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NEON Site-Level Plot Summary
Wind River Experimental Forest (WREF)

Document Information

Date
March 14, 2019

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Site Background

The Wind River Experimental Forest NEON site (WREF) site is approximately 60 kilometers northeast of Vancouver in Skamania County, Washington. The WREF site is at the United States Forest Service (USFS) Pacific Northwest Research Station – Wind River Experimental Station in the Gifford Pinchot National Forest (GPNF). WREF covers roughly 10,360 acres within Major Land Resource Area 3 (MLRA 3) – Olympic and Cascade Mountains. Most of the area lacks a Natural Resources Conservation Service (NRCS) Soil Survey; a small portion occurs within the 1990 Soil Survey of Skamania County, Area, Washington (WA659). A USFS Soil Resource Inventory (SRI) is available for GPNF. This product, produced at a smaller scale than NRCS soil maps, provides inventory information for geology, landform, and slope, as well as general soil groupings.

Site Information

The WREF site has varied relief. Elevation and slope ranges were derived from a digital elevation model (DEM), and range from slightly less than 300 meters to over 1275 meters; slope gradients range from 0 to more than 90 percent. Mean annual precipitation is between 2200 millimeters to about 3000 millimeters based on data from the PRISM (Parameter-elevation Regression on Independent Slopes Model) Climate Group at Oregon State University.

The WREF site consists of two distinct land areas referred to here as the ‘East Unit’ and ‘West Unit’. The West Unit contains the NEON instrument tower and all but six of the NEON distributed plots. The West Unit has slope gradients ranging from 5 to 30 percent and elevations ranging from 315 to 915 meters. The West Unit is dominated by Trout Creek Hill. This cinder cone is in a small basin west of the Wind River Valley; foothills and mountains surround the

West Unit. The majority of the distributed plots for WREF are situated on slopes of Trout Creek hill or on the adjacent dissected hillslopes above and west of the Wind River. Washington Department of Natural Resources (WADNR) geological mapping identifies the geology in the West Unit as Pleistocene-age basalt flows of the Trout Creek formation. General soil information from the GPNF SRI describes the soils as derived from andesite and basalt bedrock with eolian additions of pumice and volcanic ash.

The East Unit of WREF site is about 5.5 kilometers from the West Unit and east of the Wind River. Gobblers Knob and steep mountain slopes of the Mouse Creek watershed dominate the East Unit area. Slope gradients range to more than 90 percent and the elevation rises to more than 1275 meters on the ridge of Big Huckleberry Mountain. Of the six distributed plots in the East Unit, four occur on rugged, extremely steep slopes. Washington Dept of Natural Resources (WADNR) geology maps and the Gifford Pinchot National Forest (GPNF) Soil Resource Inventory (SRI) identify colluvium and residuum from volcanoclastic tuffs and breccias as the major soil parent materials in this area. The tuffs and breccias are compositionally different and older than the basalt flows that are the major soil parent materials in the West Unit.

Both the East and West Units are heavily forested with some differences in stand age, however, based on aerial imagery review and vegetation type listed in the NEON plot data, no plots were situated within recent clear cuts or on bare soil. Common tree species at most plots were silver fir, western hemlock (*Tsuga heterophylla*) Douglas-fir (*Pseudotsuga menziesii*) and western red cedar (*Thuja plicata*). No marked differences in plant communities occur across the plots.

Analysis of Plots for Sampling

NEON provided 34 distributed plots that NRCS evaluated for WREF characterization sampling. The West and East Units differ considerably in parent materials and landforms. The majority of the WREF distributed plots and the tower area are in the West Unit. The East Unit contains only a few distributed plots (Figure 1). Because of the parent material, landform differences and distance between units, the soils in the East Unit differ distinctly in formation factors and likely in properties from the West Unit. Rugged terrain that occurs in most of the East Unit is prohibitive to efficient soil sampling. To ensure that the soil characterization data would reflect consistent soil properties and conditions most like the tower area and majority of the distributed plots at WREF, soil sampling was completed on plots primarily in the West Unit and the western side of the East Unit.

NRCS soil mapping (Haagen, 1990) is available for lower slopes of the eastern side of Trout Creek Hill in the West Unit only. Soils in this area are mapped as the Stabler series (Medial, amorphic, mesic Vitric Hapludands). The pedon that was sampled and classified at the NEON instrument tower (NRCS Pedon ID 2017WA059001_MP) was confirmed by NRCS to be Stabler. Based on the extent of Stabler soil map units on comparable landforms in the vicinity of the West Unit, as well as comparable soil concepts from the SRI mapping, it appears that the majority of Trout Creek Hill in the West unit and the western edge of the East Unit would have soil mapping and map units akin to the Stabler series.

Because the majority of WREF does not have NRCS soil mapping, plots were not selected by soil type; rather, the SRI product, WADNR geology maps, landform and slope GIS analysis, and soil confirmation at the NEON tower pit were used to select sample plots that had similar soil forming factors (parent material, topography, time). Logistical concerns and site characteristics (e.g. difficulty of access, steep slopes, rock exposures) were also considered to ensure successful sampling.

