

Soil Crusts
of
Moses Coulee Area
Washington

Site Reports

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Airplane Canyon

These plots are in a remote area with little to no grazing impact. Our lithosol plot on the summit had the highest diversity of soil crust species in our study. Vegetation was *Artemisia rigida*, *Poa secunda* and *Achatherium thurberianum*, and the soil was about 50% covered with cobbles and gravels. Nearby is a biscuit area with *A. tridentata* ssp. *wyomingensis*, *Pseudoregneria spicata*, *Poa secunda* and *Bromus tectorum*. On our descent down a north facing slope, we sampled a third area with abundant *Festuca idahoensis*, scattered *A. tridentata* ssp. *wyomingensis*, *Eriogonum thymoides*, *P. spicata*, *P. secunda* *Balsamorhiza howellii* and *Eriogonum heracleoides*.



Airplane Canyon summit and plot on the north facing slope.

Baird Springs area and Monument Hill

On Monument Hill our plot was just south of a telecommunications tower, owned by The Nature Conservancy. The area is fenced off, and appeared relatively undisturbed. High winds while we sampled the plot illustrated how much of a factor wind in to soil erosion. The plot was on a lithosol with *A. rigida*, *Eriogonum thymoides*, *Phlox hoodii*, and *Poa secunda*. Quail scat and small scratch areas were evident across the area.



Monument Hill. Above: Survey team including Roger Rosentreter and Cecile Gueidan surveying at Monument Hill. Below: Molly Boyter searching.



Monument Hill. Above: Soil crusts in dense cover on soil. Below: Grouse droppings were common.

At the base of the hill, we sampled two more plots somewhat near Baird Creek. One plot was on the low slopes of a southwest-facing hill with *Elymus cinereus*, *Pseudoregneria spicata*, *Poa cusickii*, *Achillea millefolium*, and *Chrysothamnus* sp.



Baird Springs Hill. Above: habitat. Below left: fairly dense soil crust cover under grasses. Below right: large *Peltigera ponojensis* thallus.

The second low plot was along Baird Creek on The Nature Conservancy land. The area is fenced and appeared ungrazed. It was dominated by *Festuca idahoensis* and *A. tridentata* ssp. *tridentata*. *Cladonia* spp. were dense and widespread. This plot was one of the most species-rich plots in the study, with 35 species found.



Baird Springs North. Above: habitat. Below left: *Cladonia fimbriata*. Below right: *Diploschistes muscorum* thallus.

Burton Draw

We sampled a series of plots along the bottom and sides of Burton Draw.

B1 had *A. tridentata* ssp. *wyomingensis*, *Chrysothamnus nauseosus*, *Hesperostipa comata*, and *Pseudoregneria spicata*. There was evidence of some grazing but not heavy.

B2 had similar vegetation with the addition of *Eriogonum thymoides*. B3 had

Hesperostipa comata, *P. spicata* and *Chrysothamnus nauseosus* on silty loam, with no rocks. There was evidence of burn on this plot. B4 was on rocky ridges of talus slopes

with *Ribes cereum*, *A. tridentata*, *A. tridentata* ssp. *wyomingensis*, *Pseudoregneria spicata* and *Chrysothamnus nauseosus*. B5 was on bottomland between cliffs, with *A.*

tridentata ssp. *wyomingensis*, *H. comata*, *E. thymoides* and *C. nauseosus*. The area had evidence of a past burn and of grazing, yet 36 soil crust species were found here. B6 was

on a south facing rocky slope, with *Sisymbrium altissimum*, *C. nauseosus*, *Bromus tectorum*, *Lupinus* sp. and scattered *A. tridentata* ssp. *wyomingensis*. There was evidence of past burn and grazing.



Burton habitats. Above: Burton 4. Below: Burton 5.



Burton, Rob Smith at Burton 4 above with Burton Draw in the background. Below left: *Acarospora schleicheri* thallus. Below right: cowpie colonized by mosses.

Castle Rock area

Three plots were surveyed in this area on the northeast corner of Banks Lake. The Osbourne Heights and Castle Rock plots were on BLM land and Northrup Canyon was in Steamboat State Park.

The Osbourne Heights plots were on top of the plateau overlooking Banks Lake. OSB lith was on a gravelly lithosol with *Artemisia rigida*, *Eriogonum thymoides*, *Allium* spp., and *Poa secunda*. A lot of *Syntrichia ruralis* grew between the rocks, and *Leptogium subaridum* was frequent on top of this moss. Although we did not survey wood substrates, we noticed abundant *Xanthoria* sp. on the sage trunks, indicating high nitrogen compounds, possibly due to nearby cattle or field fertilization. Soil crusts here were well developed; 38 soil crust species were found. OSB was several deep-soiled biscuits nearby. Forty soil crust species were found at OSB.



Osbourne Heights plots. Above: OSB lith habitat. Below: OSB biscuit.

The Castle Rock plot was in a basin in the State Park surrounded by tall basalt cliffs. The dominant shrub was *Artemisia tridentata* ssp. *wyomingensis*. Other plants in the habitat were *Hesperostipa comata*, *Pseudoregneria spicata*, *Chrysothamnus nauseosus* and *Bromus mollis*. The area was very dry and parched, but we found good soil crust patches.



