbed except for a 5 ac. area with *Bryoerythrophyllum columbianum* and some BSCs.

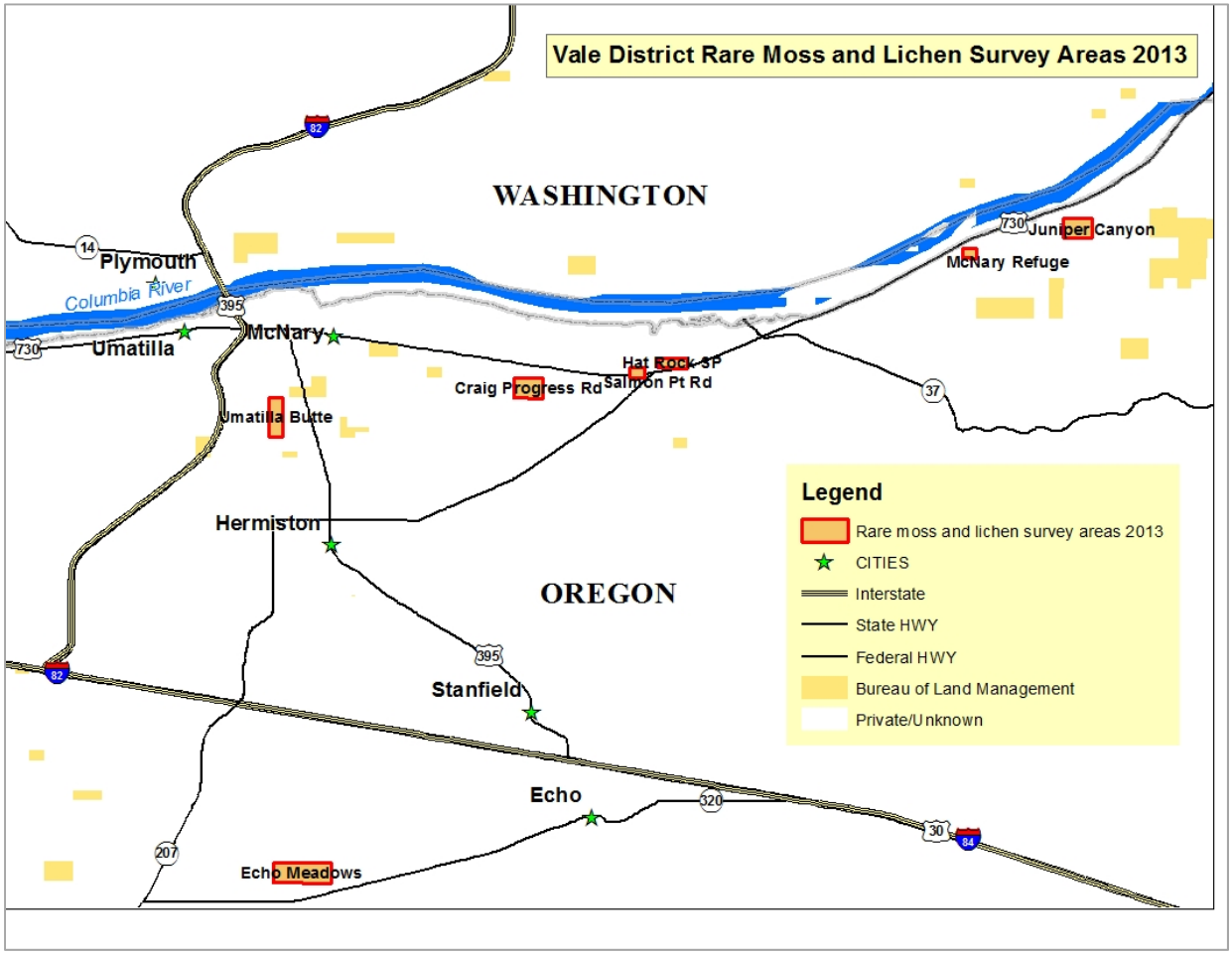
Discussion

These surveys indicate that, *Aloina bifrons* is rarer than *Bryoerythrophyllum columbianum. Aloina bifrons* appears to be an early seral species since it was found in areas not crowded with grass or other cryptogams. Whereas most mosses have leaves only one cell layer thick, the leaf in *A. bifrons* is more than one cell layer thick and has filaments on the adaxial side (top). This extra material could slow its rate of growth in an already slow-growing group of organisms in dry harsh conditions, which could be another reason for its rarity. Although the sporophytes were often immature because of the timing of the surveys they were usually present. Since *Aloina bifrons* is unique, it is easy to identify in the field and is the only species of the genus in North America with a hairpoint. Because *A. rigida*, a species without a hairpoint, was reported from eastern Washington (Heinlen and Vitt 2003), plants without hairpoints were also searched for during the survey but none were seen.

Bryoerythrophyllum columbianum is endemic to British Columbia, California, Idaho, Oregon, and Washington. During the survey, it was found almost anywhere where the ground had not been recently disturbed. In these habitats in the Columbia Basin, it is not abundant but locally common. It appears at the end of early seral stage and persists through late seral stage. 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). Sporophytes are rare for *B. columbianum* (Zander 2007) but a few old empty capsules were found.

Forty nine percent of the moss species found in the survey, including *Aloina bifrons* and *Bryoerythrophyllum columbianum* are in the Pottiaceae, a family of "Mosses of Harsh

Environments" (Zander 1993). Eventually *B. columbianum* became familiar enough to identify under low magnification. Thereafter, identifying *Didymodon* to species became the biggest challenge. Since *D. vinealis* is ubiquitous and plastic it is difficult to differentiate other species from it. The characters are subtle and the genus (and Pottiaceae for that matter) notoriously difficult. More details on identification is in the Appendix A.



Umatilla Butte, Umatilla Co.
T5N-R28E-S28, 161 ac.
September 15, 16, 2013

Results
The target moss species, *Bryoerythrophyllum columbianum*, was found 14 times (eight site forms). The rare moss, *Didymodon eckleliae* and an unknown species of *Didymodon* were each found once. *Acarospora schleicheri,* a biotic soil crust (BSC) lichen indicating old growth conditions, was present. The target moss and lichen species, *Aloina bifrons* and *Texosporium sancti-jacobi* were not seen.