Eleven preferred sample plots and five back-up plots were selected in case on-site difficulties were encountered. The 11 selected plots targeted the dominant conditions across the study area. Figure 1 shows the plots on the WREF site and the East and West units. The majority of the WREF plots occur on Trout Creek Hill which has uniform slopes, geology, vegetation, and climate; fewer sample points were required to capture the limited variability. Plots rejected for sampling occurred in non-typical landform settings, areas that were difficult to sample, or plots that possessed repeated geology and/or landform settings that were already well represented by selected plots. A few plots were rejected because they were not representative of the conditions found at WREF.

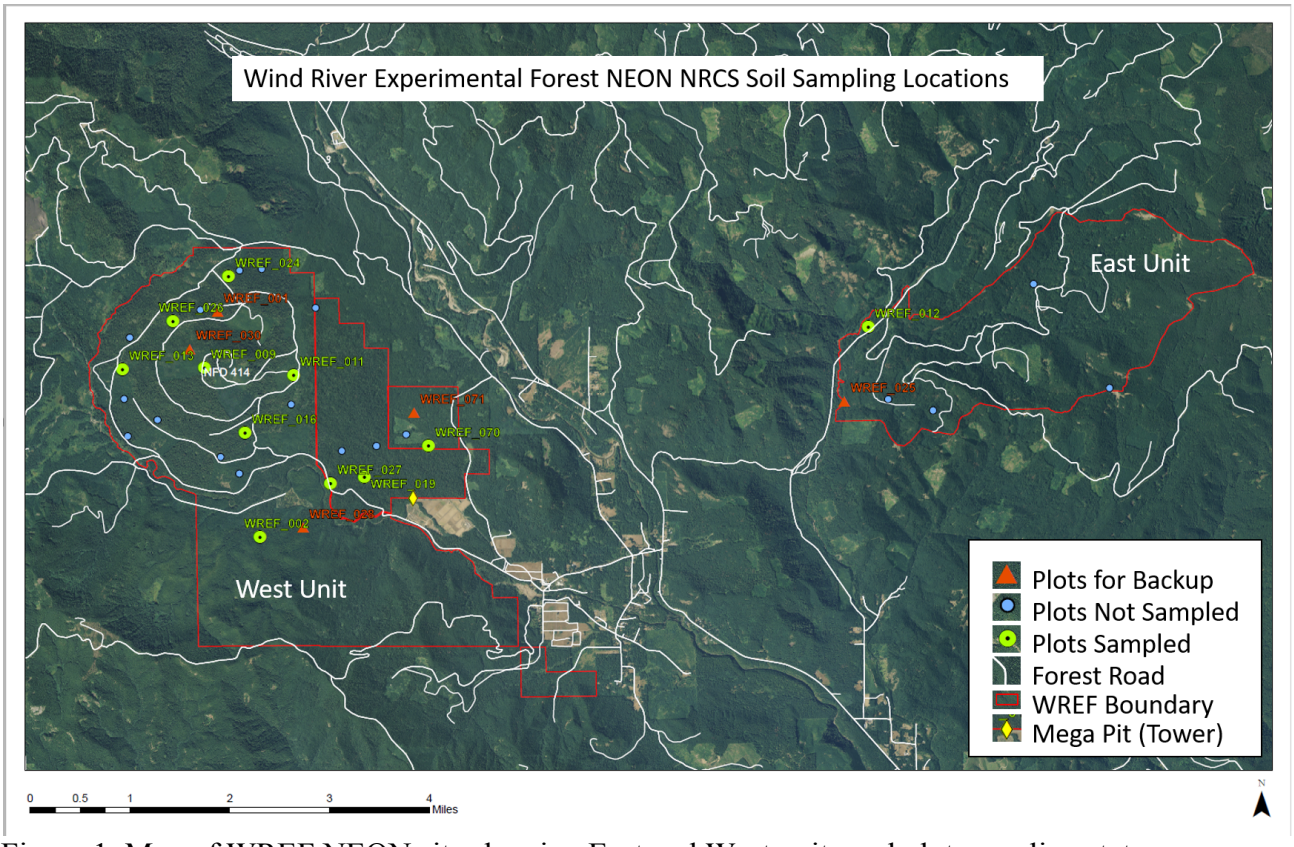

Figure 1. Map of WREF NEON site showing East and West units and plot sampling status.

Plot Findings

Based on preliminary characterization Kellogg Soil Survey Laboratory sample results, all profiles will classify as Andisols. Given the proximity to Trout Creek Hill, a volcanic cinder cone, this is not surprising. All pedons formed primarily from this ash had some percentage of small, indurated cinder fragments, or small, soft pumice fragments.

All plots supported coniferous dominated woodlands with combinations of Douglas-fir (PSME), western hemlock (TSHE), and Pacific silver fir (ABAM).

All plots occurred within GPNF SRI map units 5B and 43. These map units identify soils that have organic forest litter at the surface and textures that range from sandy loams to silty clay loams. The SRI identifies parent materials of aeolian origin (volcanic ash) mixed with or overlying basalt residuum or colluvium. NRCS sampling confirmed these relationships.