Castle Rock Basin. Above: Habitat with low *Artemisia tridentata* ssp. *wyomingensis* and grasses. Below left: good coverage of soil crusts. Below right: small thalli of *Peltigera didactyla*.

The third plot we visited in the Castle Rock area was Northrup Canyon, an undulating hilltop with *A. tridentata* ssp. *wyomingensis*, *P. spicata*, and *Festuca idahoensis*. The area is surrounded by *Pseudotsuga menziesii* and *Pinus ponderosa* forest and canyon bottom shrubs. *Acarspora schleicheri* and *Diploschistes muscorum* were well developed in this area.



Northrup Canyon. Above: the rocky habitat, with trees and shrubs nearby. Below: close view of the soil crust, with deep patches of *Syntrichia ruralis*.



Northrup Canyon. Above: *Acarospora schleicheri* on old *Diploschistes muscorum* thallus, protected by a large rock. Below: Close up of *Acarospora schleicheri*.

Coal Creek area

We sampled several plots in this area. There was no evidence of fire or grazing on the plots. Coal Coulee E 1 was a grassland of *Festuca idahoensis*, *Pseudoregneria spicata*, *Eriogonum* sp., *Achillea millefolium*, *Bromus squarrosus*, *B. tectorum* and *Lomatium* sp. on a bench low on the slope with fine soil.

Coal Coulee E 2 and 4 were lithosols with fine, ashy soils. Vegetation was *Artemisia rigida*, *Poa secunda*, *Pseudoregneria spicata*, *Lomatium* sp., *Eriogonum niveum*, and *Bromus tectorum*. We saw *Tragopogon dubius* and dragon pod on Coal Coulee E 4. Aspect was northerly. Plot 2 was on a broad upper slope and plot 4 was on the top of the slope.

Coal Coulee N 1 and N 2 were on the other side of the coulee, on south facing slopes with similar fine soils. Coal Coulee N 1 was mid-slope, with *A. rigida* and *P. secunda* on deep soil interspersed with large rocks. Although there were no cowpies or evidence of burn, there were patches of weedy *Bromus* sp. and tumble mustard.

Coal Coulee 2 was low on the slope, with *A. tridentata* ssp. *wyomingensis*, *P. secunda*, *P. spicata*, *F. idahoensis*, *B. tectorum*, *Eriogonum heracleoides*, *E. niveum*, *Tragopogon dubius*, and *Achillea millefolium*.

Coal Creek plots were on the south side of the Coulee. Coal Creek S 1 was at the bottom of the bench on fine soil, with *A. tridentata* ssp. *wyomingensis*, *P. spicata*, *P. secunda* and *Leptodactylon* sp. Coal Creek S 2 was at the top of the bench and just off the edge, with *A. rigida* and *P. spicata* and a few tufts of *A. tridentata*. *Texosporium sancti-jacobi* was found in this area.



Coal Creek area habitats. Above: Coal Coulee E 1. Below: Coal Coulee N 1.



Above: *Texosporium sancti-jacobi* habitat at Coal Creek. Below: close up photo.

Douglas Creek area

Six plots were sampled in the Douglas Creek area. The area was trampled by cattle and most plots had many weedy species. On the majority of the plots, the number of soil crust species found was very low.

The Blue Gate Flat plot was on deep loam. The dominant vascular plants were *Artemisia tridentata*, *Poa bulbosa* and *Pseudoregneria cristata*. Along the dirt road going up to Douglas Lithosol, Douglas Eroded Slope was a steep, north facing slope eroded by cattle trampling, with a few trees and shrubs. Douglas Lithosol was a basalt lithosol with *Eriogonum thymoides*, *Poa bulbosa* and *P. secunda*. The slope was slightly north. Douglas Creek Trail was on a north facing slope with *A. tridentata* ssp. *wyomingensis* and *P. spicata*.