Site Description
Umatilla Butte is an elongate hilly mass oriented north south. Many roads and trails used in varying amounts, cross the parcel. There are abandoned and recently used quarries. A well used gravel road accesses a contemporary quarry from the east. An historical quarry in the north is accessed by an overgrown road which longitudinally bisects the parcel most of the length.

This parcel extends several acres north of Bensel Rd. (Co. 1268 Rd.) where it includes part of a pond. Surrounding the pond it is relatively lush with *Populus, Salix* and other vascular vegetation. *Salix* is also present in the basin of the old quarry. Throughout the parcel, there is *Artemisia tridentata, Chrysothamnus nauseosus, Balsamorhiza sagittata, Eriogonum, Salsola kali*, and bunchgrasses. *Bromus tectorum* is minimal except north of Bensel Rd. Elevation ranges from 500 to 700 ft. The moisture regime is xeric.

Above: Looking north. Below: Looking south.

Left: Taken from 181. Right: 161 in middle distance.

There are many exposed rocky areas that range in age since last disturbance. Two quarry excavations are freshly exposed. The historical quarry and other areas have mostly bare rock with minimal lichen development. The oldest exposed rock has well-developed lichens, patches of grasses and forbs and mosses including *Didymodon eckleliae* (pending verification), *Grimmia anodon*.

Didymodon eckeliae at 176.

Despite a significant amount of disturbance by roads, trails, illegal dumping, an abandoned vehicle, and actual removal of material (quarrying), Umatilla Butte was one of the best parcels surveyed. There are no apparent signs of grazing so *B. tectorum* is relatively low. Therefore, the areas that have escaped disturbance support diverse, old, and pristine BSC's. The best areas are the rocky ridges and hillocks studded with both small and large species of bunchgrass (Root and McCune 2012b). The BSC's tend to be on level or low angle slopes. The conspicuous yellow BSC lichen, *Acarospora schleicheri*, is in these areas. It is an indicator of old growth conditions (Root et al. 2011, Rosentreter et al. 2007). Some specific sites of excellent BSC habitat are at 169, 171, 173, 174, 175, 180, 181, 182, and 183.

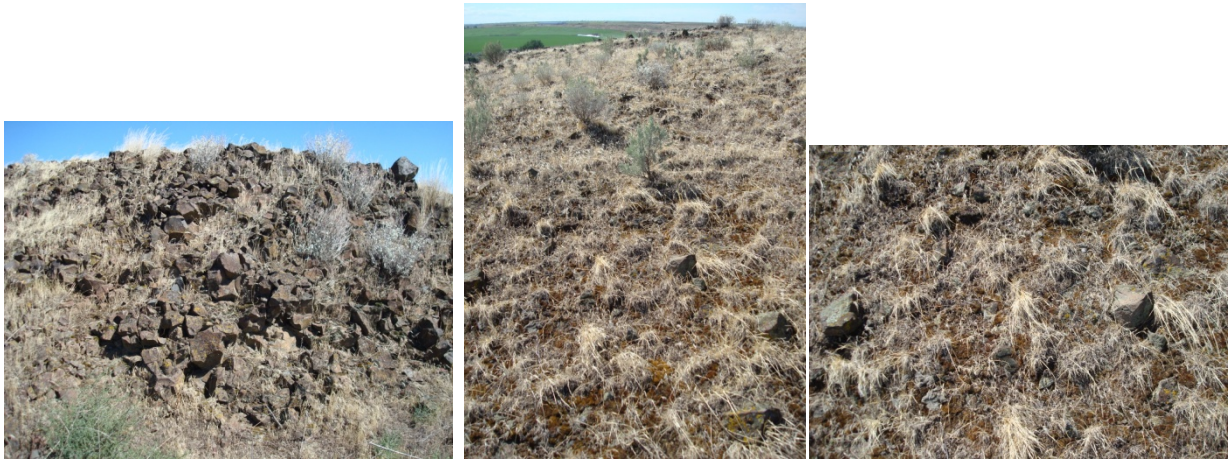
Acarospora schleicheri with *Bryoerythrophyllum columbianum* at 175.

Texosporium sancti-jacobi was expected because of the presence of *Acarospora schleicheri*, the bunchgrass slopes, and the proximity to river corridors (Root and McCune, 2012b, Root et al., 2011, Root pers. com. 2013). Umatilla Butte is about four and half km from the Columbia River and only one km from the Umatilla River. Intense searching for *T. sancti-jacobi* was unsuccessful, but it is still suspected here.

Steep north facing slopes and "rock gardens" are dominated by larger, faster growing mosses such as *Syntrichia ruralis, Anacolia menziesii, Brachythecium albicans.* An unknown species of *Didymodon* (w/ cauducous stem tips) was found on steep coarse sandy soil at 161. Because of the unstable nature of coarse sandy soil, it is more vulnerable to disturbance (Root and McCune 2012a). Here the relatively well-developed (50% cover) BSCs on coarse sand are the only ones seen of all the parcels, reflecting the lack of trampling from grazing.

Abundance and Distribution

Bryoerythrophyllum columbianum is a common component of the local BSC's and rocks. It was collected or observed 14 times and was evenly scattered along the length of the butte. Several square centimeters of the rare, *D. eckeliae*, was found once but probably is on other rocky areas of the butte.



Left: *B. columbianum* and *Grimmia anodon* at 168. Middle and right: *B. columbianum* at 173.

Left to right: *B. columbianum* along rocky hill top at 181, 182, 183.

Further Study and Recommended Protection
Specifically surveying the BSC's of Umatilla Butte is recommended especially continuing to search for *Texosporium sancti-jacobi.* Umatilla Butte is ecologically in parts severely compromised and near pristine. A good example of this juxtaposition is where the BSC layer meets the vertical wall of a quarry from below. Because Umatilla Butte is located in an urban area, it has escaped the practice of grazing. The absence of this ubiquitous form of BSC disturbance (Ponzetti and McCune 2001) and destruction is obvious due to the increased diversity and high coverage of BSC species. In addition, the low disturbance has also minimized *Bromus tectorum*, a severely ecologically altering factor (Ponzetti et al., 2007) from invading and choking out BSCs. Instead, it has suffered from quarrying and off road vehicle use, which has left the remaining habitats very good or very poor.