Summary of Soils

All WREF plots met requirements for andic soil properties. In brief, Andic requirement are greater than 5 percent volcanic glass in a specified size range (glass is the particle size constituent that composes what is generalized as volcanic ash), phosphate retention of 25 percent or more, and a minimum acid oxalate extraction of Al plus one-half Fe greater than 0.4 percent. At WREF, glass content of all mineral horizon samples rarely ranged below 10 percent, and quite often had between 15 and 20 percent volcanic glass. The phosphate retention and oxalate criteria are an indicator of the amorphous or short-order-range (SOR) minerals in a soil. Weathering of volcanic glass in moist to wet environments commonly yields SOR. SOR have high cation and anion exchange and water retention compared to layer silicate clays. Clay content as determined by particle size analysis may not adequately reflect the influence of SOR in soil. Therefore, a number of substitute particle size terms exist in lieu of common texture names such as sandy or clayey that apply to Andic soils (Soil Survey Staff, 2014, p 230). At WREF, two substitute terms are of import – ashy and medial. Briefly, the criteria for ashy are a 1500 kPa water content <30% and a rock fragment content <30% (volume). For medial, the criteria are a 1500 kPa <100% and a rock fragment content <30% (volume).

The term medial is also used as a textural modifier in soil profile descriptions as in, for example, medial gravelly loam. Presence of SOR in a soil imparts a distinctive feel to the field texture. The field sample “smears” in a certain manner and rubbing may cause release of free water. Use of the medial in the profile description is a common convention where Andic soils occur.

Water retention for most horizons was measured to be below 15 percent on air-dried samples, likely because of the higher quantities of unweathered volcanic glass and organic carbon contents below 4 percent in most horizons.

All of the soils are in the ‘udic’ soil moisture regime; the soil does not dry to the wilting point in any part for more than 90 cumulative days. This is a common soil moisture regime in areas of higher precipitation.

All of the soils sampled had organic surface horizons that ranged from 6 to over 10 centimeters, typical for forested soils in the foothills of the Washington Cascades.

Based on the above criteria, all the sampled soils classify as Vitric Hapludands.

Plots WREF_002, WREF_011, WREF_013, WREF_016, WREF_019, WREF_024, WREF_027, and WREF_070 were all correlated to the Stabler soil series in the field, which classify as Vitric Hapludands.

All soils were described in the field as having 'medial' textures. This is a term that describes a certain degree of weathering and water retention in soils with andic properties. Volcanic materials that are highly weathered typically have higher water retention. With less weathering comes lower water retention.

Laboratory analyses show that Plots WREF_013, WREF_016, WREF_019, WREF_024, and WREF_027 do not meet the water retention criteria for medial, probably because of higher quantities of unweathered or slightly weathered volcanic glass. These textures would be described as 'ashy' textures. These pedons would be considered 'taxadjuncts' of the Stabler series. Stabler taxadjunct has a slightly different soil classification but does not differ enough to dramatically change how a soil would be managed.

The Stabler series is in the 'mesic' soil temperature regime; mean annual soil temperature ranges from 8 to 15 degrees C at 50 centimeters depth. Without on-site soil temperature monitoring, correlations were made to vegetative communities. Pacific silver fir was noted at plots WREF_011, WREF_013, and WREF_024. Pacific silver fir at elevations present at WREF, in combination with Douglas-fir and western hemlock is an indicator the 'frigid' temperature regime (mean annual soil temperature is below 8 degrees C). Because this difference in soil classification is enough to change the type of forest, it was decided that management would be affected (unlike with the taxadjunct). As such, for these three plots, the term 'cool' was added to the soil name (Stabler, cool) to differentiate these plots from the warmer, lower elevation Stabler plots that lacked Pacific silver fir.

Plots WREF_009, WREF_012, and WREF_026 closely resembled the other plots These plots would have met the classification for the Stabler series but had more than 35 percent coarse fragments in the soil. In the field, these plots were described as 'medial-skeletal'. Based on the lab analyses, these soil textures would classify as 'ashy-skeletal' because of the greater than 35 percent quantity of rock and higher quantities of unweathered or slightly weathered volcanic glass contents in the profiles.

Plot WREF_012 was the only plot selected from the East Unit and did not occur immediately on the cinder cone. It was selected because it was the only site in that area that was representative of the dominant conditions; it was the closest replication in terms of landform position and plant community of any of the other distributed points in the East Unit.

Plot WREF_012 occurred on a floodplain-step immediately below a toeslope of the cinder cone. Parent material was identified as alluvium based on the landform position; high percentages of volcanic glass are seen in the lab results and pumice was described in the profile. With a short distance from numerous cinder cones and other volcanic features in the area, it is not surprising

to find andic soil properties in alluvial systems, as in this plot. With the ‘ashy-skeletal’ soil textures and identical plant community, WREF_012 was described as similar to WREF_009 and WREF_026.

Other than a few subtle differences in quantities of rock fragments and soil climate, the 11 plots selected to sample at WREF displayed consistent and comparable soil properties regardless of aspect, slope position, or landform. Soil development here is governed by higher quantities of precipitation and volcanic parent material and the plots are typical of western Washington coniferous forests.

References

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