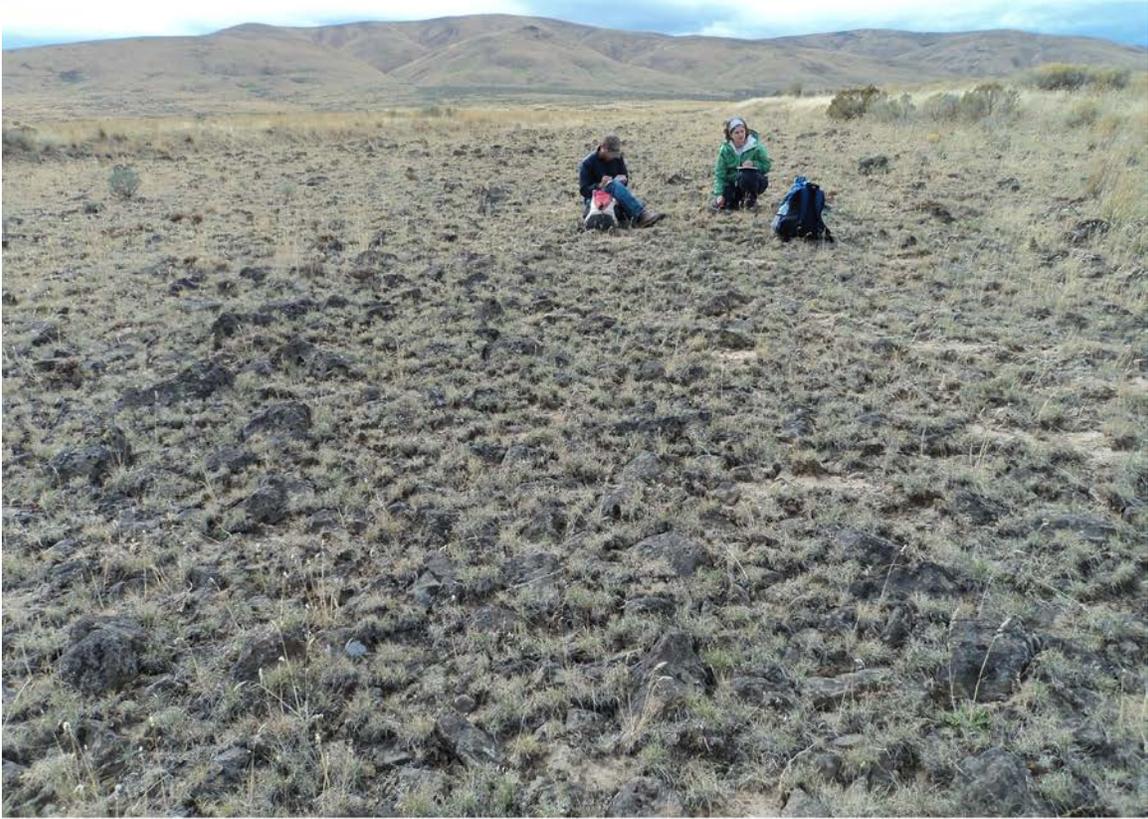
Douglas Weedy Slope faced the southwest and was on well-drained gravelly soil among pillow basalts. Vegetation was *Pseudoregneria spicata*, *Poa bulbosa*, *Bromus tectorum*, *Verbascum thapsus* and *Linaria* sp. Douglas Creek North included above and below the cliff wall on 5-30° slopes below the wall cobbly soil had *Artemisia rigida*, *P. spicata*, *Poa secunda*, *Bromus tectorum*, *B. hordaceus*, *Amelanchier alnifolia*, *Philadelphus lewisii*, *E. thymoides*, and *E. sphaerocephalum*. On slope edges above the wall, east facing slopes held a lithosol with *A. rigida*, *E. sphaerocephalum*, *E. thymoides*, *P. spicata*, *B. hordaceus*, *P. secunda* and *Phlox hoodii*. This plot had the highest number of soil crust species in the Douglas Creek area. Douglas Creek rim was clay loam soil with *A. rigida* and *Poa secunda*.



The plot at Douglas Creek rim and a close up photo of the soil crust cover, with *Syntrichia ruralis* on clay soil.



Douglas Creek North area.



Douglas Lithosol plot.

Duffy Creek area

In the Duffy Creek area we sampled a series of plots along the top of the plateau that included plots of recently planted *Pseudoregneria spicata*, *Artemisia tridentata* and fairly undisturbed lithosols. Although the area was nominally ungrazed, we saw cowpies in some plots. The non-lithosol plots had few soil crusts.

Duf 1 had *Artemisia tridentata* with a nice stand of *P. spicata*, *Carex filiformis* and *Festuca idahoensis*. Soil crusts consisted almost entirely of the mosses *Gemmabryum caespiticium*, *Ceratodon purpureus* and *Syntrichia ruralis*. Duf 1 Lith had *Eriogonum thymoides*, *Poa secunda*, *Nestotsus stenophyllus* and *Antennaria flagellaris*. This plot had 44 soil crust species, the highest in this area.



Duffy Creek plots. Above: Duf 1 with lithosols nearby. Lower: Duf 2 Arttritti.

We sampled 4 plots at the Duf 2 location. Duf 2 CRP was recently planted *P. spicata* with some *F. idahoensis*, and these grasses with litter provided approximately 95% cover. Moss cover was approximately 15%, and consisted of *Ceratodon purpureus* and *Gemmabryum caespiticium*. The Duf 2 lith plot had *Poa secunda*, *Penstemon gairdneri*, *Eriogonum thymoides*, *Elymus elymoides*, *A. flagellaris* and *Haplopappus stenophyllus*. The soil was deeper than the Duf 1 lith site, had higher vegetation cover, lower rock cover and more bare soil (40-45%). Duf 2 Arttrivy 1 was about 20% *Artemisia* with scattered forbs and grasses. The only soil crust species were mosses and *Cladonia squamules*. Duf 2 Arttrivy 2 had about 85% cover of *P. secunda* and *P. spicata*, *Achillea millefolium*, *Penstemon garidneri* and *A. tridentata* ssp. *wyomingensis*.



Duf 2 lithosol.

Three plots were sampled at Duf 3. Duf3 Arttriyw hd about 50% cover of sparse *Artemisia tridentata* ssp. *wyomingensis*, *P. spicata* and alfalfa. Mosses were well developed beneath the sage bushes. This plot appeared to be heavily impacted, possibly grazed. Duf 3 lith was similar to the lithosol areas we sampled in the Duf 1 and Duf 2 areas, but although soil crust species were present, they were far less abundant. Vegetation included *H. stenophyllus*, *E. thymoides*, *P. secunda* and *Antennaria flagellaris*. Duf 3 Biscuit was one biscuit mound with *A. tridentata* ssp. *wyomingensis*, *P. spicata* and cheatgrass.