Root and McCune (2012a, p. 6) found "…the diversity of biotic soil crust lichens in grasslands along the Columbia River was most remarkable. These grasslands with a warm climate and little rainfall favor *Texosporium sancti-jacobi, Trapeliopsis bisorediata, T. steppica, Acarospora schleicheri* and *Rhizocarpon diploschistidina*. Much of the land in such areas is privately-owned and used for grazing, wind farms, and agriculture making the public lands along the Columbia River especially valuable for protection of uncommon biotic crust lichens." Umatilla Butte is one of the few remaining parcels of this habitat with extant well-developed soil crusts.

Access
Within Hermiston turn west onto Bensel Rd. from Hwy 395. Drive about two thirds of a mile and park at gate to butte entrance.

Cryptogams at Umatilla Butte

MOSSES

Anacolia menziesii
Brachythecium albicans
Bryoerythrophyllum columbianum
Bryum argenteum
Ceratodon purpureus
Didymodon australasiae
Didymodon eckleliae
Didymodon sp. (cauducous)
Didymodon vinealis
Encalypta rhaptocarpa
Gemmabryum caespiticium
Grimmia anodon
Grimmia laevigata
Grimmia montana
Grimmia ovalis
Grimmia trichophylla
Pseudocrossidium obtusulum
Syntrichia montana/princeps
Syntrichia ruralis
Tortula brevipes

LICHENS

Acarospora schleicheri
Cladonia chlorophaea
Diploschistes muscorum
Leptochidium albociliatum
Leptogium lichenoides

Juniper Canyon, Umatilla County
T6N-R30E-S35, 161 ac.
April 9 & August 30, 2013

Results
Target moss species, *Aloina bifrons* was found four times (3 site forms) and *Bryoerythrophyllum columbianum* twice (2 site forms). In addition, two species of moss new to the state, *Tortula protobryoides* and *T. inermis,* were each found once. The rare moss, *Didymodon eckleliae*, was also found once. The target lichen species, *Texosporium sancti-jacobi* was not seen.

Site Description
This parcel has a seasonal stream draining directly into the Columbia River. Its opposing slopes face north and south. They are moderately steep and range in elevation from 400 to 1000 ft. The moisture regime is xeric.

There are three distinctive habitats. The first is the north facing slope that has coarse sandy soil and much more vascular plant biomass than the south facing slope. The upper north facing slope has some *Juniperus occidentalis* and *Balsamorhiza sagittata*. *Artemisia tridentata* and *Chrysothamnus nauseosus* are scattered and patchy throughout. *Bromus tectorum* dominates the ground but *Phlox* sp. and other forbs are also present.

Because the deep coarse sandy soil on the north facing slope is highly erodible (Root and McCune, 2012a) the impact of cattle is obvious. Their numerous trails parallel to the slope form "bovine terracing". The horizontal surfaces of the trails are loose bare sand, while the slopes above and below the trails sometimes have moss and lichen (*Cladonia* sp.) communities of various developments.

The species dominating along the trails are the mosses *Syntrichia ruralis*, *Anacolia menziesii*, *Brachythecium albicans.* These relatively large fast growing species bind and cover soil (Christy and Harpel 1997). They are apparently benefiting from the cooler and shadier conditions of the north facing slope in contrast to the opposing slope. Biomass and diversity of lichens of the north facing slope is low. Biomass and diversity of bryophytes is moderate. *Bromus tectorum* appears to compete with lichens and mosses here (Ponzetti 2007).

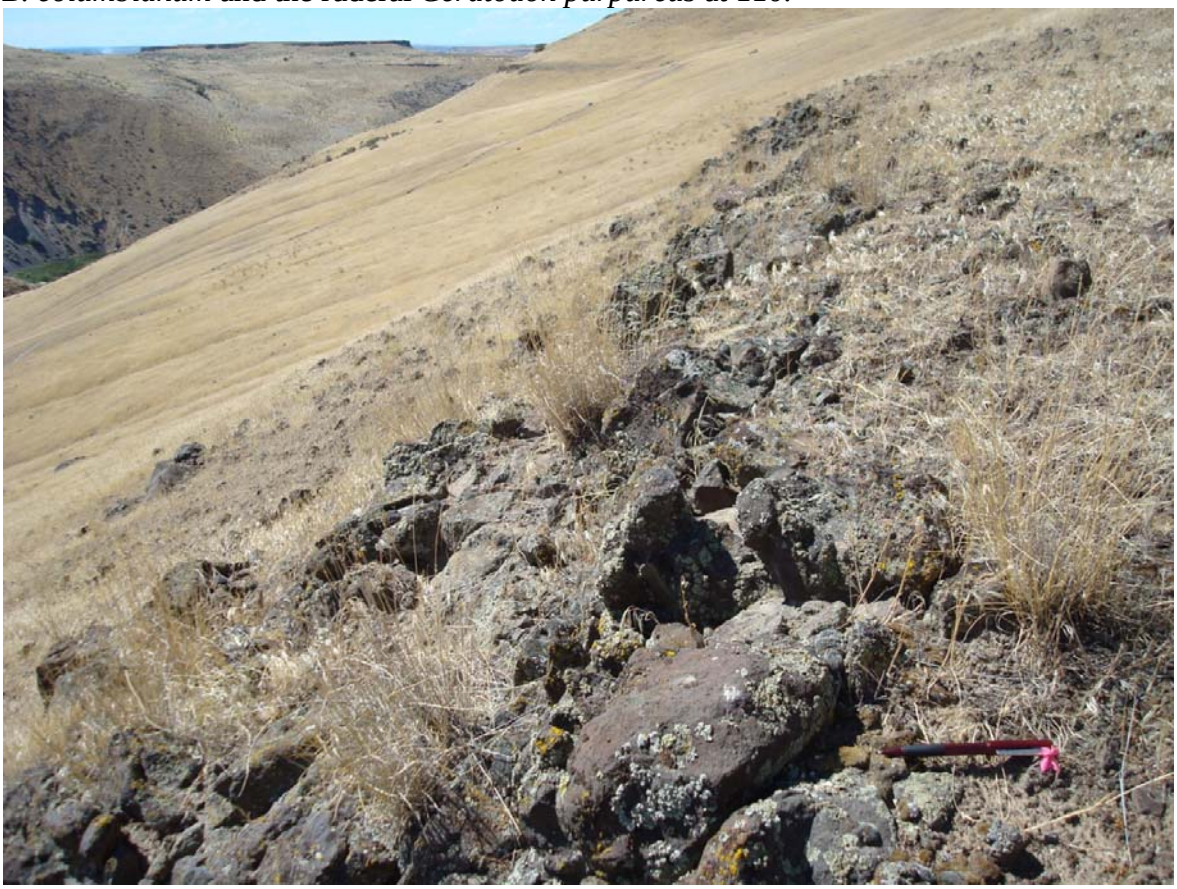
At the bottom of the north facing slope, *Tortula inermis* was collected from a rocky shoulder (visible on topographic map, at 113). This distinctive species does not have a hyaline awn (uncommon for the genus) and the plant assumes a particular habit when dry; the leaves are fold longitudinally and collectively spiral around its stem. As new to Oregon, this species also represents a range extension to the northwest (Zander 2007). However, within the Columbia River Basin, it is part of the Intermountain Semi-Desert ecological province in which southern arid taxa are known to occur (Christy and Harpel, 1997).