Duf 3 biscuit, with poor soil crusts.

Two plots were sampled at Duf 4. Duf 4 Arttritri had dense, short *A. tridentata* ssp. *tridentata*, with sparse *Erigeron linearis*, *Eriogonum sphaerocephalum*, *P. cristatum*, and *Achillea millefolium*. There was dense *Gemmabryum caespiticium* cover with some *Cladonia squamules*, *Ceratodon purpureus* and *Leptogium* sp. Duf 4 lith appeared similar to the Duf 3 lithosol but with less *Antennaria*. It also had *Phlox hoodii* and *Syntrichia ruralis*. This litho sol was completely surrounded by CRP plantings.



Duf 4 Arttritri, with dense *Gemmabryum caespiticium* under the *Artemisia* shrubs.

Fichtenberg Road

Five plots were surveyed in this area. Three were on top of the plateau and northeast of the railroad tracks. All had evidence of grazing. All plots had moderately high soil crust diversity. Fichtenberg Rd E 1 had fine soil with a small amount of sand. Aspect was north northwest. Vegetation was *Festuca idahoensis*, *Poa secunda*, *Eriogonum* sp. and *Haplopappus* sp. Soil crust cover was fairly complete, with a high proportion in mosses. Fichtenberg Rd. E 2 had rocky soil with *Artemisia* sp. (*tripartita?*), *Phlox hoodii*, *Erigeron* sp., *Selaginella densa* and *P. secunda*. Aspect was north through west. Fichtenberg Rd. E 3 had rock, gravel and soil, and aspect was east. The vegetation was *Artemisia tridentata* ssp. *wyomingensis*, *P. spicata*, *Phlox* sp., *Bromus japonicus* group, *P. secunda*, and *Eriogonum heracleoides*. This plot was the least disturbed of the three.

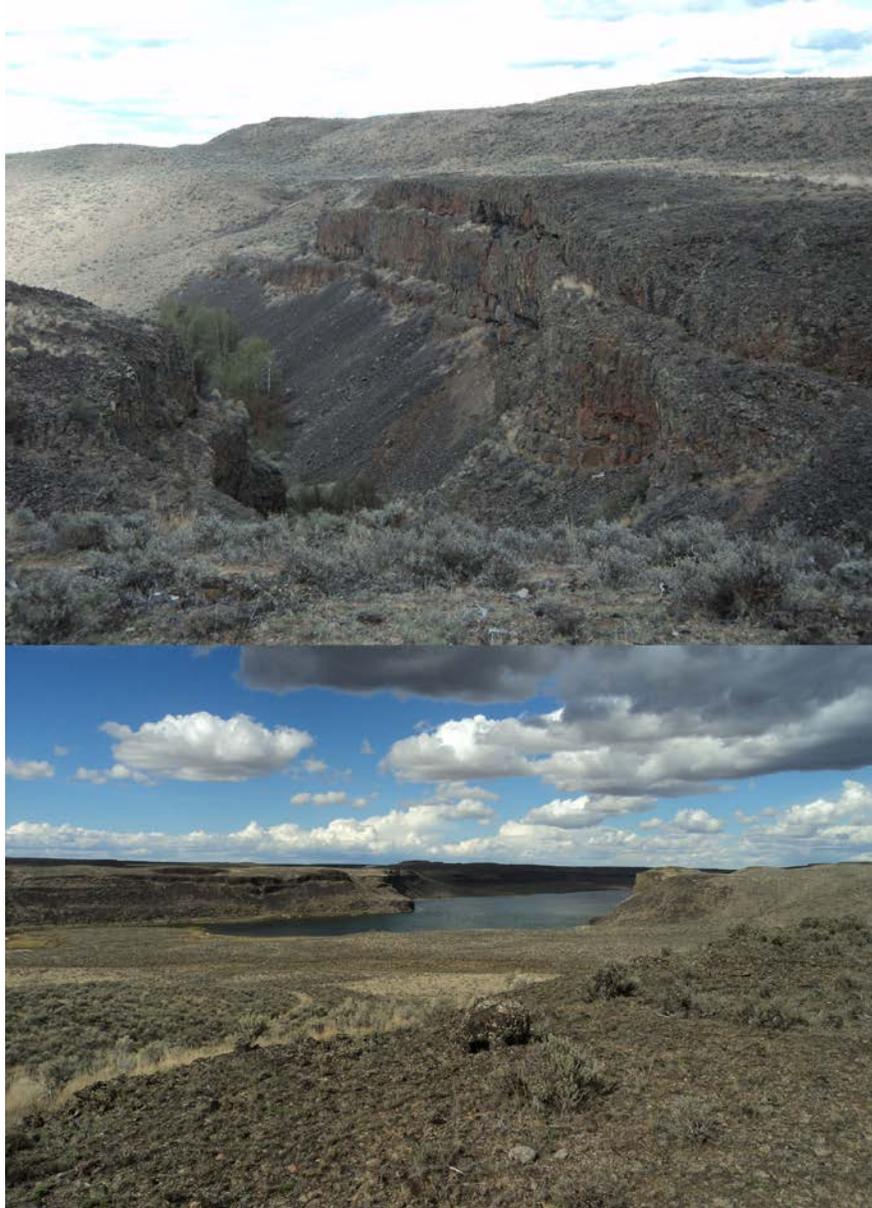


Fichtenberg Rd. E. Above: typical habitat on plot 3. Below: good soil cover of mosses and *Cladonia* squamules.