The second distinctive habitat is the south facing slope which has thinner soil, rockier conditions, and less vascular plant coverage than the north facing slope. Shrubs are sparse and *Juniperus* absent. The ground is thinly covered with shorter *Bromus tectorum* and the weed *Erodium*

cicutarium. The top of the slope has rimrock but because of the southern exposure, it is mostly bare of lichens and bryophytes.

The silty soil over the hard subsurface resists collapsing therefore the substrate for lichen and bryophyte communities can withstand trampling better than the north facing slope (Belnap et al. 2001, Root et. al. 2011, Root and McCune 2012a). The best habitat is low rising exposed bedrock where few vascular compete with BSCs. In addition, cattle are not attracted here because of this lack of vascular vegetation, so there is little trampling. These refugia (Root et al. 2011) are at most only a few square meters in size and sometimes have *Agropyron spicatum* associated with them (Ponzetti et al. 2007). The target and rare moss species, *Aloina bifrons*, *Bryoerythrophyllum columbianum*, *Tortula inermis*, *T. protobryoides*, and *Didymodon eckleliae* were found in habitats like this.

B. columbianum and the ruderal *Ceratodon purpureus* at 110.



Above: *Aloina bifrons* at 8. Below: The location of both *A. bifrons* and *D. eckleliae* at the east end of the parcel on the lower south facing slope looking west at 103.

Tortula protobryoides was encountered low on the south facing slope (7). On thin soil over rock, the small delicate *Tortula* was collected because of its apparently cleistocarpic (irregularly rupturing) capsules. It was sent to Zander, the world expert of Pottiaceae, for identification. This species is new to Oregon (Zander 2007, Christy 2013).

Habitat of *Tortula protobryoides* at 7

Left: Note cleistocarpic condition of the lower horizontal capsule, longitudinally ruptured.

Left: Habitat of *Aloina bifrons* at waypoint 104. *A. bifrons* on bare soil, not visible in photo. *Didymodon vinealis* lower center.

The third and final distinctive habitat is the intermittent stream at the bottom of the two slopes. During the first visit on April 9, 2013 the stream was trickling and by the second visit on August 30, 2013 it was wet in areas but not running. The riparian corridor is broad and mostly open, it has scattered *Salix* and graminoids. At 112 there is a large area where it has been eroded down to bedrock by the stream (see photos below). *Hennediella heimii* grows here as discrete patches of fruiting moss in April but had disappeared by August. It is the first time I have encountered this genus which was mixed with a few other unusual species of the Bryaceae that still need to be identified. I could find only one other record of *H. heimii* for Oregon on the Tropicos website; Wasco Co., *Chambers s.n.*, 1977. Is it rare in Oregon? Shortly upstream and downstream conditions are not as favorable for bryophytes being either too brushy or too dry.

Along the stream at the bottom of the south facing slope near the west end of the parcel, there is a steep rock face. With cavities, shallow alcoves, and numerous microsites this habitat is intriguing but after close inspection neither bryophytes nor lichens were abundant and nothing of significance was found. This is probably because the rock is fragile and too unstable to provide lasting habitat.

Abundance and Distribution

Most sites of the target and rare species are located in rocky areas on the south facing slope. All sites are small, a few square centimeters, while those of *Aloina* are even smaller because the individual stems are sparsely spread across the same small area. The biomass of lichens and bryophytes of the south facing slope is low but diversity is higher than the opposing slope. Some of the diversity belongs to the limited patches of biotic soil crusts. For example, *Psora dicipiens* was seen which is "… very common on highly calcareous, exposed soils…" (McCune and Rosentreter, 2007), was seen.

Further Study

Juniper Canyon should be explored farther upstream, beyond the private property to the east. The stream in that area probably would be nonexistent or insignificant in regard to bryophytes. Although the impacts of grazing wouldn't necessarily be any less, it would offer more rocky habitats that could support more populations of the rare species above or additional species.

Access

From Cold Springs Junction, Hwy 37, drive almost six miles east on Hwy 730 to Juniper Canyon trail head (McNary Wildlife Refuge) and park at gate. Hike along the south shore of the creek into the BLM parcel.

Cryptogams at Juniper Canyon

MOSSES

Aloina bifrons
Anacolia menziesii
Bryoerythrophyllum columbianum
Bryum argenteum s.l.
Ceratodon purpureus
Coscinodon calyptratus
Didymodon australasiae
Didymodon eckleliae
Didymodon vinealis
Encalypta rhaptocarpa
Gemmabryum caespiticium
Grimmia montana
Hennediella heimii
Imbribryum cf. gemmiparum
Polytrichum piliferum
Pseudocrossidium obtusulum
Pterygoneurum ovatum
Rosulabryum cf. elegans
Rosulabryum sp.
Syntrichia caninervis
Syntrichia montana/princeps
Syntrichia papillosissima
Syntrichia ruralis
Tortula inermis

LICHENS

Caloplaca tominii
Cladonia sp. (squamules only)
Collema coccophorum
Leptochidium albociliatum
Leptogium lichenoides
Peltigera didactyla
Psora dicipiens
Rhizoplaca chrysoleuca
Umbilicaria phaea

Next to Hat Rock State Park, Umatilla County
T5N-R29E-S22, 80.3 ac.
September 12, 2013

Results
The target moss species, *Bryoerythrophyllum columbianum*, was found 11 times (five site forms), once with sporophytes, which are rare for the species (Zander 2007). The rare moss, *Didymodon eckleliae* and the uncommon lichen, *Phaeophyscia constipata* (McCune and Geiser, 2009), were each found once. The other target moss, *Aloina bifrons,* and target lichen, *Texosporium sancti-jacobi* were not seen.

Site Description
This parcel is between Hat Rock State Park and Hwy 730. The elevation ranges from 400 to 500 feet. Most of the area is a low bluff lined with rimrock one to ten meters high. The bluff outline is triangular with rimrock walls facing northeast, northwest, and south. *Juniperus occidentalis* and other trees are absent. Shrubs and forbs include *Artemisia tridentata*, *Chrysothamnus nauseosus*, and bunchgrass. *Bromus tectorum* covers most of the bluff top, especially the interior where the soil must be deeper (Root and McCune 2012a). The moisture regime is xeric.

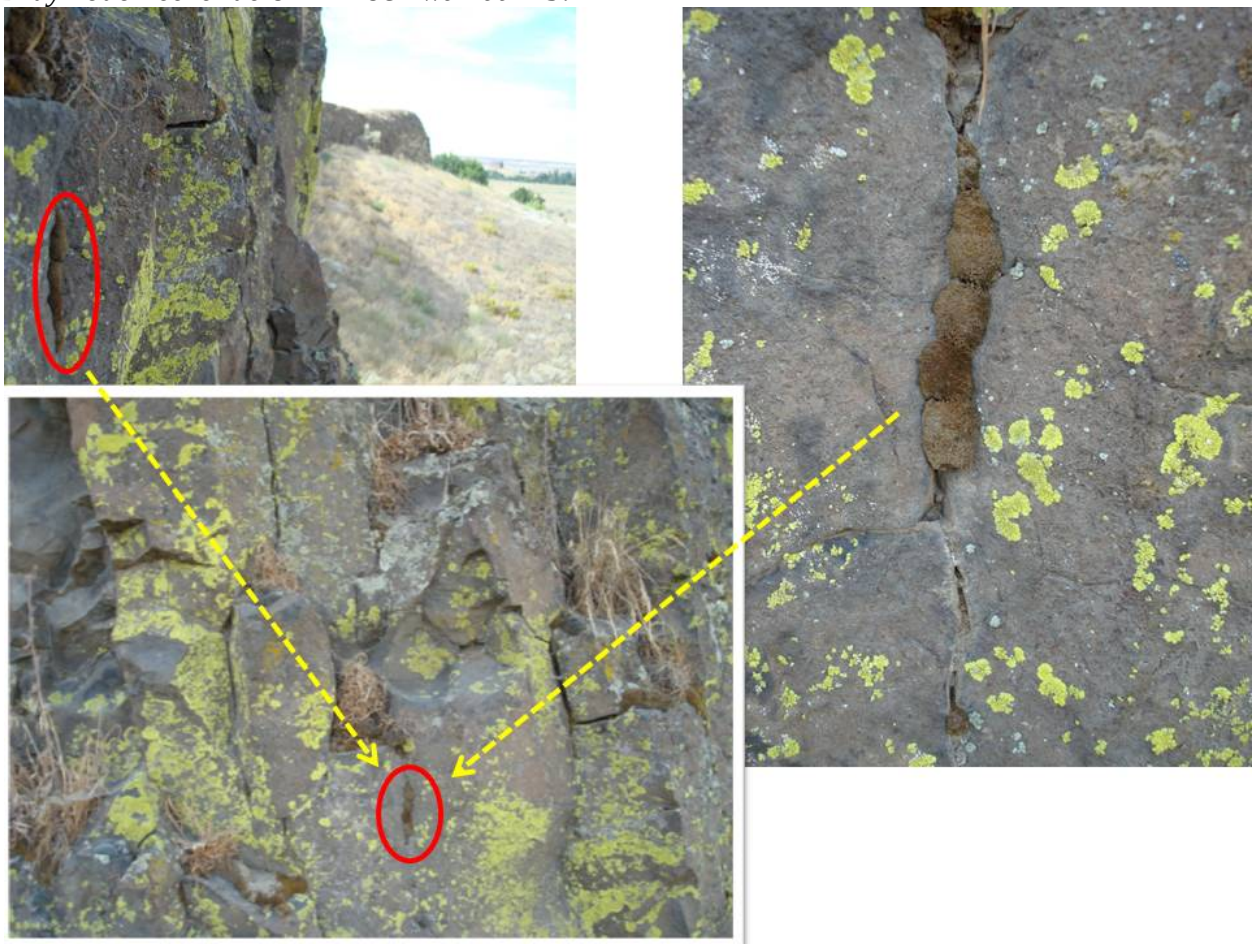
The most interesting areas of this parcel are the top of the bluff and the rimrock walls. The top of the bluff, which is generally level, has low mounds and shallow depressions. These subtle topographic features are probably formed by erosion, the mounds being resistive bedrock. There is very little *Artemisia* on top of the bluff. Aside from a few ATV tracks, disturbance is low. There are animal burrows with entrance holes as big around as a soccer ball. There is evidence of grazing but not in recent years. Well-developed communities of biotic soil crusts (BSC) are present but unfortunately, *Bromus tectorum* is thick in places and prevents them from being more extensive (Ponzetti et al. 2007).

The BSCs are best over bedrock where competition from *Bromus tectorum* and damage by cattle trampling is minimal (Belnap et al. 2001, Root and McCune 2012a, b). Although diversity is moderate to high for both lichens and mosses the species composition is homogeneous across the top of the bluff. This phenomenon is analogous to tundra habitat. The cryptogamic community, a mixture of saxicolous and BSC species, appears to be mid to late seral.

The second best habitat for bryophytes and lichens is the northeast facing rimrock wall. There are numerous microsites for bryophytes and lichens. Saxicolous lichens are diverse and relatively abundant. At the north end of the bluff there is a large draw that slopes from the top of the bluff to the base. The north facing wall of the draw supports many species including the regionally "uncommon" lichen, *Phaeophyscia constipata,* (McCune and Geiser 2009) and the rare moss, *Didymodon eckleliae.* The rimrock walls facing northwest and south are too exposed to the sun to offer good habitat and support less diversity and biomass.

Phaeophyscia constipata on right hand wall at 128.

Didymodon eckeliae on rimrock wall at 129.



Abundance and Distribution

Bryoerythrophyllum columbianum is a common component on the bluff, recorded for 10 locations. It is found in the southeast and southwest corners of the parcel on the bluff top. These sites, often on mounds, have thin rocky soils where BSCs persist free from damage of trampling (Root and McCune 2012b) and *B. tectorum* (Ponzetti et al., 2007).