Fichtenberg RR plots were southwest of the railroad. Fichtenberg RR 1 had a northeast aspect and fine soil with patches of cobble, and the soil appeared darker than the other plots nearby, perhaps indicating fire in the past. It had *Phlox hoodii*, *P. secunda*, *P. spicata*, *Selaginella* sp., and *Astragalus purshii*. Soil crusts and *Selaginella* covered the ground well. We saw no signs of grazing. Fichtenberg RR 2 had a north aspect, and sandy loam soil that appeared to have burnt in the past. Old cowpies were present, indicating some level of grazing. Vegetation was *Artemisia rigida*, *Eriogonum niveum*, *E. thymoides*, *Elymus elymoides*, *P. secunda* and *Phlox hoodii*. A good deal of bare mineral soil was visible.

Grimes Lake area

Grimes Lake northeast plots were high on a hillside south of Grimes Lake. GLNE 1 had *Artemisia tridentata* ssp. *wyomingensis* with *Hesperostipa comata*, *Pseudoregeria spicata* and some rabbitbrush in good condition with few weeds. Some cowpies were present. A lot of *Diploschistes muscorum* was visible. GLNE 2 was a lithosol with *A. rigida*, *Eriogonum thymoides*, *Poa secunda* and *Phlox hoodii*. Large rocks and cobbles were scattered across the plot area. Forty one soil crust species were found on this plot. GLNE 3 was somewhat of a lithosol, on north facing slopes with seepy moist soil.

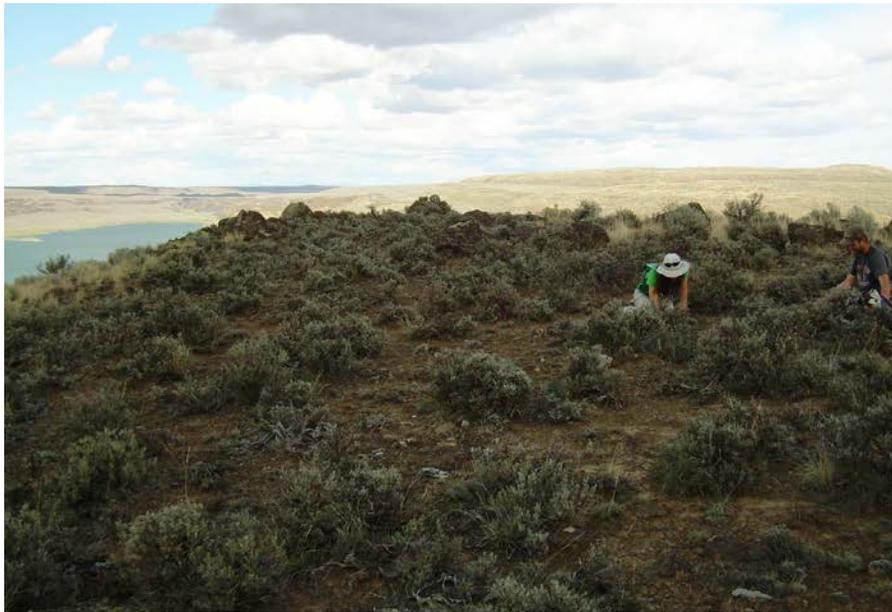


Grimes Lake NE plots. Above: GLNE 3, north-facing slope with seepy soil. Below: GLNE 1 on plateau top.



GLNE 2, grassy lithosol with exposed soil brought to the surface by small mammals.

East Grimes Lake South plots were south of GLNE plots and south of Long Canyon. EGLS triwy was ungrazed *A. tridentata* ssp. *wyomingensis* habitat with *Hesperostipa comata* and *P. spicata*, in a somewhat sheltered pass. EGLS was found in a mosaic of habitats on the plateau top. It had *A. rigida* and *P. secunda*. Possible pygmy rabbit scat was found here. EGLS UpAT was another part of this mosaic, with *A. tridentata* ssp. *wyomingensis* and *P. spicata*.



East Grimes Lake South plots, on plateau top. Above: EGLS 2. Below: EGLS 3.

Hanes and Lamp Rds.

All three of these plots were in an open grassland near fenced rangeland. There was no evidence of past burn but cowpies were found across the area. There is some confusion over the name of Lamp or Lamb Rd, since both of these names were found on maps.

Hanes North was along the top of a very low ridge with 0-2% slope. *Artemisia rigida* bushes, *Pseudoregneria spicata* and *Poa secunda* grew in gravelly soils. Some trails and areas with bare soil may have been created by cattle. Some *Bromus squarrosus* was seen. This grassland had 42 species of soil crusts.