B. columbianum at 117.

Although this parcel has the most *B. columbianum* found in the survey, it was collectively only a few square meters in total. *B. columbianum* was found only once below the bluff, on a boulder on the northeast facing slope.

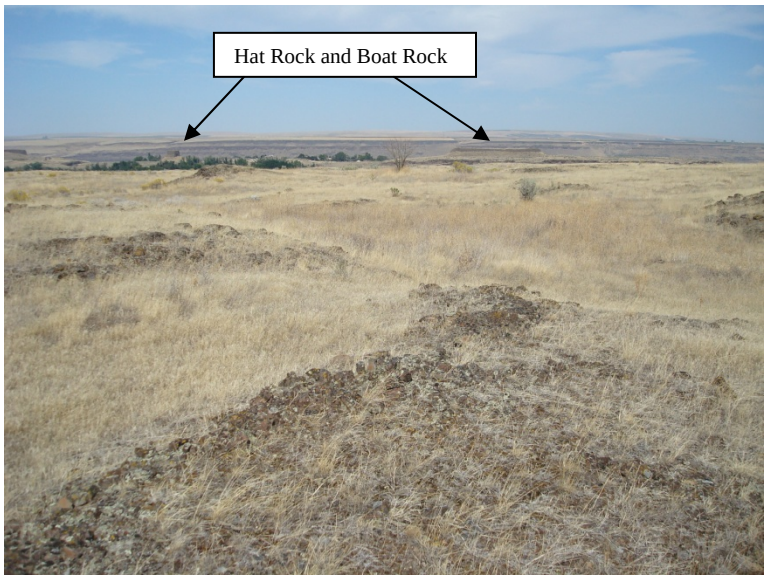
B. columbianum at 114.

Example of good BSC and saxicolous species including *B. columbianum* on rocky soil at 116.

Above another site of *B. columbianum* (circled in red) with *Didymodon vinealis* et al. at 120.

Good habitat with *B. columbianum* at 126.

B. columbianum at 125.



Above an example of low mounded topography on bluff top with *B. columbianum* at 124.

Another point of interest is the potential of moss balls (Hardman 2010). On top of the bluff, *Grimmia trichophylla* grows into an areolate form, continuing upward until it is nearly spherical, and approaches detachment. Examples were collected but it is not certain that they were truly vagrant. Small vegetative spheres were seen among broadly attached turfs of *G. trichophylla* but not necessarily far away.

Further Study
Surveying the BSCs on the bluff and saxicolous lichens on the rimrock would increase the known diversity of the area.

Access: From Hwy 730 take Hat Rock State Park Road. Drive a half mile or less and park at a pull out along the road, cross the barbed wire fence and head towards the bluff.

Cryptogams next to Hat Rock State Park

MOSSES

Anacolia menziesii
Bryoerythrophyllum columbianum
Bryum argenteum
Ceratodon purpureus
Didymodon australasiae
Didymodon eckleliae
Didymodon vinealis
Encalypta rhaptocarpa
Gemmabryum caespiticium
Grimmia montana
Pseudocrossidium obtusulum
Pterygoneurum ovatum
Rosulabryum cf. *elegans*
Syntrichia montana/princeps
Syntrichia ruralis
Leptochidium albociliatum
Leptogium lichenoides
Coscinodon calyptratus
Grimmia ovalis
Grimmia pulvinata
Grimmia trichophylla
Homalothecium nevadense
Orthotrichum laevigatum

LICHENS

Buellia sp.
Cladonia chlorophaea
Collema tenax
Dermatocarpon reticulatum
Diploschistes muscorum
Peltigera rufescens
Phaeophyscia constipata

LIVERWORTS

Cephaloziella divaricata

Next to McNary Wildlife Refuge & Hwy 730, Umatilla Co.
T5N-R30E-S4, 40.5 ac.
September 13, 2013

Results
The target moss species, *Bryoerythrophyllum columbianum*, was found nine times (4 site forms). *Aloina bifrons* was found once. The rare moss, *Didymodon eckleliae* (awaiting verification) was found four times (two site forms). The uncommon macrolichen, *Phaeophyscia constipata*, was also observed here. The target lichen species, *Texosporium sancti-jacobi* was not seen.

Site Description
This parcel is a few hundred feet above the Columbia River. It is a southwest facing slope with rimrock and a partial bluff. Grasses, including *Bromus tectorum*, cover the ground. *Chrysothamnus nauseosus* is the dominant shrub. Several *Opuntia polycantha* are located on top of the bluff and at midslope. In one of these, two black widow spiders were observed. The elevation ranges from 500 to 800 ft. The moisture regime is xeric.

The rocky soils of this parcel are the best habitats for mosses and lichens (Belnap et al. 2001, Root et al. 2011, Root and McCune 2012a, b). These rocky soils increased in area up the slope. The best areas are the top of the bluff on low mounds with rocky soil and small bunchgrass (Ponzetti et al., 2007). The rimrock wall is good but not great habitat because of its southwest aspect and instability. The ground at the base of the wall is good because the rock that has crumbled down provides protection and microsites for terricolous species. In general, mosses and lichens are restricted to rocky situations due to protection from *Bromus tectorum* (Ponzetti et al., 2007) and trampling (Root and McCune 2012a, b).

Upper slope, scattered rocky areas, and rimrock wall.

Abundance and Distribution
Small to medium patches of *Bryoerythrophyllum columbianum* are evenly scattered across the parcel above 600 feet on rocky soil at mid slope, at the base of rimrock, and on top of the bluff. Only one small patch of *Aloina bifrons* was seen at mid slope in a rocky area. Small patches of *Didymodon eckleliae* were found on the rimrock wall and once at mid slope. A few thalli of *Phaeophyscia constipata* were observed on the rimrock wall.

Left to Right: *A. bifrons* and *D. eckeliae* at 147. Mostly *Grimmia trichophylla*, *B. columbianum*, and other species on bluff top at 141. *B. columbianum* and other species on bluff top at 138.

Didymodon eckeliae at 133 and 135.

Bryoerythrophyllum columbianum by knife lower right and center at 136.

Access
Drive northeast on Hwy 730 and park at large pull-out at 131. Walk northeast along railroad tracks a few hundred meters and then hike up slope into parcel.

Cryptogams next to McNary W. R. along Hwy 730

MOSSES

Aloina bifrons
Anacolia menziesii
Bryoerythrophyllum columbianum
Bryum argenteum s.l.
Ceratodon purpureus
Coscinodon calyptratus
Didymodon australasiae
Didymodon eckleliae
Didymodon vinealis
Encalypta rhaptocarpa
Gemmabryum caespiticium
Grimmia montana
Grimmia ovalis
Grimmia trichophylla
Pseudocrossidium obtusulum
Syntrichia caninervis
Syntrichia ruralis
Tortula brevipes

LICHENS

Buellia sp.
Cladonia sp. (squamules only)
Leptochidium albociliatum
Phaeophyscia constipata
Rhizoplaca chrysoleuca
Xanthoparmelia cf. *plittii*

Echo Meadows, Umatilla Co.
T3N-R28E-S22, 318 ac.
September 17, 18, 2013

Results
The target moss species, *Aloina bifrons* was found six times (five site forms) and *Bryoerythrophyllum columbianum*, was found once. The target lichen species, *Texosporium sancti-jacobi*, was not seen.

Site Description
Echo Meadows is a level landscape with a single low hill in the middle, on top of which is the only rocky habitat of the area. The elevation ranges from 650 to 750 ft. The moisture regime is xeric. Two gulches support S*alix*. Shrubs include *Artemisia tridentata, Chrysothamnus nauseosus,* and *Salsola kali*. There are small and medium sized bunchgrass species. *Bromus tectorum* is dominant but thinner on mounds where bare mineral soil is present.

Above and below: General Echo Meadows habitat from hill top.

Both coarse and fine soils are present but the fine textured appeared to be more stable and better habitat for mosses and lichens (Belnap et al. 2001, Root and McCune 2012a, b). Soil texture can affect the invasibility of *B. tectorum* (Root and McCune 2012a). At this site, the fine textured soil appears to compact, allowing it to remain pristine longer than larger textured soil before getting overgrown by *B. tectorum*. *Aloina bifrons* and *Didymodon vinealis* pioneer soil exposed by burrowing animals. These small disturbance events may assist these mosses to persist indefinitely by continually providing exposed soil and caliche (Root and McCune 2012b) in what otherwise would be completely covered by *B. tectorum.* Even in good bunchgrass habitat (Root and McCune 2012b) there is *B. tectorum* in the interspaces.

There is evidence of coyotes, deer, rabbits, and gopher snakes but not cattle. Despite the absence of cattle as a disturbing agent, BSC lichens are still low in quantity and diversity because of *B. tectorum* (Ponzetti et al. 2007). Small rich patches of mosses and lichens could be relic sites of previously much larger areas that are being overgrown. Where grass is not choking out BSC's (as it is along the west) there are some relatively good patches scattered across the parcel, especially along the east side. These are probably early seral and mostly lack target species.

Abundance and Distribution

Aloina bifrons is infrequent to common in the north half to one third of the parcel. In the south half, there is a small amount towards the southeast corner. One small site is along the Oregon Trail (188). Just north of that is a 0.5 m² patch which is part of a larger community of BSC. That community, including *Collema*, forms a thin "skin" over compacted sandy loam. From the distance of a standing position, the several dark species appear as a "five o'clock shadow" on the ground. This habitat is the second best of the parcel and is tens of meters broad (190). At 191 there is a patchy population of *A. bifrons* across 100 m². Two more small patches of *A. bifrons* are towards the northwest corner.

A. bifrons on side of Oregon Trail at 188. Middle: Old soil mound by burrowing animal.

A. bifrons et al. darkening soil, forming "five o'clock shadow". Light spots are bare soil (190).

A. bifrons at 191.

A. bifrons at 193, 204.

The hill top and the east face of the hill top (208-210) is where the BSC's are best and the only location of *Bryoerythrophyllum columbianum* (210). Except for small bunchgrass, *Opuntia polycantha*, and wind flattened *Artemisia* and *Chrysothamnus*, arid windswept conditions reduce the competition from vascular plants. The only boulders on the whole parcel are here (210); they are covered with saxicolous lichens, and a moderate amount of *Bryoerythrophyllum columbianum* grows between them.

Bryoerythrophyllum columbianum on hill top at 210.

Potential Threat
At the large and excellent *A. bifrons* habitat described above (190) there are a couple of pipes several inches in diameter and fitted with valves that emerge from the ground (water well?). Future work on or use of these pipes could inadvertently damage the surrounding habitat by human trampling.

Access
From Echo, Oregon drive five and half miles southwest on Oregon Trail Rd. (Hwy 320), turn right (north) onto a gravel road. Drive another half mile and turn right (east) into parcel which is an Oregon Trail Historic Site.

Cryptogams at Echo Meadows

MOSSES

Aloina bifrons
Bryoerythrophyllum columbianum
Ceratodon purpureus
Didymodon australasiae
Didymodon vinealis
Funaria hygrometrica
Gemmabryum caespiticium
Grimmia montana
Pseudocrossidium obtusulum
Pterygoneurum ovatum
Syntrichia caninervis
Syntrichia montana/princeps
Syntrichia papillosissima
Syntrichia ruralis
Tortula brevipes

LICHENS

Caloplaca tominii
Cladonia sp. (squamules only)
Collema tenax
Leptogium lichenoides

Salmon Point & Hwy 730, Umatilla Co.
T5N-R29E-S22, 40.2 ac.
September 13, 2013

Results
The target moss species, *Bryoerythrophyllum columbianum*, was found four times (two site forms). The rare moss, *Didymodon norrisii* (awaiting verification) was found once. The target moss and lichen species, *Aloina bifrons* and *Texosporium sancti-jacobi* were not seen.

Site Description
This parcel is a slight hill. The elevation ranges from 420 to 480 feet. The moisture regime is xeric. It is well vegetated with mature bushes, *Artemisia tridentata*, *Chrysothamnus nauseosus*, and cf. *Ceanothus cuneatus*. *Bromus tectorum* dominates the sandy ground.

Cattle, ATV tracks, burrowing animals, and ant nests have disturbed biotic soil crusts. Apparently, before succession proceeds very far they are overgrown by *Bromus tectorum*. This is probably why the most abundant bryophyte or lichen on the parcel is the pioneering moss *Syntrichia ruralis* (Ponzetti and McCune 2001).

Bright colored nitrophilous lichens have colonized large diameter stems of *Artemisia tridentata*. Yellow *Candelaria pacifica* and orange *Xanthoria gariculata* are responding to air born nitrogen and/or other nutrients originating from agriculture and cattle that surround the parcel.