Hanes and Lamb Rds. Above: Hanes Rd. plot area. Below: Lamb Rd E 1 plot with patchy *Artemisia rigida*.

Lamb Rd. E 1 was on the middle of a gentle slope of about 2%. Cowpies were scattered across the area and there was a swale near the plot. Soils were fine and coarse. The habitat appeared to be an old stand of *A. rigida* with trampling disturbance between shrubs. Other vascular plants were *Eriogonum thymoides*, *Festuca idahoensis* and *Bromus japonicus* group.

Lamb Rd. E 2 was on the middle of the same hillside as Lamb Rd. E 1, with a 3% slope. Soils were fine to coarse almost as large as gravel, all mixed together. Fine Mt. St. Helens ash was in a layer about 1 inch down. About 60% of the plot was exposed soil, with *Artemisia tridentata* ssp. *wyomingensis*, *Poa bulbosa*, *P. secunda*, *Bromus japonicus*, *Festuca idahoensis*, and *E. niveum*. *Artemisia* and grass clumps were colonized by *Cladonia squamules*, and although there were large *Diploschistes muscorum* thalli, the soil crust community was very simple. Recent small mammal activity added to the older disturbance by cattle.



Lamb Rd. close ups. Above: *Eriogonum thymoides* with some bare soil around it. Below: *Cladonia fimbriata* in a protected spot.

Marlin Rd. and Irby Heights

Both of these plots were on the same slope with fine soils mixed with Mt. St. Helens ash. Neither plot had evidence of grazing. Species richness was poor on both plots, with 28 species found on Irby Heights and 28 found on Marlin Rd.

Marlin Rd. S was a stand of *Artemisia rigida* with *Festuca idahoensis*. Slope was about 2%. Soil made little pedestals. There was a lot of soil disturbance, possibly from freezing and thawing. Although there were few small mammal holes, about 50% of the soil was not covered with vegetation. There was no evidence of burn.

Irby Heights was north of the Marlin Rd. plot. Soils were fine and sandy, with Mt. St. Helens ash visible. *Artemisia rigida* and some *Eriogonum thymoides* were scattered between *F. idahoensis*. Although no standing *Artemisia* shrubs were burned we saw two old burned stumps. A mossy crust covered nearly 100% of the plot, with some small mammal disturbance.



Irby heights plot with nearly 100% moss cover. The Marlin Rd plot is between this area and the cars visible in the background.

Odessa and Cache Craters

Odessa Craters and Cache Craters make up a great roadside stop with trails on BLM land. Cache Craters Plots were along Cache Craters Trail. The plots were on fine, shallow volcanic soil of ash and pea-sized gravel. Vegetation was *Artemisia tridentata* ssp. *wyomingensis* and *Pseudoregneria spicata* with lithosols containing *A. rigida*, *Eriogonum thymoides*, *E. niveum*, *Poa secunda*, and *Lomatium* sp. Slopes in the plots were 8-10%. There was no evidence of grazing or fire. Soil crust diversity was moderate on these plots, ranging from 22-28 species.



Cache Crater habitats on gravelly soils. Lower photo shows grass clump densely covered with soil crust lichens.

Odessa Craters trail is longer and presents more habitats than Cache Crater trail. Odessa Craters Trail 1 was a lithosol low on the slope with *A. rigida*, *P. spicata*, *Bromus japonica* and *Poa secunda*. Most of this lithosol had fine soil, with good soil crust lichen cover. There was a layer of Mt. St. Helens ash beneath the topsoil. A few areas had fine, rough textured gravel. In these the soil crust species were very different and included vagrant *Dermatocarpon reticulatum* and *Aspicilia* spp. It is because of this diversity of soil textures that Odessa Crater Trail had the high soil crust diversity of 43 species.



Odessa Craters. Above: Odessa Craters Trail 1 showing the lithosol with fine, rough-textured gravel and grass clumps. Below: Vagrant Xanthoparmelia in the lithosol area.

Odessa 2 was also low on the slope with fine loam soil, with Mt. St. Helens ash below the surface. Aspect was north, and the slope was 20%. The sample area was a low mound with *A. tridentata* ssp. *wyomingensis*. *Texosporium sancti-jacobi* grew under the canopy of the *Artemisia* and nearby. The soil surface was lumpy around old grass clumps.



Odessa close ups. Above: moss grows on one side of old grass stubble. Below: *Cladonia imbricarica* at Odessa 3.



Odessa habitats. Above: Odessa 3 area. Below view of Odessa Craters area.

Odessa 3 was inside or near one of the craters, in a fairly low position. The soil was fine. Vegetation was mixed with patches of *A. rigida*, *Eriogonum thymoides*, *E. niveum* and *Pseudoregneria spicata*. In a fairly flat place along the trail we found a large area with many tiny thalli of *T. sancti-jacobi*. There was extensive soil crust cover, but a strange deadness in patches throughout this area. We were not able to come up with any hypotheses to explain the sick look of the lichen thalli.



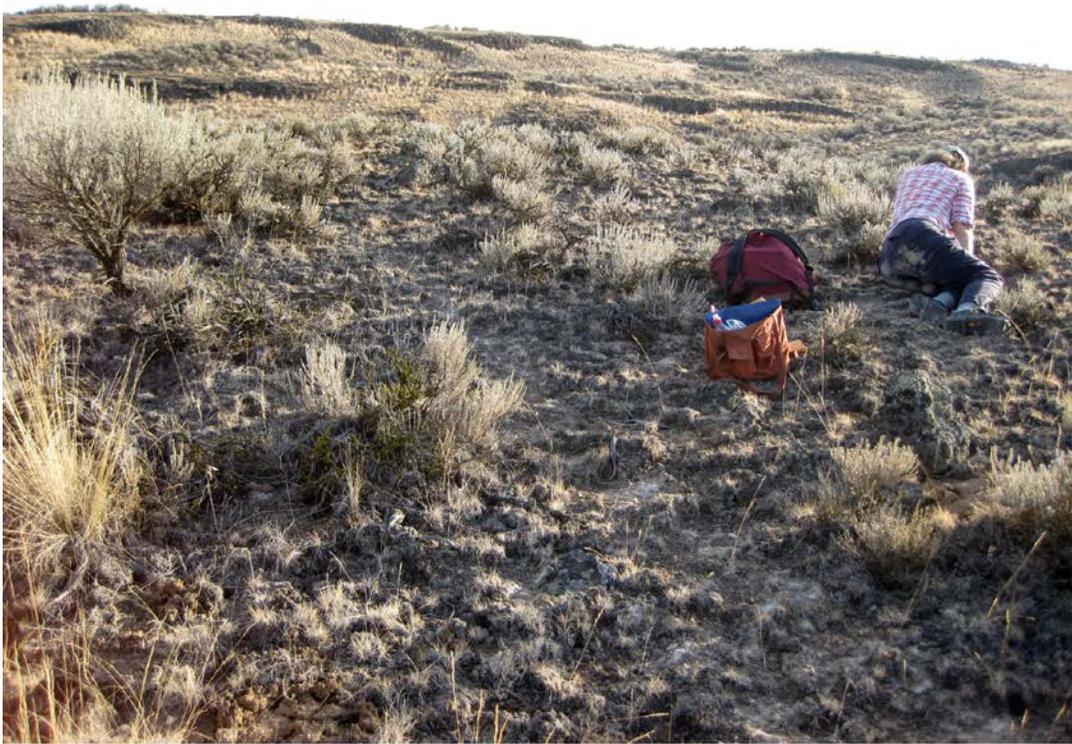
Odessa Craters. Above: Soil crusts covered nearly all of the soil in extensive patches. Note *Texosporium sancti-jacobi* in the center of the photo. Below: close up of *T. sancti-jacobi*.

Pacific Lake

Pacific Lake is an interesting geological phenomenon. A small lake used to stand here, but a drain hole apparently suddenly opened in the lava below the lake and drained it within hours. An old BLM campground remains and in spite of the lack of a lake, it is still a beautiful area to camp. The plots were high on bluffs on both sides of the lake. Neither plot had high species richness.

Pacific Lake N was on fine, ashy soils with some gravel and cobbles. *Artemisia tridentata*, *A. rigida* and another low sage, possibly *A. arbuscula*, were the dominant vegetation, with *Poa secunda*, *Erigeron sp.*, *Eriogonum s.p* and *E. thymoides*. A tiny thallus of *Texasporium sancti-jacobi* was found here. There was no evidence of grazing, but there was a trail, possibly made by campers.

Pacific Lake 1 was on a bluff top on the south side of the lake. There was no evidence of cattle grazing, but deer do frequent the area. Grass stubble was trampled by cattle long ago when the lake still contained water. Soil was fine between rocks. Mount St. Helens ash covered much of the area, and on this soil, the soil crust covered nearly 100%. Soil crusts appeared to be early successional with low species and a lot of *Cladonia*. *Artemisia rigida* shrubs here were very old; other species present were *Pseudoregneria spicata* and *Poa secunda*.



Pacific Lake. Above: Pacific Lake 1 plot. Below: Large *Peltigera ponojensis* thallus.

Quirk Rd. Wildlife area

Three plots were surveyed at Quirk Road. The plots were in rolling low hills. Although we saw a few copypies at the beginning of the trail, none of the plots had any sign of grazing.

The Quirk Binocs plot on the top of a low hill had *Artemisia rigida* as the dominant shrub; *Pseudoroegneria spicata* and *Poa secunda* were dominant in the forb/grass layer. Relatively little exposed or disturbed mineral soil was present. Much of the hill crest had loose rock/gravel. This plot had the moderately high species richness of 32 species.

Quirk Rd. S 1 was an open grassland on a gentle upper slope facing north to northeast. Soil was fine with some sand. The dominant species were *P. spicata*, *Bromus japonicus* group, and possibly *Hordeum* sp. Other plants were *Erigeron* sp., *Phlox* sp., and *Eriogonum heracleoides*. Soil crusts were well-developed.

Quirk Rd. S 2 was also on an upper slope, facing north. The slope was approximately 8%, and was dominated by *A. rigida* and *A. tridentata* ssp. *wyomingensis* with dense *P. spicata*, some *Festuca idahoensis* and bits of *Bromus japonicus*. Soil was highly disturbed here by small mammals and a larger burrowing animal as well. Most of the lichens present here were *Cladonia* spp. Mosses grew at the grass bases. Species richness was low here.