Abundance and Distribution
Good bryophyte and lichen habitats are limited to four rocky areas where *Bromus tectorum* does not choke them out. These are on a low crest and north of there. *Bryoerythrophyllum columbianum* is common at each of these sites, which were only several square meters each. The best is at 149 where *Didymodon norrisii* is relatively extensive.

Bryoerythrophyllum columbianum at 148 and 150.

Left: *Bryoerythrophyllum columbianum* at 151. Right: *Bryoerythrophyllum columbianum* and *Didymodon norrisii* at 149.

Access
Park at the junction of Hwy's 730 and 207 and walk 100 to 200 meters west to the parcel.

Cryptogams at Salmon Point & Hwy 730

MOSSES

Bryoerythrophyllum columbianum
Bryum argenteum s.l.
Ceratodon purpureus
Didymodon australasiae
Didymodon norrisii
Didymodon vinealis
Encalypta rhaptocarpa
Gemmabryum caespiticium
Grimmia montana
Grimmia pulvinata
Pseudocrossidium obtusulum
Rosulabryum cf. *elegans*
Syntrichia papillosissima
Syntrichia ruralis

LIVERWORT

Cephaloziella divaricata

LICHENS

Candelaria pacifica
Cladonia sp. (squamules only)
Leptochidium albociliatum
Leptogium lichenoides
Xanthomendoza galericulata
Xanthoparmelia cf. *plittii*

At Craig Rd & Progress Rd., Umatilla Co.
T5N-R29E-S20, 159 ac.
September 14, 2013

Results
The target moss species *Bryoerythrophyllum columbianum* was found twice (1 site form). The target moss and lichen species *Aloina bifrons* and *Texosporium sancti-jacobi* were not seen.

Site Description
This level square-shaped parcel is at 460 ft. *Artemisia tridentata, Chrysothamnus nauseosus,* and *Salsola kali* are various ages. *Artemisia tridentata* is head high, standing dead, and as coarse woody debris. Bunchgrass and forbs are present but *Bromus tectorum* dominates the ground. There is a swale along the west side with mature *Salix*. The moisture regime is xeric.

This parcel has low habitat value because cattle and humans have heavily impacted it. The fine sandy soil is disturbed throughout. Skeletal remains of cattle and old junk are present. Stems of *Artemisia tridentata* host bright-colored nitrophilous lichens. Yellow *Candelaria pacifica* and orange *Xanthomendoza galericulata* are responding to air born nitrogen and/or other nutrients originating from agriculture and cattle that surround the parcel.

Left: Typical habitat. Right: the biological soil crust lichen, *Placidium squamulosum.*

Abundance and Distribution
Diversity and biomass for bryophytes and lichens is low partly due to the absence of rock. However, there is a five acre polygon where *Bryoerythrophyllum columbianum* is present that also has biotic soil crusts and bunchgrass. This is the best area of the parcel and is within 153-159. *Bryoerythrophyllum columbianum* is at 153, on fine sandy soil sparsely patchy in an area of 1.5 square meters. There is also a small amount spread across several square meters at 156.

Bryoerythrophyllum columbianum at 153.

Bryoerythrophyllum columbianum at 153.

Bryoerythrophyllum columbianum at 156.

Access
From Hwy 730 turn south onto Craig Rd. Drive one third of a mile, the parcel will be on the east side of the road. Parking is difficult to find.

Cryptogams at Craig and Progress Rds.

MOSSES

Bryoerythrophyllum columbianum
Ceratodon purpureus
Didymodon australasiae
Didymodon vinealis
Funaria hygrometrica
Gemmabryum caespiticium
Pseudocrossidium obtusulum
Syntrichia caninervis
Syntrichia ruralis

LIVERWORT

Cephaloziella divaricata

LICHENS

Candelaria pacifica
Cladonia sp. (squamules only)
Diploschistes muscorum
Leptochidium albociliatum
Leptogium lichenoides
Placidium squamulosum
Xanthomendoza galericulata

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Appendix A
Notes on identification of bryophytes

The primary source for identification was Flora of North America vol. 27.

Under low magnification, the form of *Bryoerythrophyllum columbianum* I usually collected was a complete and deep purplish maroon color. When dry the ovate-lanceolate leaves were erect and tightly imbricate (not contorted at all), the short sharp tips of the upper leaves are held close to one another. Under higher magnification of a compound light microscope I would first search for and observe whether the leaf apex was acutely sharp. This is caused by the costa being shortly exserted and bare of epidermal cells that cover it lower down, revealing the smooth elongate cells of the costa itself. The next helpful character was the adaxial (top) side of the costa just below the apex where the lamina is not keeled and where the costa is covered with quadrate papillose cells forming a bulge. Other characters are the recurved margins in the middle ± ½ of the leaf length and the thin-walled basal cells. The latter character should not be taken as definitive on its own since other species (*Didymodon*) can have this also when the leaves are immature.

In the lab, after I learned *B. columbianum* well, it soon became apparent that the challenge of the remainder of identification would be differentiating species of *Didymodon* and grasping the vast range of variability of *D. vinealis.* From the beginning, I expected *D. brachyphyllus* because of the appropriate habitat and similar studies (McIntosh 2003a). Some collections include what appear to be this species, however they completely intergraded with typical forms of *D. vinealis.* According to Zander 2007, *D. brachyphyllus* "… never has lanceolate leaves…" which is where I drew the line. In addition, some collections fit *D. luridus* (syn. *D. trifarius*) very well but again, according to Zander 2007, that species doesn't exist in North America, at least not north of Mexico. With that said it does not necessarily mean *D. brachyphyllus,* or other species of *Didymodon,* aren't lurking in a collection packet. Therefore, for the purposes of this study *D. vinealis* is referred to in the broad sense.

A few tricky specimens were collected in which the habit of *B. columbianum* was atypical (color and leaf aspect). If one held a very narrow search image then these could have been passed over in the field but instead more thorough collections, sites, and data were achieved.

KOH was used regularly on species of the Pottiaceae.

Color of basal cells of axillary hairs was not particularly helpful because of ambiguous shades. Those of *Bryoerythrophyllum* varied from hyaline to light brown while in *Didymodon vinealis,* the color varied from light brown to brown. The literature states that the basal cells in *D. vinealis* are brown, while in *B. columbianum* they are hyaline.