Quirk Rd. area plots. Above: Quirk Binocs lithosol. Below: Quirk Rd. S 2.

Rattlesnake Canyon

We surveyed seven plots in the Rattlesnake Canyon area. We started near an old cattle oiler, so the area was heavily trampled, even on rocky lithosols. As we went farther from the oiler, there was less trampling apparent, but clearly cattle had grazed the entire area. In spite of the abundant lithosols, species richness in the whole area was low, with 20 species the highest number found on any one plot.

RC oiler was a lithosol just to the west and uphill from the oiler. The lithosols were on the hillside in large swaths going with the slope. Rock surfaced about 75% of the area, with *Poa secunda*, *Erigeron pumulis* and sparse *Artemisia rigida* growing in soil between the rocks. *Syntrichia ruralis*, *Ceratodon purpureus* and *Gemmabryum caespiticium* dominated the soil surface, and few lichens were found.

RC 1 was near the Oiler lithosol, and had *A. tridentata* ssp. *wyomingensis* with *P. secunda*, *P. spicata*, *Bromus tectorum*, *Lupinus* sp., and *Ranunculus testatus*. Twenty percent of the soil was bare. *Aspicilia* spp. and *Psora globifera* were present but infrequent. RC lith 1 was a nearby lithosol. RC lith 2 was another lithosol on a 30% slope, with sparse *A. rigida*, *P. secunda*, *Haplopappus stenophylla* and *E. pumulis*. A lot of the soil was exposed, and there were many rocks. RC 2 was a nearby *A. tridentata* ssp. *wyomingensis* habitat. Other plants included *E. pumulis* and *Bromus tectorum*. RC 3 lith was an *A. rigida* lithosol similar to the others, and RC 3 was similar to RC 2.



Rattlesnake Canyon. Above, view of one of the lithosols, across the canyon to the RC 3 plot area. Below: RC 1 *Artemisia tridentata* ssp. *womingensis* habitat.



Rattlesnake Canyon. Above: RC lith 2 showing heavily grazed and trampled lithosol. Below: close up of soil near the cattle oiler.



Rattlesnake Canyon. Above: RC lith 3, heavily grazed and very rocky. Below: surveying RC lith 2.

Rock Island Wildflower area

Rock Island Wildflower area was along the Rock Island Grade Wildflower Trail on BLM lands near Wenatchee. The vegetation was *Artemisia tridentata* ssp. *wyomingensis* with *Pseudoregneria spicata* on silty loam soils with a northwest aspect. No photograph was taken. Thirty five species were found on this plot.

Sterett Rd.

We surveyed two plots along Sterett Rd. They were located on top of the plateau with a slight east or east northeast aspect, and cows were present at the time of the survey. Both plots had moderately high species richness.

Sterett Rd W 1 had rocks and gravelly soil. Dominant vascular plants were *P. spicata*, *Eriogonum heracleoides*, *E. niveum*, *Bromus japonica*, *Brodiaea* sp. and *Selaginella* sp. A few *Artemisia rigida* were scattered across the area. *Selaginella* covered much of the soil and rocks. There was very little exposed soil.

Sterett Rd. S had fine soil with gravel. Vascular plants were *A. rigida*, *P. secunda* and little else. One small area had a rock garden with little to no vascular vegetation.



Sterett Rd W area. Above: typical vegetation. Below *Syntrichia ruralis* covered most of the soil in spaces between rocks.

Sulphur Springs area

Three areas were searched near Sulphur Springs.

SS Area is near the headwaters of the springs and adjacent to cropland. It was reached by driving with the farmer's permission across farmland. Plants in the habitat were *Artemisia tridentata* ssp. *tridentata* and ssp. *wyomingensis*, *Pseudoregneria spicata*, and *Poa secunda*. This plot was one of the most species-rich plots we visited; 45 soil crust species were found on the plot.

Downstream from the SS Area plot, we visited the small Sulphur Springs canyon off of Jameson Lake Rd. near Hwy 2. In this canyon, we surveyed two plots. South Sulphur Springs had sandy loam with some gravel on steep hillsides. Dominant plant species were *Artemisia rigida*, *P. spicata*, *P. secunda* and *Salvia dorrii*. Forty two species were found here. South Sulphur Canyon was a lithosol on shallow basalt soils. Common vascular plants were *A. rigida*, *Salvia dorrii*, *Eriogonum sphaerocephalum*, *Poa secunda*, and *Lupinus* sp. The lower number of species found here is likely due to the steep slopes in this area.

Two-Step plots were located south of Hwy 2 on a plateau with sandy silt loam. 2-Step Arttrivy had *A. tridentata* ssp. *wyomingensis*, *Chrysothamnus nauseosus*, *Festuca idahoensis*, *Poa secunda* and *Pseudoregneria spicata*. 2-Step-art rig was a lithosol with *A. rigida*, *Phlox hoodii*, *Erigeron poliospermus* and *Poa secunda*. The 2-Step plots were moderately species-rich.



Habitats at South Sulphur Springs.



South Sulphur Springs. Above: Molly Boyter and Heather Root collect at a flatter area that had more soil crusts than the steep slopes. Below: *Cladonia squamules* protected by a rock.